FORMAT FOR A PRA RECORD (version 3 of the Decision support scheme for PRA for quarantine pests)

	European and Mediterranean Plant Protection Organisation		
	Organisation Européenne et Méditerranéenne pour la Protection des Plantes		
	Guidelines on Pest Risk Analysis		
	Lignes directrices pour l'analyse du risque phytosanitaire		
	Decision-support scheme for quarantine pests Version N°3		
PEST RISK ANALYSIS FOR *Raoiella indica*			
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Date: 2008-05-09			Core Members consultation in 2008-10
Stage 1: Initiation			
1 What is the reason for performing the PRA?			In 2004, Dr Etienne (INRA, Guadeloupe) reported to the EPPO Secretariat the introduction of *Raoiella indica* in Martinique. Since then, the mite has spread to most Caribbean islands, Florida and Venezuela, causing foliar damage to coconut, date palms and banana plants. It is also found on various ornamental palms and other plants. Therefore, it may represent a threat to the ornamental palms industry and to date palm and banana crops in the EPPO region. *R. indica* was added to the EPPO Alert list in 2004. The Panel on Phytosanitary Measures considered that a

		PRA should be performed.
2 Enter the name of the pest		*Raoiella indica* Hirst
2A Indicate the type of the pest		Phytophagous mite infesting host leaves
2B Indicate the taxonomic position		Acari, Tenuipalpidae
3 Clearly define the PRA area		EPPO member countries
4 Does a earlier PRA exist?		A PRA was performed for the USA (Borchert & Margosian, 2007)
5 Is the earlier PRA still entirely valid, or only partly valid (out of date, applied in different circumstances, for a similar but distinct pest, for another area with similar conditions)?		The Borchert & Margosian (2007) PRA is valid for the United States only. However, much of the information used in this PRA has been extracted for use in the current PRA.
Stage 2A: Pest Risk Assessment - Pest categorization		
6 Specify the host plant species (for pests directly affecting plants) or suitable habitats (for non parasitic plants) present in the PRA area.		*R. indica* is oligophagous. It has been reported on at least six families. However, its true host range is still poorly known. In particular it is likely that not all host genus have been identified in the family Arecaceae. Some host records appear erroneous because it is not clear if the organism can complete its life cycle on these plants. *Coco* sp and to a lesser extent *Musa* sp are the most damaged host plants. The following records are found in the literature (see *Peña et al.* 2006; Borchert & Margosian 2007, for review) and are considered as true hosts. **Species in bold are those present in the PRA area.** <u>Arecaceae :</u> *Acoelorraphe wrightii* (Everglades palm), *Adonidia merrilli* Becc. (Manila palm, Christmas palm), *Aiphanes* spp. (multiple crown palm, ruffle palm), *Areca catechu* L. (Betel nut palm), ***Areca* sp**., *Bactris plumeriana* Mart (Coco macaco, Prickly pole), ***Caryota mitis* Lour** (Fishtail palm), *Chamaedorea* spp. (Chamaedorea palm), *Chrysalidocarpus lutescens* (Golden cane palm), *Cocos nucifera* (Coconut palm), *Dictyosperma album* (Princess palm, Hurricane palm), ***Dypsis decaryi*** (Triangle palm), ***Dypsis lutescens*** (Areca palm, Golden cane palm, Butterfly palm), *Licuala grandis* (Licuala palm, Ruffled fan palm), *Livistonia chinensis* (Chinese fan palm), ***Phoenix canariensis*** (Canary island date palm), ***Phoenix dactylifera*** L. (Date palm),

		Phoenix reclinata Jacq. (Senegal date palm), *Pritchardia pacifica* (Fuji fan palm), *Pseudophoenix sargentii* (Buccaneer palm/Sargent's cherry palm), *Pseudophoenix vinifera* (Buccaneer/Wine palm, Cacheo, Katié), *Ptychosperma elegans* (Queensland palm, Solitaire palm, Alexander palm), *Ptychosperma macarthurii* (Macarthur palm), ***Rhaphis excelsa*** (Lady palm, Bamboo palm), *Roystonea borinqueña* (Puerto Rican royal palm, Royal palm), ***Syagrus romanzoffianum*** (Queen palm), *Syagrus schizophylla* (Arikury palm), *Veitchia merrillii* (Christmas palm), ***Washingtonia robusta*** (Washington palm/Mexican fan palm), *Roystonea regia* (in Venezuela, Vasquez, personal communication) Host list is expanding as new detections occur and all Arecaceae should be considered as potential hosts. <u>Heliconiaceae :</u> ***Heliconia bihai*** (Yellow dancer, Macaw flower), ***Heliconia caribaea*** (Caribbean heliconia, Wild plantain, Balisier), ***Heliconia psittacorum*** (Parrot's beak, Parrot flower), ***Heliconia rostrata*** (Lobster claw) <u>Musaceae :</u> ***Musa* spp.** (Banana, Plantain), *Musa acuminata* (Dwarf banana, Edible banana, Plantain), *Musa balbisiana* (Wild banana), *Musa corniculata* (Red banana, Plantain), *Musa x paradisiaca* (Common banana, Edible banana, Plantain), *Musa sapientum* (Edible banana, Plantain), *Musa uranoscopus* (red flowering Thai banana), <u>Pandanaceae :</u> *Pandanus utilis* (Screw pine) <u>Strelitziaceae :</u> ***Strelitzia reginae*** (Crane/bird of paradise flower), Ravenala madagascariensis (Traveller's tree). <u>Zingiberaceae :</u> *Alpinia purpurata* (red ginger, Jungle King/Queen), *Etlingera elatior* (red torch ginger), *Nicolaia elatior* (red torch ginger; torch lily) The citations of *Ocimum basilicum* (basil) (Lamiaceae) and *Phaseolus vulgaris* and *Acer* sp. as true host appear erroneous.

7. Specify the pest distribution		The origin of *R. indica* is unclear. It was first found and described in India in 1924, then in several Asian and African countries (see below). In 2004, it was detected in Martinique and was subsequently found in many of the Caribbean islands, USA (Florida) and Venezuela. Present known distribution (EPPO, 2008) **EPPO region:** Israel (a single record from Russia in 1979 is considered as highly doubtful). **Africa:** Egypt, Mauritius, Réunion, Sudan. **Asia:** India (Gao, Karnataka, Kerala, Madhya Pradesh, Tamil Nadu, West Bengal) Iran, Israel, Oman, Pakistan, Philippines, Sri Lanka, United Arab Emirates. **Caribbean:** Dominica, Dominican Republic, Guadeloupe, Martinique, Puerto Rico, Saint Lucia, Saint Martin, Trinidad and Tobago, US Virgin Islands (St Thomas) **North America:** USA (Florida) **South America**: Venezuela
8. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	Yes	It is a single taxonomic entity, but several several *Raoiella* species from India described on *Phoenix* will be reported shortly as synonyms of *R. indica* (Ochoa, pers. comm., 2008).
10. Is the organism in its area of current distribution a known pest (or vector of a pest) of plants or plant products?	yes	*R. indica* is considered as an important pest of young coconut and *Areca catechu* in India, and of young coconut and bananas in the Caribbean (Jeppson *et al.* 1975).
12 Does the pest occur in the PRA area?	Yes	*R. indica* is reported in Israel but is not a pest of economic importance there. The single record in Russia is very doubtful since it is on *Acer* sp..
13. Is the pest widely distributed in the PRA area?	No	
14. Does at least one host-plant species (for pests directly affecting plants) or one suitable habitat (for non parasitic plants) occur in the PRA area (outdoors, in protected cultivation or both)?	Yes	Date palms and bananas are cultivated crops in the Southern parts of the EPPO region. Ornamental palms, among which some suitable hosts (e.g. *Phoenix canariensis* or *Washingtonia robusta)* are widely planted outdoors in gardens, parks and along streets. Other hosts such as *Areca* spp., *Heliconia* spp., *Strelitzia* spp. or *Musa* spp. are produced, imported and sold as ornamental indoor plants or cut flowers in the whole EPPO region.
15. If a vector is the only means by which the pest can spread, is a vector present in the PRA area? (if a vector is not needed or is not the only means by which the pest can spread go to 16)		No vector is needed

16. Does the known area of current distribution of the pest include ecoclimatic conditions comparable with those of the PRA area or sufficiently similar for the pest to survive and thrive (consider also protected conditions)?	Yes	*R. indica* is found in tropical and subtropical areas. It is able to survive in the EPPO region on host plants grown as ornamentals in protected conditions such as greenhouses or houses. In addition, it is present outdoors in Israel and Egypt. Detailed climatic studies were carried out during the EWG.
17. With specific reference to the plant(s) or habitats which occur(s) in the PRA area, and the damage or loss caused by the pest in its area of current distribution, could the pest by itself, or acting as a vector, cause significant damage or loss to plants or other negative economic impacts (on the environment, on society, on export markets) through the effect on plant health in the PRA area?	Yes	Some of the recorded host plants, such as banana (on which foliar damage has recently been observed in the Caribbean's), date palm and several ornamental plants are grown in the EPPO region, both in protected conditions and outdoors.
18. This pest could present a risk to the PRA area.	Yes	This pest could present a risk to the PRA area.

Section 2B: Pest Risk Assessment - Probability of introduction/spread and of potential economic consequences

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.1. Consider all relevant pathways and list them		Within the literature concerning *R. indica* the following pathways are mentioned: plants for planting, commercial consignments of cut branches and cut flowers, cut branches and cut flowers with travellers, handicrafts, wind. The EWG considered the following pathways as relevant pathways: **Plants for planting of host plants** There is trade of plants for planting of ornamental hosts of *R. indica* from infested areas to the EPPO region such as Arecaceae from Egypt, *Areca* spp from the Caribbean (Dutch Horticultural Product Board, **,**Product-info Areca (palm) (in Dutch; 2003) *Musa acuminata* and *M. balbisiana* (Banana and Plantain) are mainly traded as plants in vitro. This was not considered a likely pathway. Coconut plants for planting are imported in the EPPO region for ornamental purposes. **Cut flowers and cut branches of host plants (commercial consignments)** *Heliconia* sp. and *Strelitzia* sp are imported from the Carribean. **Cut flowers, cut branches and handicrafts transported by passengers** (e.g. hats, bowls made of palm leaves) Passengers coming back from the Caribbean regularly bring back tropical "souvenirs" including cut flowers and handicrafts (Mendonça *et al.*2005). The EWG did not consider the following commodities as relevant pathways: • Banana coconut and date fruit *R. indica* is a foliage pest and so far has not been found on fruit during surveys (Elwan, 2000). This was confirmed by Ms Navia and Mr Palevski (acarologists) present at the meeting and by Mr Etienne who commented that he had only collected the mite on leaves (Etienne, pers.comm. 2007). There is one reference mentioning the presence of *R indica* on date fruits, but again Ms Navia and Mr Palevski considered the source of this reference unreliable. • Seeds There are no records of *R. indica* on seeds. The EWG considered that seeds are not pathways.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
		• Wind current (Welbourn, 2007) The wind may disseminate the pest once introduced, but is not considered as a pathway of introduction form the infected countries into the PRA area.
1.2. Estimate the number of relevant pathways, of different commodities, from different origins, to different end uses.		The EWG found this question extremely difficult to answer and not adding particular information to the risk assessment as the number of pathways does not always give an indication of the risk
1.3. Select from the relevant pathways, using expert judgement, those which appear most important. If these pathways involve different origins and end uses, it is sufficient to consider only the realistic worst-case pathways. The following group of questions on pathways is then considered for each relevant pathway in turn, as appropriate, starting with the most important.		Plants for planting of host plants Cut flowers and cut branches of hosts plants Cut flowers, cut branches and handicrafts transported by passengers [1]
Pathway n°: 1		**Plants for planting of host plants**
1.4. How likely is the pest to be associated with the pathway at origin taking into account factors such as the occurrence of suitable life stages of the pest, the period of the year?	**Likely** **Low**	In the infested countries in the Tropical environment (Caribbean, India) the pest is widespread. All stages of the pest can be found all year round. When an area is infested, mites are also often found on non-host plants located around the infested area (Peña pers. comm., 2008).
1.5. How likely is the concentration of the pest on the pathway at origin to be high, taking into account factors like cultivation practices, treatment of consignments?	**Moderatly likely** **High**	Nurseries in Florida are informed about the pest and likely to follow management practices (Peña pers. comm., 2008). There is no specific study on the concentration of the pest on different host plants. Observations made by Peña indicate that concentration may vary depending on host plants. In particular the concentration of the pest on coconut plants was high but on ornamentals planted near coconuts *R. indica* concentrations observed so far have been much lower (pers. comm., 2008). Level of uncertainty is high, as there is no information on the pest in nurseries of ornamental plants.

[1] This pathway was included in the pathway analysis during the process as the EWG wanted to compare it with the pathway of commercial import.

<table>
<tr><th>Question</th><th>Rating + uncertainty</th><th>Explanatory text of rating and uncertainty</th></tr>
<tr>
<td>1.6. How large is the volume of the movement along the pathway?</td>
<td>Minimal

Low</td>
<td>Some data was gathered by the EPPO Secretariat on the trade of palm plants, based on a questionnaire addressed to EPPO member countries in March 2008. Algeria, Croatia, Czech Republic, France, Germany, Hungary, Malta, the Netherlands, and Turkey provided information. It appears that the Netherlands are by far the country receiving the largest amounts of imports. Data were provided on pieces of palm trees over different periods for these countries (*as indicated). Based on the information provided, an average is made by year and country, and ordered according to the importance of traded number of palms:

Theses data are presented below:

1. <u>Quantities traded</u>

<table>
<tr><th>Country</th><th>Mean* number of palm traded per year</th></tr>
<tr><td>The Netherlands</td><td>6 644 516</td></tr>
<tr><td>Germany</td><td>222 269</td></tr>
<tr><td>Hungary</td><td>40 000</td></tr>
<tr><td>Turkey</td><td>45 290</td></tr>
<tr><td>France</td><td>21 297</td></tr>
<tr><td>Croatia</td><td>18 018</td></tr>
<tr><td>Algeria</td><td>778</td></tr>
<tr><td>Malta</td><td>625</td></tr>
<tr><td>Czech Republic</td><td>275</td></tr>
<tr><td>Total</td><td>6993068</td></tr>
</table>
*Numbers represent the mean numbers of palms traded per year from 2004 – 2008, with the exception of France which provided data from 1995 to 2000.

2. <u>Species traded (Netherlands and France)</u>
Genus names were provided mainly by the Netherlands and France. There were 520604 unspecified palm plants traded. The most traded Genus was Howea spp.

<table>
<tr><th>Genus or species of palms</th><th>Percentage of traded palms</th></tr>
<tr><td>Howea spp.</td><td>35.60</td></tr>
</table>
</td>
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</table>

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
		(continued below)

Chrysalidocarpus spp.	22.04
Livistonia spp	16.35
Areca spp.	12.84
Rhapis spp.	8.16
Licuala spp.	0.54
Raphis spp. (=Rhapis spp.)	0.47
Caryota spp.	0.38
Chamadorea spp.	0.36
Neodypsis spp.	0.29
Phoenix spp.	0.18
Cocos spp.	0.12
Others	0.14

3. Origin of imported palm species

3.1 Import from outside the European Union

Using the data obtained from countries that completed the survey, it was then possible to determine the relative contribution of countries of origin where the pest occurs in terms of palm trade:

Origin	**Sub area**	**Quantities**	**% contribution to total traded***
Sri Lanka	Asia	1166029	17.00
Dominican Republic	Carribean	135422	1.97
Egypt	Africa	12821	0.19
USA	North America	7380	0.11
Reunion	Africa	2375	0.04
Israel	Asia	73	<0.00
India	Asia	33	<0.00
Pakistan	Asia	20	<0.00
United Arab Emirates	Asia	14	<0.00

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
		(see continuation below)

Guadeloupe	Caribbean	6	<0.00
Iran	Asia	1	<0.00
Others		5449192	79.4

*I.e. the proportion of source palm material contributing to the total traded pieces of palm for the countries that participated in the survey.

3.2 Import of Musa spp.

Some comprehensive statistics were obtained regarding the import of Musa spp into the Netherlands. The primary import source was consistently South Africa:

Category	Origin	Destination	2005	2006	2007	Total
Musa	South Africa	the Netherlands	963934	991903	858818	2814655
Musa	China	the Netherlands	173702	372617	453895	1000214
Musa	India	the Netherlands	433200	259505	302730	995435
Musa	Turkey	the Netherlands	66773	89985	31050	187808
Musa	Egypt	the Netherlands	43444			43444
Musa	Israel	the Netherlands	4520	5	2638	7163
Musa	Costa Rica	the Netherlands	1	1500		1501
Musa	USA	the Netherlands	743		72	815
Musa	Burundi	the Netherlands		280		280
Musa	Brazil	the Netherlands			84	84
Musa	Ghana	the Netherlands			73	73
Musa	Australia	the Netherlands	20			20
Musa	Guatemala	the Netherlands			14	14
		Subtotal	***763***	***280***	***243***	***1286***
		Total	*767*	*335*	*10563*	*11665*

No figure is available on coconut plants imports.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.7. How frequent is the movement along the pathway?	**Very Often** **Medium**	Palm are imported on a daily basis throughout the whole year in sea containers.

Question	**Rating + uncertainty**	**Explanatory text of rating and uncertainty**
1.8. How likely is the pest to survive during transport/storage?	**Very Likely** **Low**	The temperature during transport is not detrimental to the pest. It will survive during transport.
1.9. How likely is the pest to multiply/increase in prevalence during transport /storage?	**Unlikely** **Low**	The temperature, humidity and duration of transport time are not suitable for multiplication.
1.10. How likely is the pest to survive or remain undetected during existing management procedures (including phytosanitary measures)?	**Likely** **Low**	If the number of individuals is low it is very likely to be undetected. Flat mites are frequently undetected due to their minute size, flat bodies and somewhat sessile behaviour (USDA, 2005) There are currently no specific phytosanitary requirements for plants for planting of host plants in most EPPO countries that would be effective against this pest.
1.11. In the case of a commodity pathway, how widely is the commodity to be distributed throughout the PRA area?	**Widely** **Low**	The plants for planting are likely to be distributed in the whole EPPO region. It should be noted that initial distribution may be restricted to nurseries to acclimatize the plants, but then the plant can be distributed throughout the whole EPPO region, both for outdoor and indoor use (palm being more and more used as indoor plants).
1.12. In the case of a commodity pathway, do consignments arrive at a suitable time of year for pest establishment?	**Yes** **low**	In the Netherlands which is the main importer, ornamental plants are imported all year round. (Statistics Netherlands, Dutch Database: http://statline.cbs.nl).
1.13. How likely is the pest to be able to transfer from the pathway to a suitable host or habitat?	**Likely** **Low**	The pest is already on a suitable host. Infested plants for planting are likely to be grouped close to other suitable (or the same) hosts to which *R. indica* could transfer Outside the mite could easily transfer to host plants mostly by wind.
1.14. In the case of a commodity pathway, how likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) to aid transfer to a suitable host or habitat?	**Very likely** **Low**	The intended use of the plants is planting. This aids transfer (see answer to Q1.13)
Pathway n°: 2		**Cut flowers or Cut branches of host plants**
1.4. How likely is the pest to be associated with the pathway at origin taking into account factors such as the occurrence of suitable life stages of the pest, the period of the year?	**Likely** **Low**	In the infested countries in the Tropical environment (Caribbean, India) the pest is widespread. All stages of the pest can be found all year round. In the Caribbean it is often associated with host plants. When an area is infested, mites are often found on different plants around the infested area (Peña pers. comm., 2008).

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.5. How likely is the concentration of the pest on the pathway at origin to be high, taking into account factors like cultivation practices, treatment of consignments?	**Moderatly likely** **Medium**	The pest does not cause any visible damage on Heliconias, Strelizias (*Peña* , pers. Comm.) consequently the producers are not likely to apply any phytosanitary treatment. Cut branches with discolorations and high populations are not likely to be exported. Specific management practices in cut flower or cut branches production are not well known.
1.6. How large is the volume of the movement along the pathway?	**Minimal** **Medium**	There is no host- specific data available for the different cut flowers and cut branches. *Heliconias* and *Strelitzias* are host of *R. indica* and are common flowers in florist shops. During the years 1997-2000 the leading exporting countries of tropical flowers have been Costa Rica, Ecuador, **Mauritius**, USA (Hawaii), Ivory Coast and Cameroon. Other exporting countries are Colombia, Mexico, the **Dominican Republic**, Malaysia, Singapore, Jamaica, New Zealand and Australia. Flowers are also imported in France from **Martinique** and **Guadeloupe** (countries in bold are those where *R. indica* is known to occur). The main European importers are Germany and Italy (Pizano, 2005). Tropical flowers imports to the EU represent about 5% of the total imports of fresh cut flowers to the region (Pizano, 2005). The volume was estimated to be low and the EWG considered that the data provided in EUROSTAT are not detailed enough. Medium uncertainty as the opinion is not supported by specific figures.
1.7. How frequent is the movement along the pathway?	**Very Often** **Medium**	The cut flowers mentioned above are imported throughout the year. Medium uncertainty as the opinion is not supported by specific figures
1.8. How likely is the pest to survive during transport/storage?	**Very Likely** **Low**	Cut flowers are usually transported by plane so the pest is very likely to survive during transport. Transport by sea container is developing, but this is not likely to affect survival of the pest due to the temperature requirement for storage and transport for tropical flowers (10-13°C).
1.9. How likely is the pest to multiply/increase in prevalence during transport /storage?	**Unlikely** **Low**	The transportation time by plane is too short to allow the pest to multiply Transport by sea container is developing but multiplication is not likely to occur as temperature requirement for transport for tropical flowers is 10-13°C and there is insufficient time for multiplication of the pest to occur.
1.10. How likely is the pest to survive or remain undetected during existing management procedures (including phytosanitary measures)?	**Likely** **Low**	If the population is low it is very likely to be undetected. Flat mites are frequently undetected due to their minute size, flat bodies and somewhat sessile behaviour (USDA, 2005) There are no specific phytosanitary requirements that could be effective against this pest.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.11. In the case of a commodity pathway, how widely is the commodity to be distributed throughout the PRA area?	**Widely** **Low**	Cut branches and flowers can be sold throughout the whole EPPO region.
1.12. In the case of a commodity pathway, do consignments arrive at a suitable time of year for pest establishment?	**Yes** **Low**	In the Netherlands, cut flowers and cut branches are imported all year round and these flowers are distributed later throughout the PRA area.
1.13. How likely is the pest to be able to transfer from the pathway to a suitable host or habitat?	**Unlikely** **Low**	The tropical cut flowers and cut branches of palms are usually used for indoor decoration. This reduces the risk of transfer to suitable hosts. Some producers of ornamental plants for planting or cut flowers in EPPO countries have a cut flower store and may store cut flowers near or in their production site. The probability that both the stored cut flowers and the produced cut flowers and plants for planting are host plants of *R. indica* was considered very low by the EWG.
1.14. In the case of a commodity pathway, how likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) to aid transfer to a suitable host or habitat?	**Unlikely** **Medium**	The commodity is intended for indoor decoration and they usually remain indoors. Such use does not aid transfer to a suitable host. The cut flowers or branches may be discarded for composting but the probability of such event is not known.
Pathway n°: 3		**Passengers transporting cut flowers, cut branches, or handicrafts of host plants**
1.4. How likely is the pest to be associated with the pathway at origin taking into account factors such as the occurrence of suitable life stages of the pest, the period of the year?	**Likely** **Low**	In the infested countries in the tropical environment (Caribbean, India) the pest is widespread. All stages of the pest can be found all year round. When an area is infested mites are often found around the infested area (Peña pers. comm., 2008).
1.5. How likely is the concentration of the pest on the pathway at origin to be high, taking into account factors like cultivation practices, treatment of consignments?	**Moderatly likely** **Medium**	The EWG considered that cut flower or cut branches production (usually field grown) was under a less intensive pest management system than nursery. The pest does not cause any visible damage on Heliconias, Strelizias (*Peña* , pers. comm., 2008) consequently the producers are not likely to apply any phytosanitary treatment. Cut branches with discolorations are not likely to be sold. Specific management practices in cut flower and cut branches production are not well known.
1.6. How large is the volume of the movement along the pathway?	**Minimal** **Medium**	There is no specific data available for such volume of movement, but compared to commercial trade it is expected to be very low.

Question	**Rating + uncertainty**	**Explanatory text of rating and uncertainty**
1.7. How frequent is the movement along the pathway?	**Very Often** **Medium**	Tourism to/from Central America and the Caribbean is whole year round. Medium uncertainty as the opinion is not supported by specific figures.
1.8. How likely is the pest to survive during transport/storage?	**Very Likely** **Low**	Tourists travel by plane from the Caribbean so the pest is very likely to survive.
1.9. How likely is the pest to multiply/increase in prevalence during transport /storage?	**Unlikely** **Low**	The transportation time by plane is too short to allow the pest to multiply.
1.10. How likely is the pest to survive or remain undetected during existing management procedures (including phytosanitary measures)?	**Likely** **Low**	If the population is low it is very likely to be undetected. Flat mites are frequently undetected due to their minute size, flat bodies and somewhat sessile behaviour (USDA, 2005) There are no specific requirements in Europe for passengers (persons are allowed to bring back small quantities for personal consumption (EU, 2000)).
1.11. In the case of a commodity pathway, how widely is the commodity to be distributed throughout the PRA area?	**Widely** **Low**	Tourists are coming from all areas in the EPPO region although west Europeans are believed to travel more frequently outside Europe.
1.12. In the case of a commodity pathway, do consignments arrive at a suitable time of year for pest establishment?	**Yes** **Low**	Tourism to Central America and the Caribbean is whole year round.
1.13. How likely is the pest to be able to transfer from the pathway to a suitable host or habitat?	**Very Unlikely** **Low**	The tropical cut flowers and cut branches of palms are mainly used for indoor decoration. The risk of transfer to suitable hosts is very unlikely.
1.14. In the case of a commodity pathway, how likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) to aid transfer to a suitable host or habitat?	**Very Unlikely** **Low**	The commodity is intended for indoor decoration and they usually remain indoors. Such use does not aid transfer to a suitable host. The cut flowers or branches may be discarded for composting but the probability of such event is not known.
1.15. Do other pathways need to be considered?	**NO**	

<table>
<tr><th>Question</th><th>Rating + uncertainty</th><th>Explanatory text of rating and uncertainty</th></tr>
<tr><td>Conclusion on the probability of entry.
Risks presented by different pathways.</td><td></td><td>Plants for planting: the risk is considered low to medium
Cut flowers: the risk is considered low.
Cut branches and cut flowers: with tourists presents a very low risk

The EWG considered that the risk of entry was low.</td></tr>
<tr><td>1.16. Estimate the number of host plant species or suitable habitats in the PRA area (see question 6).</td><td>Moderate number

Medium</td><td>Within EPPO region, the following families reported to be host of R. indica are known to occur:
- palm trees: Areca sp., Caryota mitis (Fishtail palm), Dypsis decaryi (Triangle palm), Dypsis lutescens (Butterfly palm), Phoenix canariensis (Canary island date palm), Phoenix dactylifera (Date palm), Phoenix reclinata (Senegal date palm), Rhaphis excelsa (Lady palm), Syagrus romanzoffianum (Queen palm), Washingtonia robusta.
- banana trees: Musaceae (Musa sp.). In the EPPO region, Banana is produced in Spain (Canary Islands), Israel, Jordan, Morocco, Cyprus, Portugal (Madeira), Turkey.
- Streliziaceae: Strelitzia reginae (Crane/bird of paradise flower). There is a limited production of S. reginae in the EPPO region (e.g. Canary Islands, the Netherlands), which may have the potential to expand. It is very common in Israel in gardens.
- Heliconiaceae: Heliconia bihai (Yellow dancer), Heliconia caribaea (Caribbean heliconia/wild plantain), Heliconia psittacorum (Parrot's beak), Heliconia rostrata (Lobster claw). There is a limited production of Heliconia spp. In the EPPO region (e.g. Canary Islands, the Netherlands), which may have the potential to expand.
- There is no report of coconut production within the EPPO region but coconut trees are planted along beaches in the Canary Islands.</td></tr>
<tr><td>1.17. How widespread are the host plants or suitable habitats in the PRA area? (specify)</td><td>very widely:

Low</td><td>According to FAO Stats (http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567):

Palm trees
Area in ha covered by harvested dates in 2004, 2005 and 2006:

<table><tr><th>Countries</th><th>2004</th><th>2005</th><th>2006</th></tr><tr><td>Algeria</td><td>136774</td><td>147906</td><td>154372</td></tr><tr><td>Tunisia</td><td>40000</td><td>46000</td><td>46000</td></tr><tr><td>Morocco</td><td>32900</td><td>34700</td><td>48000</td></tr><tr><td>Turkey</td><td>4046</td><td>4164</td><td>4164</td></tr><tr><td>Israel</td><td>2600</td><td>2600</td><td>2600</td></tr><tr><td>Spain</td><td>866</td><td>893</td><td>900</td></tr></table></td></tr>
</table>

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
		

Jordan	615	615	656

Palm trees are also planted for ornamental purposes in the Mediterranean coastal area. In Spain mainly *Phoenix canariensis*, *P. dactilifera* and *Washingtonia* sp. are grown (data from the Spanish PRA on *Rhynchophorus ferrugineus*.

Within the EPPO region, there are some endemic palms in the wild (*Phoenix canariensis* in Canary Islands, *Chamaerops humilis* in the Mediterranean basin (Spain, Italy, Baleares, Sardinia, Sicilia, France, Portugal, Morocco, Algeria, Lybia), *Phoenix theophrasti* in Crete (Jones, 1995). Palm trees are present both indoors throughout the whole EPPO region and outdoors in the Southern part.

Banana trees
Area in ha covered by harvested bananas in 2004, 2005 and 2006:

Countries	2004	2005	2006
Spain	9715	9553	10000
Morocco	5200	5300	5540
Turkey	3000	3600	4000
Israel	2656	2747	2747
Jordan	1287	1287	1449
Portugal	1204	1206	1206
Cyprus	262	250	260
Italy	11	8	8
Algeria	14	12	1

Strelitzia and Heliconia
There are some producers of Strelitzia and Heliconia in the Netherlands (Dutch Database: http://statline.cbs.nl) and Canary Islands (Gonzalez Hernandez, pers. comm. 2008). No additional data is available.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.18. If an alternate host or another species is needed to complete the life cycle or for a critical stage of the life cycle such as transmission (e.g. vectors), growth (e.g. root symbionts), reproduction (e.g. pollinators) or spread (e.g. seed dispersers), how likely is the pest to come in contact with such species?		No alternate host needed
1.19. How similar are the climatic conditions that would affect pest establishment, in the PRA area and in the current area of distribution?	**Outdoors: Slightly similar Medium uncertainty** **Protected conditions Similar Medium uncertainty**	Based on the results of two climatic analyses, within the PRA area, the climate of the Canary Islands is most similar to that in the Caribbean where *R. indica* has recently caused significant damage to wild hosts. No other locations within EPPO have climates very similar to the Caribbean. As *R. indica* is also present in Israel, but not an economic pest there, the NAPPFAST analysis used Israeli climate factors to determine similar climate areas. This analysis highlighted that only parts of the Mediterranean coast are found to be similar to Israeli conditions namely Algeria, Italy, Morocco, Spain, Tunisia and Turkey (see Appendix 1). This area is estimated to allow for a low survival of the pest, as is the case in Israel. A CLIMEX analysis highlighted the same area. There is moderate uncertainty for Madeira and the Azores. In protected conditions (e.g. nurseries, glasshouses) that produce palms or other ornamental hosts, it is assumed that the conditions will be favourable for the establishment of the mite.
1.20. How similar are other abiotic factors that would affect pest establishment, in the PRA area and in the current area of distribution?	**no information** **High**	Requirements for abiotic factors are not known for this mite.
1.21. If protected cultivation is important in the PRA area, how often has the pest been recorded on crops in protected cultivation elsewhere?	**never (no records)** **Low**	There are no records of infestation under protected conditions but empirical experimentation demonstrated that a protected environment was suitable for the development of the mite population. (Rodrigues *et al.* 2007) The mite has always been found outside in the Caribbean because most host plants are grown outdoors (*Peña* pers comm., 2008).

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.22. How likely is it that establishment will occur despite competition from existing species in the PRA area?	**Very likely** **Low**	*Raoiella indica* can coexist, with other mite species on the same leaf (Sathiamma, 1996; Longathan *et al.*, 2000), therefore the EWG considered that the establishment of *R. indica* would not be affected by competition within species in the same trophic level.
1.23. How likely is it that establishment will occur despite natural enemies already present in the PRA area?	**Very likely** **Low**	In the countries where it has been introduced, the pest has established despite the presence of natural enemies (e.g. in Israel, Pavlesky, pers. com. 2008 and in the Caribbean, Etienne, pers. com. 2008). Some natural enemies have been recorded in Egypt, India, Mauritius and the Caribbean. *Amblyseius channabasavanni, A. largoensis A. longispinus (=Neoseiulus longispinus), A. raoiella, A. swirskii Stethorus keralicus, S. parcemunctatus,*, and *S. tetranychi.*, *Typhlodromus caudatus*, *Armascirus taurus* (Kraemer) (Cunaxidae), and *Telsimia ephippiger* Chapin (Coccidellidae), These natural enemies have been checked against Fauna Europaea to asses whether they are present in Europe (http://www.faunaeur.org/) and against the EPPO list of biocontrol agents (http://archives.eppo.org/EPPOStandards/biocontrol_web/bio_list.htm#classic) and they do not appear to occur in the EPPO region apart from *A. swirskii* which is quoted in Fauna European but with no precise location. In the Canary Islands biological control agents (BCA) are used in Banana production in particular *Neoseiulus californicus* but its efficacy against *R. indica* is not known.
1.24. To what extent is the managed environment in the PRA area favourable for establishment?	**Highly favourable** **Low**	The conditions in protected environments are highly favourable. Production systems are intended to optimize plant growth; this is likely to be favourable to the pest as well.
1.25. How likely is it that existing pest management practice will fail to prevent establishment of the pest?	**Moderately likely** **Medium**	In the Canary Islands, bananas are sprayed with acaricides. Small ornamental palms are treated specifically against *Tetranychus. urticae*. Other ornamental palms growing outdoors are not treated specifically with acaricides but are treated with insecticides (Gonzalez Hernandez, pers. com. 2008). In Israel, date palms are usually treated for the old world date mite *(Oligonychus afrasiaticus)* with acaricides (Pavleski, pers. com. 2008) The management practices are diverse and it is moderately likely that the existing pest management will fail to prevent the establishment of the pest.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.26. Based on its biological characteristics, how likely is it that the pest could survive eradication programmes in the PRA area?	**very likely outdoors /Low uncertainty** **Moderately likely on protected conditions/ low uncertainty**	Outdoors, the eradication of *R. indica*, if it becomes established, is not practical due to the cryptic nature of the pest (the small size inhibits many management methods), the ability to move on wind currents, the ability to reproduce parthenogenically, the presence of hosts in the natural environment, and the evidence from other mite introductions (Borchert and Margosian, 2007). As with other mites, it would be possible to eradicate *R. indica* from protected cultivation, for example using i) chemical applications (easily with acaricides. see question 2.3), ii) crop destruction, iii) heating of the glasshouse to 50°C for two to three days, iv) implementing a crop break for at least 4 weeks whilst ensuring no host-weeds were present to act as a "bridge". This is only possible in the absence of suitable hosts in the environment of the place of production.
1.27. How likely is the reproductive strategy of the pest and the duration of its life cycle to aid establishment?	**Very likely** **Low uncertainty**	*R. indica* reproduces fast. A generation is completed in approximately 30 days (Moutia, 1958). Female lay 2 eggs per day over an average oviposition period of 27 days. Eggs are deposited in colonies ranging in number form 110 to 300 eegs per coconut leave (Jeppson *et al*., 1975).
1.28 How likely are relatively small populations to become established?	**Very Likely** **Low uncertainty**	Even a single female can initiate the development of a population, mating has been reported to occur upon adult emergence. The mate guarding habit increases the chance of mated pairs moving together. Eggs are laid over a long period of time (Hoy *et al.*, 2006).
1.29. How adaptable is the pest?	**Moderate** **High uncertainty**	The organism seems to have a wide tolerance for climatic conditions (e.g. warm dry conditions in Israel compared with hot humid conditions in the Caribbean). This does not mean though that it could adapt to other conditions. As it is spreading, it has been found on a wider range of plants, but whether all these plants are true hosts is unclear (Hoy *et al.*, 2006). Data is lacking to properly answer this question.
1.30. How often has the pest been introduced into new areas outside its original area of distribution? (specify the instances, if possible)	**Moderate** **Low uncertainty**	The organism is currently reported from 4 continents (North-America, South-America, Africa, Asia) and was first reported in India (Hirst, 1924). See answer to question 7 in initiation.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.31. If establishment of the pest is very unlikely, how likely are transient populations to occur in the PRA area through natural migration or entry through man's activities (including intentional release into the environment)?	**Unlikely** **Low**	The pest is present in Israel and Egypt and no natural migration of the mite has been noted so far. So transient population are unlikely to occur
Conclusion on the probability of establishment		There is only a limited area of the EPPO region where hosts and suitable climatic conditions occur outdoors (see answers to questions 1.16 and 1.17 and Appendix 1 on climatic prediction). However, there are suitable protected environments and host plants throughout the EPPO region. The probability of establishment in the area identified in Appendix 1 (sub part of the Mediterranean area) is moderate. Elsewhere in the EPPO region, establishment is very unlikely outdoors, and is likely in protected conditions.
1.32. How likely is the pest to spread rapidly in the PRA area by natural means?	**unlikely** **Medium uncertainty**	Natural spread is likely to occur locally, for example by wind, but it is not likely to occur at long distances and, thus, to cause rapid spread in the EPPO region. <u>Note</u> The fact that the pest is found in countries such as Israel and Egypt, but has not been reported in other countries around the Mediterranean sea may suggest that it does not easily spread by itself. However, the absence of records in these countries may also be due to other factors, such as the unsuitability of climatic conditions (see questions 1.19) or the lack of the most suitable hosts. In some Mediterranean countries, the mite may be present, but undetected because of a lack of mite specialists.
1.33. How likely is the pest to spread rapidly in the PRA area by human assistance?	**Likely** **Medium uncertainty**	The trade of infested host plants for planting and cut flowers or branches on which mites may travel unnoticed is undoubtedly the most likely mean of transportation. <u>Note</u> The fact that the pest is found in countries such as Israel and Egypt but has not been reported in other countries around the Mediterranean sea despite the trade of some host plants between these countries may suggest that the mite does not easily spread through plant trade. However, the absence of records in these countries may also be due to other factors, such as the unsuitability of climatic conditions (see questions 1.19) or the lack of the most suitable hosts. In Egypt, and particularly Israel, the density of the mite is low to very low, which does not favour the spread by plant trade. In some Mediterranean countries, the mite may be present but undetected because of a

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
		lack of mite specialists.
1.34. Based on biological characteristics, how likely is it that the pest will not be contained within the PRA area?	**Likely** Low uncertainty	*R. indica* is small, so it is likely to remain undetected on commodities, especially at low density. It has several hosts on which it could be easily transported anonymously. In general, containment is difficult with mites. Thus, in the area where the climatic conditions are suitable outdoors, the EWG believes that there is no possibility to contain *R. indica*. Nevertheless, in the PRA area where *R. indica* is present outdoors (Israel) there has been no need for containment.
Conclusion on the probability of spread		The probability of the mite spreading if established in the EPPO region is likely because it will probably easily travel unnoticed on host plants and because containment measures appear impossible in outdoor conditions.
Conclusion on the probability of introduction and spread **The overall probability of introduction and spread should be described. The probability of introduction and spread may be expressed by comparison with PRAs on other pests.**		Entry Plants for planting: the risk is considered low to medium Cut flowers: are considered to present a low risk. Cut branches and cut flowers: carried by tourists present a very low risk Globally, the risk of entry is low to medium (considering the highest risk pathway). Establishment There are host plants present in the PRA area but the most suitable host plants (Coconut and Bananas) are restricted to Canary Islands and Madeira. The climatic conditions are likely to be suitable outdoors only in a very small area of the EPPO region it Canary Islands share climatic similarities with the Caribbean countries. There is uncertainty about Madeira and the Açores. The climatic analysis highlighted that only parts of the Mediterranean coast are found to be similar to Israeli conditions namely Algeria, Italy, Morocco, Spain, Tunisia and Turkey (see Appendix 1). This area is estimated to allow for a low survival of the pest. However there is uncertainty about climatic requirements and host range. The probability of establishment is low with the exception of restricted areas (Canary islands and possibly Madeira and the Azores). Establishment under protected conditions is likely but eradication measures could be applied. Spread

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
		Probability of spread is likely. The risk of introduction and spread is low for most parts of the PRA area. It may be higher for the Canary Islands, and possibly Madeira and the Atlantic coast of Morocco. In the Canary Islands, the import of Musa is prohibited (only tissue culture are allowed).
Conclusion regarding endangered areas **1.35. Based on the answers to questions 1.16 to 1.34 identify the part of the PRA area where presence of host plants or suitable habitats and ecological factors favour the establishment and spread of the pest to define the endangered area.**		The endangered area corresponds to places of production with host plants under protected conditions. Outdoors: the area of potential establishment outdoors is limited primarily to Canary Islands, possibly to Madeira and the Azores. And to a lesser extent to Algeria, Italy, Morocco, Spain, Tunisia and Turkey (but the pest there is likely to have a similar behaviour than in Israel where iit is not considered to be problem).
2.1. How great a negative effect does the pest have on crop yield and/or quality to cultivated plants or on control costs within its current area of distribution?	**Major/** **Medium uncertainty**	• Coconut: Information on damage and related yield losses varies. Information from coconut growers in Trinidad indicate that the production was reduced by 75% percent, two years after introduction of the mite (Duncan *et al.*, 2006) although a causal relationship has not been demonstrated. There are reports of severe foliage damage on coconut plantations, young palms and seedlings in India, but no indication of its effect on yield (Sathiamma 1996; Jeppson *et al.*, 1975). *Raoiella indica* may cause yield loss in nuts of *Areca catechu* L. (Betel nut palm) when infestations are lingering and severe (Puttarudriah and Channa Basavanna, 1958). • Date palms In date palms it is not considered as an economically important pest in the Near-East (Elwan, 2000, Zaid & Arias-Jimenez 2002, Gerson *et al.* 1983). The EWG considered that the lack of published information on damage on date palms and ornamental palms from Israel, Egypt, Oman and Iran is an indication of the minor importance of the pest in these areas. • Bananas There is severe yellowing on bananas, but no quantitative data on crop yield reduction with

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
		damage recorded on leaves in Puerto Rico, Trinidad and Tobago and Venezuela. Damage on leaves due to other pests may be confused with *R. indica* (Kane *et al.*, 2006; Welbourn, 2007). There are no reports on damage on Banana in Israel. • Ornamentals There is no evidence of loss of quality in ornamentals (gingers, heliconias and strelitzias) used for planting or as cut flowers.
2.2. How great a negative effect is the pest likely to have on crop yield and/or quality in the PRA area without any control measures?	**Minor / High uncertainty**	The main host where damage is recorded (coconut) is present in very low quantities in the EPPO region (beach landscape in Canary Islands). There is banana production in the EPPO region, but the crop yield reduction due to *R. indica* on banana is unknown. No judgement can be made for ornamental plants as there is no information. *Phoenix canariensis* is recorded as a host but there is no specific evidence of yield loss.
2.3. How easily can the pest be controlled in the PRA area without phytosanitary measures?	**Easily in production** **Impossible in the natural environment**	In protected conditions, the pest can easily be controlled with acaricides (although resistance to acaricide has not been reported for *R. indica*, it cannot be excluded) In the Canary Islands, acaricides are applied in *Musa* spp and in nurseries producing ornamental plants. No treatments are viable in the natural environment.
2.4. How great an increase in production costs (including control costs) is likely to be caused by the pest in the PRA area?	**Minimal/ High uncertainty**	To date no damage has been recorded on ornamental hosts, therefore the increase in production costs cannot be estimated. For date palms no increase in production costs are anticipated as annual routine acaricidal treatments are applied for the control of *Oligonychus afrasiaticus*. Biological control practices are now implemented for spider mite control in bananas in the Canary Islands. Those are expected to control *R. indica* as well.
2.5. How great a reduction in consumer demand is the pest likely to cause in the PRA area?	**Minimal/** **High uncertainty**	To date no damage is recorded on ornamental hosts, thus a reduction in consumer demand is not expected.

Question	**Rating + uncertainty**	**Explanatory text of rating and uncertainty**
2.6. How important is environmental damage caused by the pest within its current area of distribution?	**Minimal** **High uncertainty**	Some native plants are reported hosts but damage has not been observed. Invaded areas are recent.
2.7. How important is the environmental damage likely to be in the PRA area (see note for question 2.6)?	**Very Low/High uncertainty**	*R. indica* can coexist, with other mite species on the same leaf (Sathiamma, 1996; Longathan *et al.*, 2000), therefore it should not displace any native mite species. Potential damage on native palms (*P. canariensis*, *P. theophrasti*, *Chamaerops humilis*) is not known.
2.8. How important is social damage caused by the pest within its current area of distribution?	**Moderate** **low**	There are indications that in the coconut plantations of the Caribbean, if yield is reduced, demand for workers will be reduced. However, there is no solid data to substantiate this. No real social damage observed Regarding aesthetical damage, there are other pests causing palm yellowing so the situation is not worse.
2.9. How important is the social damage likely to be in the PRA area?	**Minimal** **low**	
2.10. How likely is the presence of the pest in the PRA area to cause losses in export markets?	**Unlikely**	European countries are minor exporters of host plants of *R. indica*. US is requiring measures for *R. indica*.
As noted in the introduction to section 2, the evaluation of the following questions may not be necessary if the responses to question 2.2 is "major" or "massive" and the answer to 2.3 is "with much difficulty" or "impossible" or any of the responses to questions 2.4, 2.5, 2.7, 2.9 and 2.10 is "major" or "massive" or "very likely" or "certain". You may go directly to point 2.16 unless a detailed study of impacts is required or the answers given to these questions have a high level of uncertainty.		

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
2.11. How likely is it that natural enemies, already present in the PRA area, will not reduce populations of the pest below the economic threshold?	**Moderately likely** **High**	In areas where it has been introduced, generalist natural enemies have been associated with *R. indica* but there is not evidence that they are reducing mite densities satisfactorily. As already noted most natural enemies recorded are not present in the PRA area. In Guadeloupe, it appears that the mite densities are below the densities than those observed earlier, suggesting that the indigenous natural enemies may have an impact on the pest (Etienne pers. comm.). In the Canary Islands biological control agents (BCA) are used in Banana production in particular *Neoseiulus californicus* but its efficacy against *R. indica* is not known.
2.12. How likely are control measures to disrupt existing biological or integrated systems for control of other pests or to have negative effects on the environment?	**Unlikely** **Medium**	In date production, it is unlikely to disrupt biological and integrated systems as acaricides that are routinely applied would be effective against *R. indica*.
2.13. How important would other costs resulting from introduction be?	**Minimal** **Medium**	In the US, communication on red palm mite has been included in existing extension programmes. As the mite is spreading into different areas of North and South America, additional costs will be related to acquire more knowledge generated from research.
2.14. How likely is it that genetic traits can be carried to other species, modifying their genetic nature and making them more serious plant pests?	**Very unlikely** **Low**	Not relevant for mites

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
2.15. How likely is the pest to cause a significant increase in the economic impact of other pests by acting as a vector or host for these pests?	**Not relevant**	
Conclusion on economic consequences		In the vast majority of the EPPO region, there are three factors that will influence economic damage: a) lack of suitable climatic conditions, b) the most suitable host, ie., coconuts, are rarely present in the EPPO region, and c) on the EPPO region, relevant hosts (bananas, date palms) have effective control practices that can be used against this pest. The group considered that there was not enough evidence of economic damage on date palms (Zaid & Arias-Jimenez, 2002; Gerson *et al.*, 1983). There is uncertainty for banana (damage recorded on leaves but not evidence for yield losses) (*Peña*, pers. comm., 2008) There is no information of damage for ornamental plants and native palms (*Peña*, pers. comm., 2008). The economic consequences for most of the EPPO region are likely to be low. The impact of the pest could be more substantial in the Canary Islands and possibly Madeira where banana are grown and the climate seems to be more suitable (Gonzalez Hernandez, pers. comm., 2008).
2.16. Referring back to the conclusion on endangered area (1.35), identify the parts of the PRA area where the pest can establish and which are economically most at risk.		Climatic conditions in the Canary Islands and possibly Madeira may be suitable for establishment but there is uncertainty whether the pest could cause damage on Banana production. There is also high uncertainty on the potential damage on endemic palms.
Degree of uncertainty **Estimation of the probability of introduction of a pest and of its economic consequences involves many uncertainties. In particular, this estimation is an extrapolation from the situation where the pest occurs to the**		**Knowledge gap and uncertainties have been identified:** ***Host range of R. indica*** True hosts for *R. indica* were considered to be those with all live stages of the mite. Conditional hosts will allow pest subsistence but not reproduction and development. Accordingly, the current host lists (Welbourn, 2007; Mendoca *et al.*, 2005; *Peña et al.*, 2006) should be re-evaluated and

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
hypothetical situation in the PRA area. It is important to document the areas of uncertainty (including identifying and prioritizing of additional data to be collected and research to be conducted) and the degree of uncertainty in the assessment, and to indicate where expert judgement has been used. This is necessary for transparency and may also be useful for identifying and prioritizing research needs. **It should be noted that the assessment of the probability and consequences of environmental hazards of pests of uncultivated plants often involves greater uncertainty than for pests of cultivated plants. This is due to the lack of information, additional complexity associated with ecosystems, and variability associated with pests, hosts or habitats.**		new hosts should be tested according to these criteria. Molecular characterization of populations of *R. indica* from different climatic regions around the world is needed to identify different bioptypes or even sibling species Although some data is available specific information on the trade volume of ornamental host plants from infested *R. indica* areas to the EPPO region is lacking. Foliar pest damage (chlorosis, necrosis) has been reported for coconut and bananas, but not for other hosts. For bananas studies are needed to correlate leaf damage levels to yield loss. **Environmental response of the organism** More information is needed on thermal and humidity requirements for the pest to establish and cause damage. Additionally, there is need to learn about the climatic factors limiting the distribution of the mite in the EPPO Region. **Biological control Agents** Effective biological control agents for *R. indica* are not known. For instance, the effect of alternate food sources (pollen, other arthropods) to conserve and augment populations of these enemies needs to be determined. Secondly, reproductive potential of the natural enemy on *R. indica*, needs to be elucidated. Third, the phenologies of *R. indica* and its natural enemies need to be determined on different plant hosts and climatic regions. Factors that have influenced the current temporal and spatial distribution of the mite in the Middle East are not known. In Israel, *R. indica* was only detected when a survey was conducted on the spatial distribution of the old world date mite (Gerson *et al.*, 1983). From 1999 to 2008, in southern date production area of Israel it has barely detected during an intensive monitoring programme for the old world date mite.
Evaluate the probability of entry and indicate the elements which make entry most likely or those that make it least likely. Identify the pathways in order of risk and compare their importance in practice.		Plants for planting the risk is considered low to medium Cut flowers is considered to present a low risk. Cut branches and cut flowers with tourists presents a very low risk Globally the risk of entry is low to medium (see page 18). Volume of trade is considered low and concentration low

Question	**Rating + uncertainty**	**Explanatory text of rating and uncertainty**
Evaluate the probability of establishment, and indicate the elements which make establishment most likely or those that make it least likely. Specify which part of the PRA area presents the greatest risk of establishment.		The most favourable host (coconut) is rarely present. Based on climate matching, the EPPO climatic conditions seem favourable only in a very limited part of the region in the Canary Islands and possibly Madeira.
List the most important potential economic impacts, and estimate how likely they are to arise in the PRA area. Specify which part of the PRA area is economically most at risk.		On the host plants recorded in the EPPO region, only banana is reported as having foliar damage (no information on yield reduction is available). There is uncertainty regarding the effect of *R. indica* on native palm trees.
The risk assessor should give an overall conclusion on the pest risk assessment and an opinion as to whether the pest or pathway assessed is an appropriate candidate for stage 3 of the PRA: the selection of risk management options, and an estimation of the associated pest risk.		This pest presents a low risk for the EPPO region. There is uncertainty about the potential risk for the Canary Islands and possibly Madeira Madeira and the Azores. Although it is likely to become established in some areas around the Mediterranean basin it is not likely to cause damage there (based on its behaviour in Israel, Egypt, Iran, and Oman).

This is the end of the Pest risk assessment	

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APPENDIX 1

NAPPFAST Polygon Climate Factor Comparison Analysis for *Raoiella indica*

Introduction

Since *Raoiella indica* (Tenuipalpidae) was detected in Martinique in 2004 (Flechtmann & Etienne, 2004), it has spread rapidly through the Caribbean region causing extensive foliar damage, primarily on young coconuts, other palms and bananas (Welborne, 2007). In contrast, *R. indica* has been present in Israel for over 25 years (Gerson et al. 1983) without causing any significant damage (Zaid and Arias-Jimenez, 2002) and it has been present in Egypt since 1942 . The aim of this study was to investigate the climatic factors that might limit the abundance of *R. indica* in Israel to explain the differences in the reported pest status of the organism between the Caribbean and Israeli infested areas.

Methods

1. The North Carolina State University-Animal Plant Health Inspection Service Plant Pest Forecasting (NAPPFAST) system was used to determine whether there were areas in the EPPO region where climatic conditions might be suitable for the mite to reach economically damaging status by comparing climatic factors from Israel with Caribbean regions using global layers.
2. We generated a polygon along the border of Israel to represent an area where the mite is present, but does not occur at sufficient densities to reach economically damaging status.
3. We generated polygons along the borders of the Dominican Republic and Puerto Rico to represent areas where the mite is a newly infesting pest causing more extensive damage.
4. For Israel and the combined Caribbean polygons we used the polygon climate match function in NAPPFAST to generate areas of similar conditions for three factors:

   (i) Growing Season Moisture % ((sum of precipitation/sum of evaporation-transpiration) *100) evaporation transpiration rate is standardized for grass surface and growing season is determined by week of last 0 C to week of first 0 C.

   (ii) Monthly minimum temperature, and

   (iii) Monthly maximum temperature (30 year averages 1976- 2005) for all 12 months.
5. For both polygons, three climate match layers were generated and exported to ESRI Arc Map 9.2. The three climate match layers for Israel were added using raster calculator, with the resultant layer (Israel 3 Combined) modified to display areas only where 2 or 3 climate match factors were present concurrently. The same process was performed on the Caribbean climate match layers (Caribbean 3 Combined). The climate match parameters for the two representative polygon areas are given in Figure 6(a-f).

Results

See Figures 1 to 5. For the three climate factors utilized in the analysis, the Caribbean factors are present in regions of India, the Philippines, Florida, Venezuela and several other areas where *R. indica* is reported as a pest (Figure 1). Within the EPPO region, only the Canary Islands share the Caribbean factors (Figure 4).
The Israeli factors are present primarily around the Mediterranean Sea with regions of Spain, Italy, Morocco, Algeria, Tunisia and Turkey having two or more factors in common (Figure 4).

Conclusion

As with many other organisms that cannot regulate their body temperature, the distribution of *R. indica* is assumed to be largely influenced by climatic factors. The similarity of climatic factors in regions around southern Europe and North Africa with Israel indicate *R. indica* may establish in these areas, but should not attain pest status.

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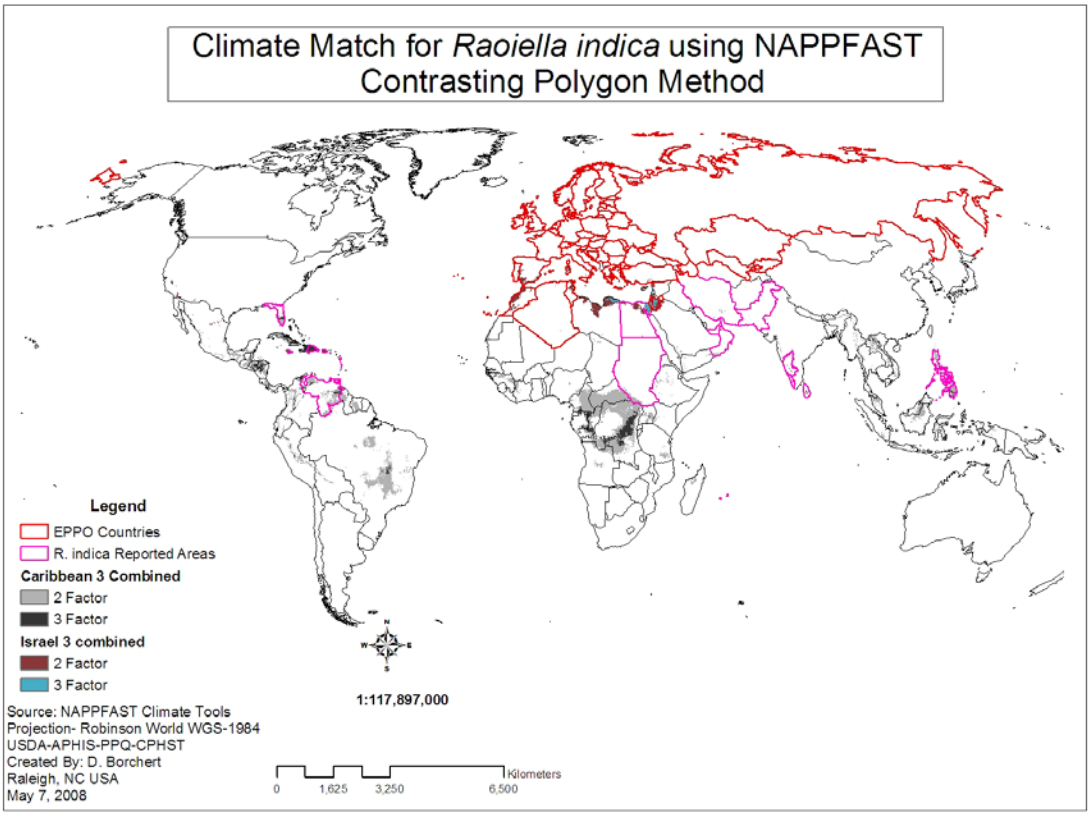


Figure 1: World map of climate match for Caribbean and Israel regions related to reported pest status.

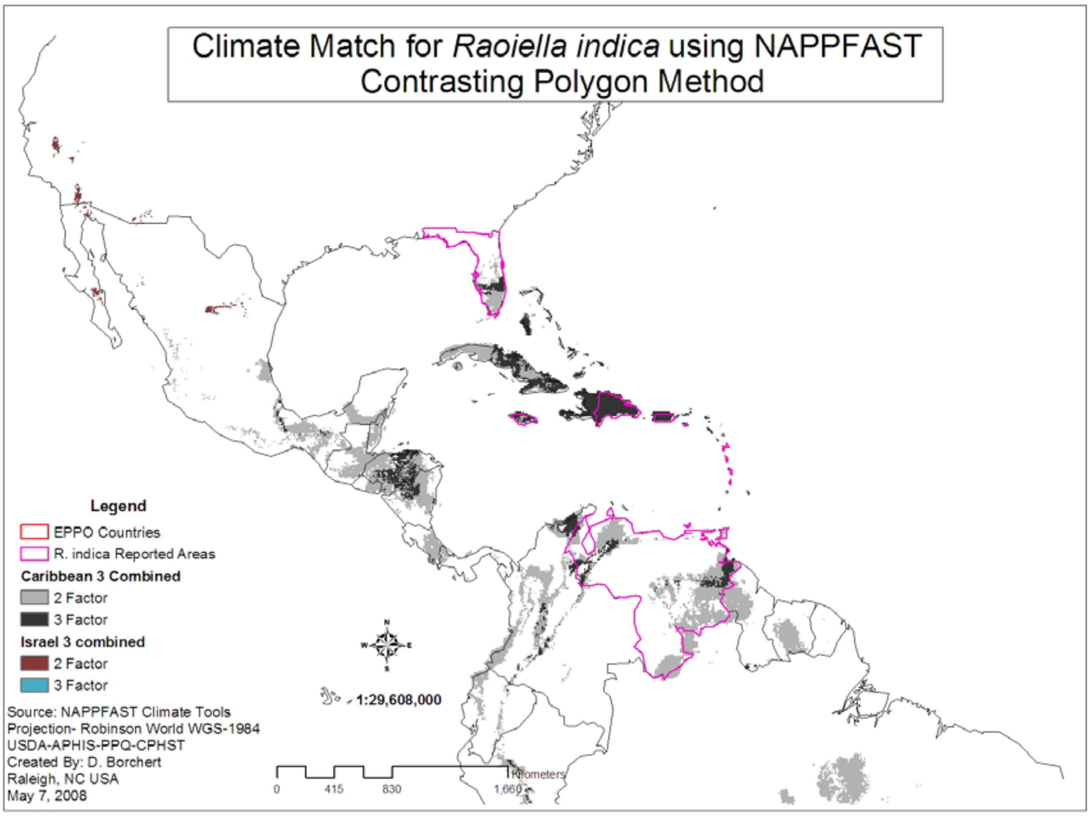


Figure 2. Gulf of Mexico detailed map of climate match for Caribbean and Israel regions related to reported pest status.

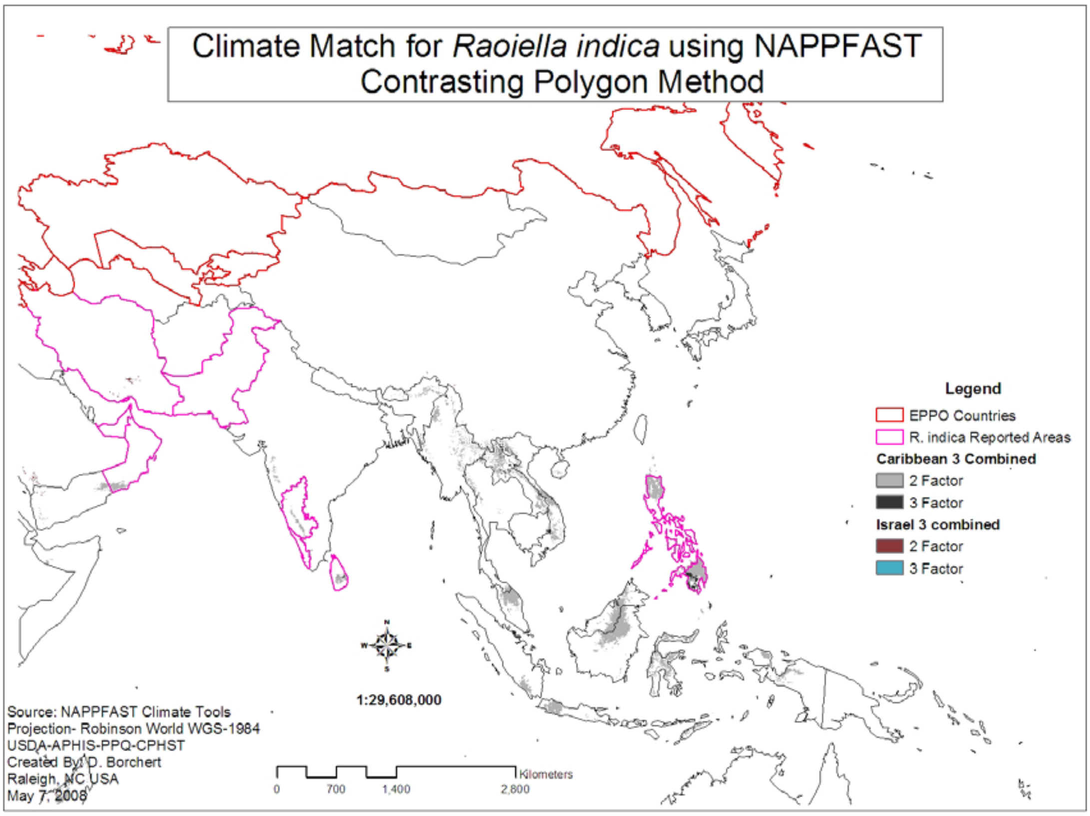


Figure 3. Indian Ocean detailed map of climate match for Caribbean and Israel regions related to reported pest status.

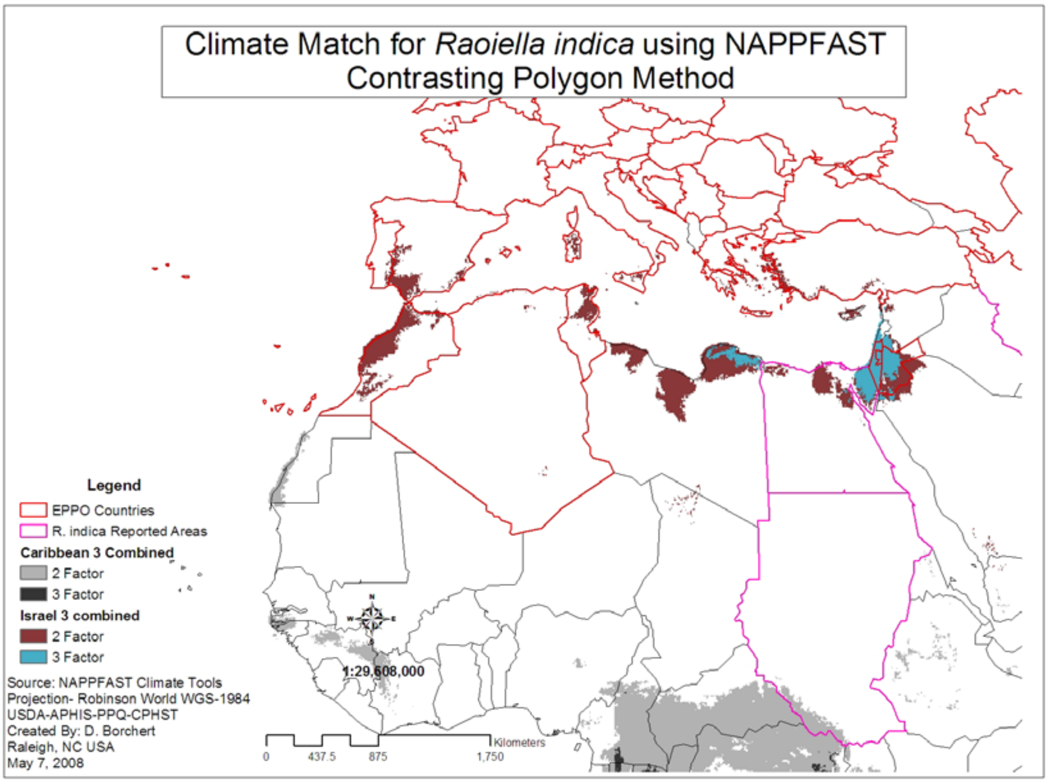


Figure 4. Mediterranean Sea detailed map of climate match for Caribbean and Israel regions related to reported pest status.

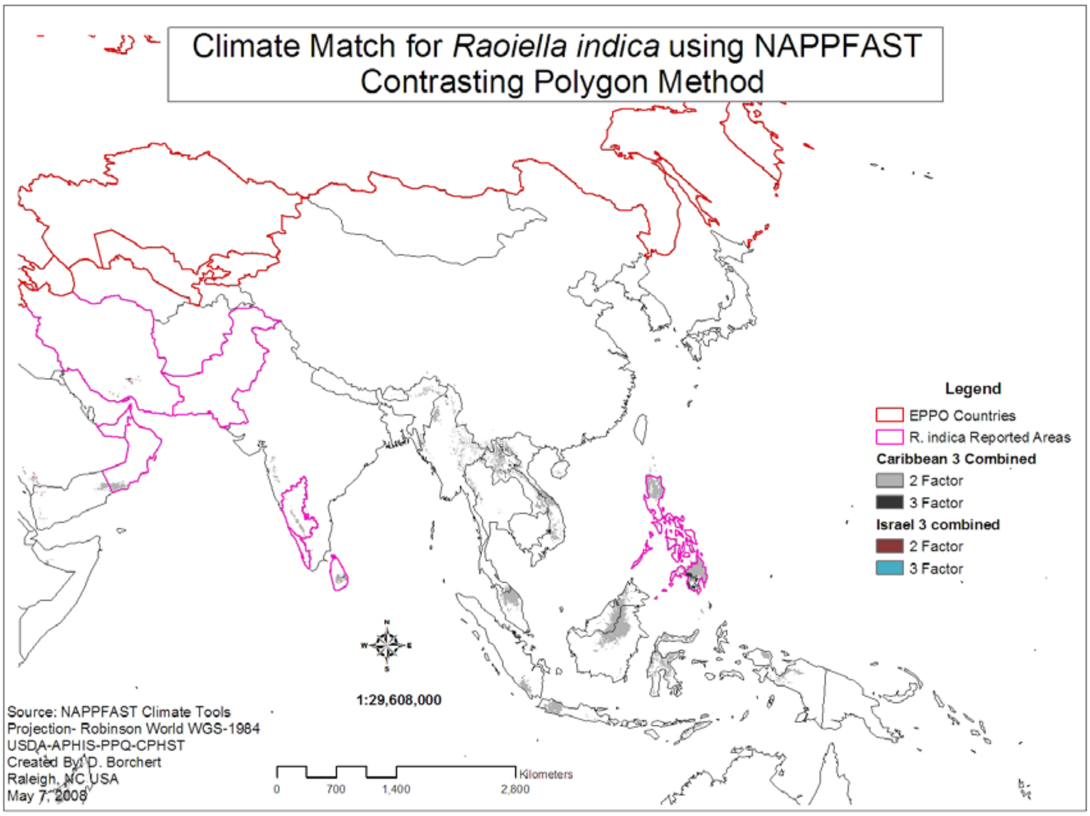
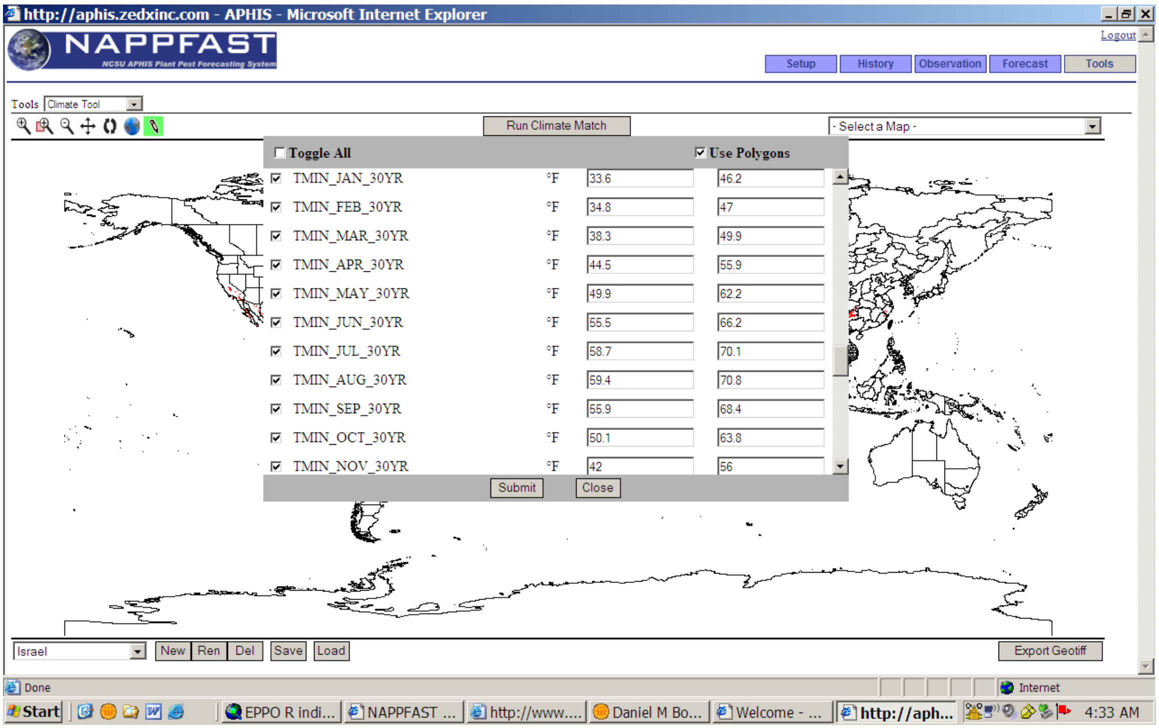
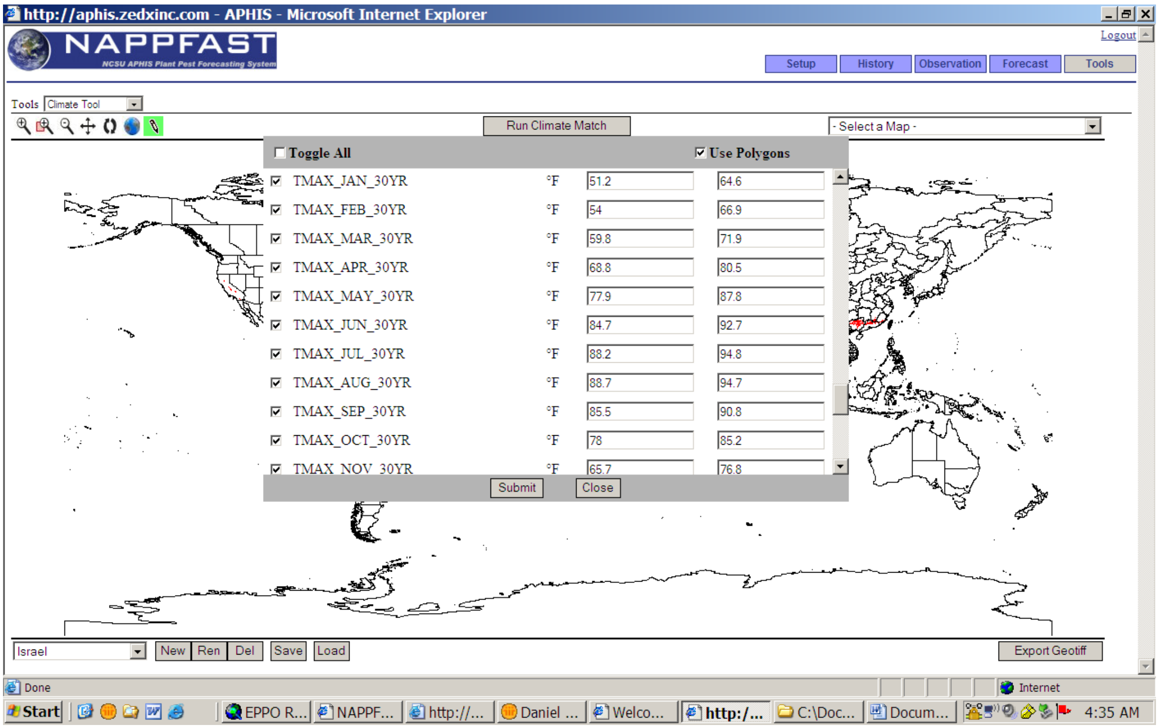


Figure 5. Detailed map of climate match for Caribbean and Israel regions related to reported pest status.

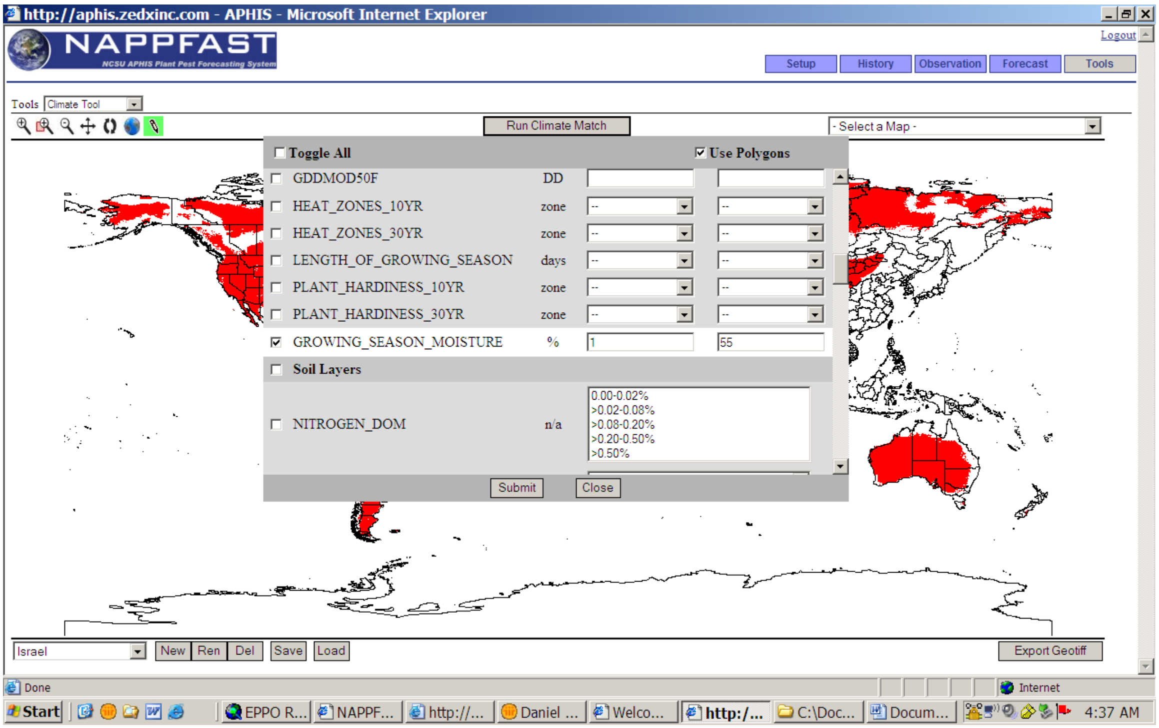
Figure 6. NAPPFAST Climate match parameter ranges for Israel and Caribbean polygons.



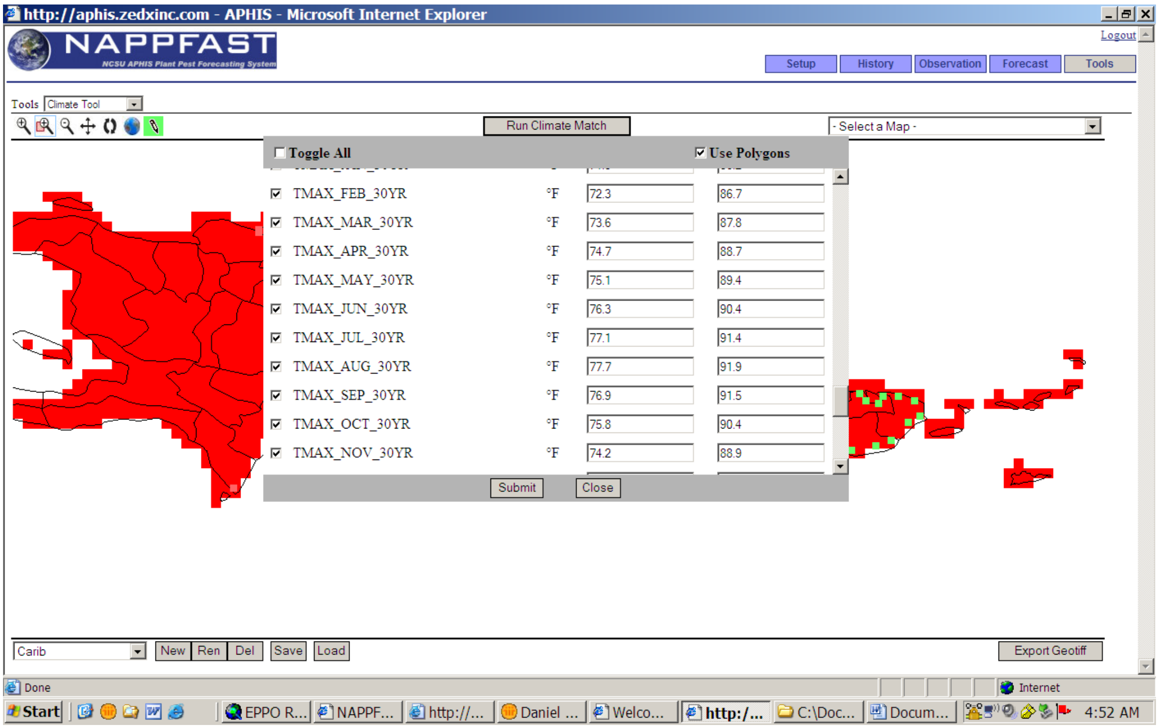
6a. Israel polygon Monthly T min ranges
Dec T min 30 yr range: 36.1-49.4 F



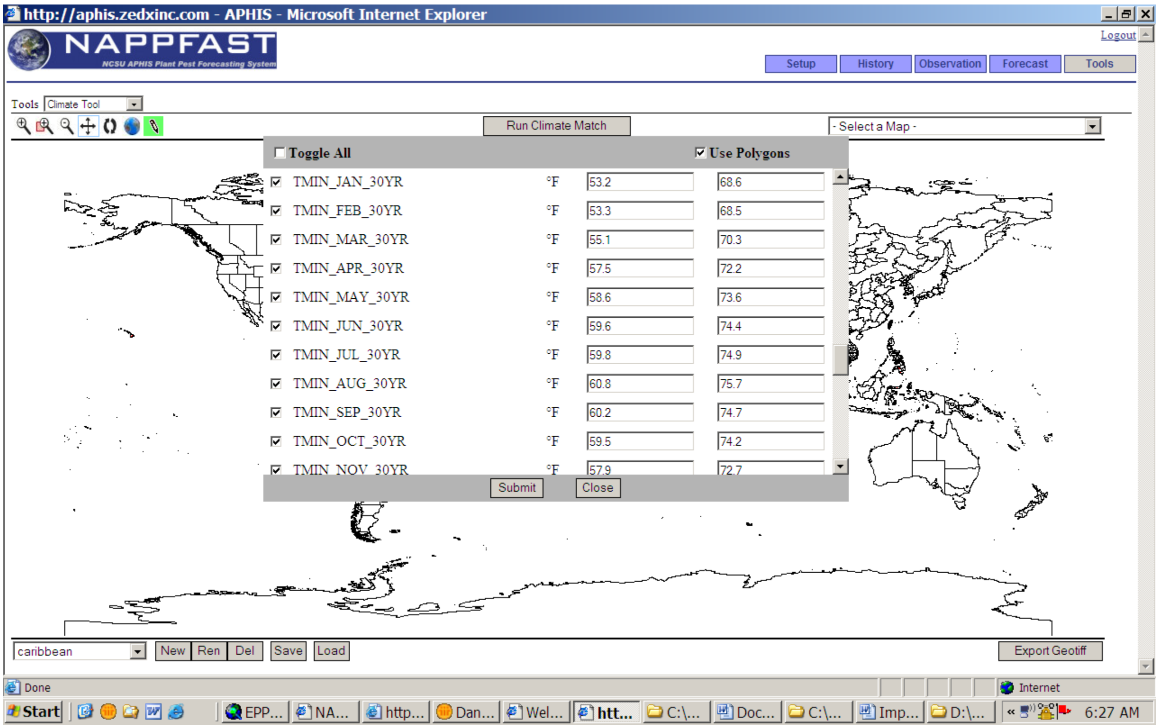
6b. Israel polygon 30 year monthly T max ranges
December T max 30 yr range: 54.1-68 F



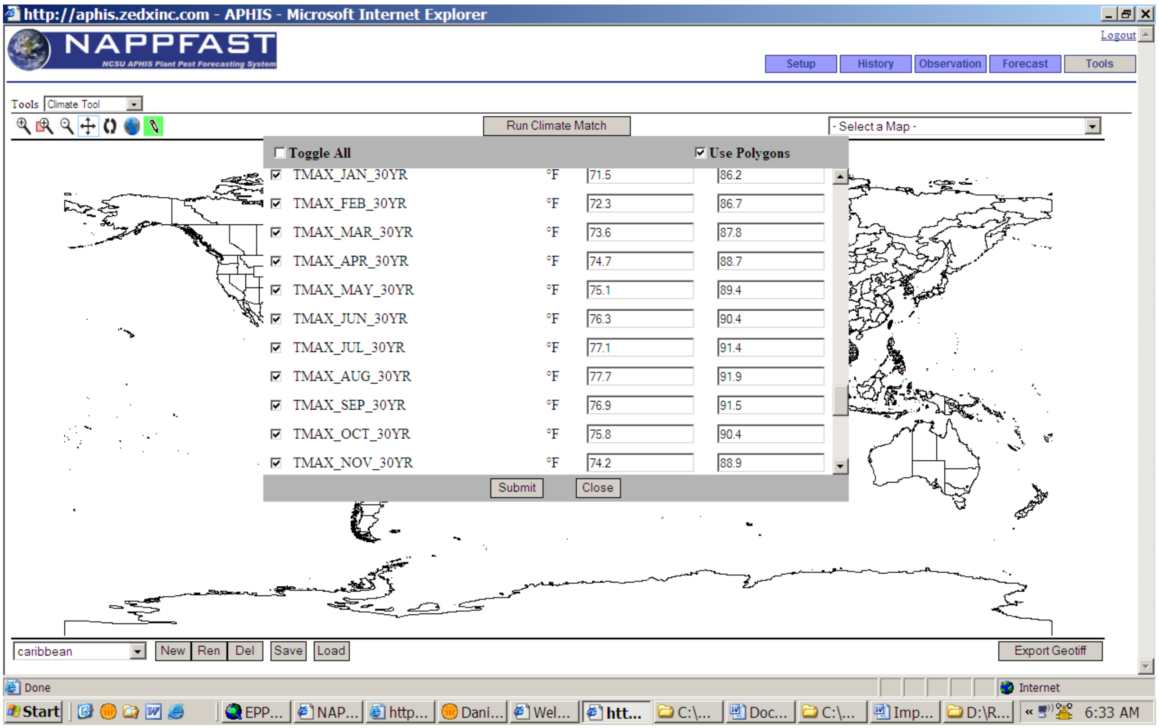
6c. Israel polygon Precipitation/Evaporation range



6d. Caribbean polygons Precipitation/Evaporation Range



6e. Caribbean polygons Monthly 30 yr T-min ranges.
December 55-70.2 F



6f. Caribbean polygons Monthly 30 yr T-max ranges.
December 72.6-87.2 F

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