



PEST RISK ANALYSIS FOR : *Drosophila suzukii*



Based on a Pest risk analysis prepared by an Expert Working Group for performing PRA 2010-07-05/08

Expert Working Group composition

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Stage 1: Initiation

1.01 - Give the reason for performing the PRA

Identification of a single pest

1.02a - Enter the name of the pest

Pest name (what you enter here will appear as a heading)

Drosophila suzukii

1.02b - Indicate the type of the pest

arthropod

1.02d - Indicate the taxonomic position

Arthropoda, Insecta, Diptera, Drosophilidae, *Drosophila suzukii*

1.03 - Clearly define the PRA area

EPPO region

1.04 - Does a relevant earlier PRA, or other relevant study (such as a management or contingency plan, cost-benefit analysis, PRA from other regions) exist?

yes

Two PRAs have been prepared on this pest:

- Damus, M. 2009. Plant Health Risk Assessment: *Drosophila suzukii* (Matsumura), Spotted wing drosophila. Unpublished, Canadian Food Inspection Agency, 2009.
- Biosecurity Australia, 2010. Draft pest risk analysis report for *Drosophila suzukii*

1.05 - Is the earlier PRA still entirely valid, or only partly valid (out of date, applied in different circumstances, for a similar but distinct pest, for another area with similar conditions)? Explain your judgement (edit in the part justification)

not entirely valid

The two PRAs are recent and include information relevant for the EPPO PRA but they are focused on risks for Canada or Australia so they are not entirely valid.

1.06 - Specify all host plant species (for pests directly affecting plants) or suitable habitats (for non parasitic plants). Indicate the ones which are present in the PRA area.

D. suzukii infests both cultivated and wild hosts.

Crops on which significant economic damage has been reported are:

Prunus spp. (mainly sweet cherries, but also on peaches and apricots), *Vaccinium spp.* (blueberries), *Rubus spp.* (e.g. raspberries and blackberries), *Fragaria ananassa* (strawberries).

Crop on which damage has been reported in the past, but no recent publications confirm it.

Vitis vinifera (table and wine grapes).

Damage on *Vitis vinifera* (table and wine grapes) has been recorded in Japan (Kansawa, 1939). Contacts were made with Dr Kimura from the zoological institute of the Hokkaido University. He confirmed that there are some reports of damages on grapes in Japan, but no details have been provided. In Oregon, the pest emerged from wine grapes but no noticeable damage had been noted (Herring, 2009). In California, the pest is present in cherry orchards in the vicinity of vineyards, and no damage has been recorded in these vineyards so far (Hauser, pers. comm. 2010). In Washington state Maiguashca *et al.* (2010) report that field cage tests were conducted with Syrah grapes. In September 2010 adults were released into each cage. No *D. suzukii* were observed in any grapes exposed to the pest in the vineyard in these studies.

Dr Kimura (*pers. comm.* 2010) explained that he once tried to rear *D. suzukii* on grapes, and observed that it could not penetrate grape's skin with its ovipositor, since grape skin is rather thick and tough. He observed that oviposition occurred on injured grapes but commented that it cannot be excluded that *D. suzukii* may be able to insert its ovipositor in grape varieties with thin skin. The observation by Dr Kimura that oviposition occurs in injured grape is consistent with other observations made in USA; in particular Maiguashca *et al.* (2010) report that injury appears to be the greatest factor in determining if *D. suzukii* can oviposit successfully and maggots hatch out.

Finally the article of Maignashca *et al.* (2010) mentions that samples of grapes that exhibited a substantial number of splits due to recent rains were received in the Entomology laboratory (Prosser Washington State), and that maggots were observed in fruit that were split. The maggots were reared and identified as *Drosophila melanogaster*, a vinegar fly species that has been long established and present in Washington vineyards. Whether more damage can be expected from *D. suzukii* is not known.

From these different observations it is difficult to conclude whether grapes are host and there is uncertainty whether they can be considered as important as those for which significant damage is repeatedly reported.

Other recorded hosts include:

Actinidia arguata (hardy kiwis), *Cornus* spp., *Diospyros kaki* (persimmons), *Ficus carica* (figs),

D. suzukii can be present in already damaged fruits, e.g. *Malus domestica* (apples) and *Pyrus pyrifolia* (Asian pears).

D. suzukii was reared on *Lycopersicon esculentum* (tomato) in the laboratory but no natural infestation has been recorded. In France numerous flies have been trapped in Tomato crops (French NPPO, 2010-12) however no information on damage is available nor on the possible close vicinity of other hosts (further information has been requested by the EPPO Secretariat).

The list of hosts is presented in Appendix 1

1.07 - Specify the pest distribution for a pest initiated PRA, or the distribution of the pests identified in 2b for pathway pests

EPPO region:

- Russia (southern Siberia, Storozhenko *et al.*, 2003)
- Spain (detected in traps in El Perelló from 2008, EPPO 2010)
- Italy (Trentino-Alto-Adige region, EPPO 2010 a); Toscana region, EPPO 2010b); Piemonte (EPPO 2010d)
- France (Corsica, Languedoc Roussillon, Midi Pyrénées, Provence Alpes Côte d'Azur and Rhone Alpes, EPPO 2010a & 2010b).

Central America :

- Costa Rica

North America:

- USA: California (2008), Oregon (2009), Washington (2009), Florida (2009) (Hauser, personal communication 2010), Louisiana (2010), North Carolina (2010), South Carolina (2010) and Utah (2010)
- Canada: British Columbia (in the Fraser River and Okanagan Valleys (Damus, 2010); Vancouver, in private Gardens (Damus, personal communication 2010))

South America :

- Ecuador

Oceania:

- Hawaii (since at least 1980) (Kaneshiro 1983)

Asia:

The fly was first observed in Mainland (Honshu) Japan in 1916 (Kanzawa 1936).

- Japan (Amami, Hokkaido, Honshu, Kyushu, Shikoku, Okada 1964; Ryukyu)
- China (Guangxi, Guizhou, Henan, Hubei, Yunnan, Zhejiang)
- India (Chandigarh, Jammu and Kashmir, Uttar Pradesh)
- Thailand (Toda, 1991)
- Korea (Delfinado & Hardy 1977, Okada 1964)
- Burma (Damus 2010)

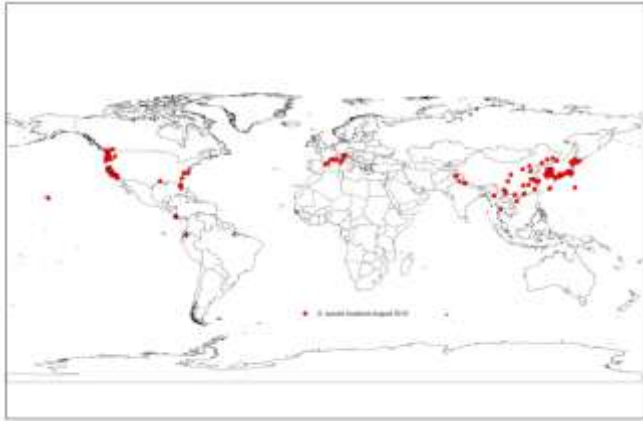


Fig 1 global distribution of *Drosophila suzukii* (2010-08)

Stage 2: Pest Risk Assessment Section A: Pest categorization

Identity of the pest (or potential pest)

1.08 - Does the name you have given for the organism correspond to a single taxonomic entity which can be adequately distinguished from other entities of the same rank?

yes

It is a single taxonomic entity. See also question 2a.

1.10 - Is the organism in its area of current distribution a known pest (or vector of a pest) of plants or plant products?

yes (the organism is considered to be a pest)

When *D. suzukii* occurs under appropriate climatic conditions, it causes significant crop damage. Records of crop damage in Japan exist from as early as 1935 (Kanzawa, 1935). In California where it has recently established, it has quickly spread and caused extensive crop damage (Bolda, 2009). Damage to fruit crops has also been recorded in France and Italy (EPPO 2009, EPPO 2010a). Symptoms have been observed on blackberry, blueberry, cherry, raspberry and strawberry. In some areas the pest has been trapped but no damage is reported so far (Spain, areas of France other than Provence Alpes Côte d'Azur and Corsica, and Piemonte Italy).

1.12 - Does the pest occur in the PRA area?

yes

In the EPPO region the pest currently has a limited distribution. There have been detections of *D. suzukii* in Spain in traps (El Perello just north of the Ebro Delta, and some 133 km SW of Barcelona), France (Corsica, Languedoc Roussillon*, Midi Pyrénées*, Provence Alpes Côte d'Azur and Rhone Alpes*, EPPO 2010a & 2010b), Italy (province of Trento - Trentino-Alto Adige, Piemonte* and Toscana*), and Far East Russia (Far East).

*in traps only

1.13 - Is the pest widely distributed in the PRA area?

not widely distributed

see 12

For a pest to establish, it should find host plants or suitable habitat in the PRA area.

Natural hosts should be of primary concern but, if such information is lacking, plants which are recorded as hosts only under experimental conditions or accidental/very occasional hosts may also be considered. The pest should also find environmental conditions suitable for its survival, multiplication and spread, either in natural or in protected conditions.

1.14 - 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

In terms of important agricultural hosts, all the major hosts (see question 6 Table 1) are present in the EPPO region, several are planted extensively.

Table 1 Production figures for Europe, North Africa, West Asia (Source FAO Stat accessed 2010/07/02 detailed tables are presented in Appendix 2)

Fruit	Surface ha (2007)	Surface ha (2008)
Cherries	265756	280447
Strawberries	207760	195010
Raspberries	92784	82167
Blueberries	17365	17504
Current	139890	115548

<i>Other berries</i>	38632	38964
<i>Peaches and nectarines</i>	412533	468637
<i>Apricot</i>	282160	271968
<i>Total potential hosts</i>	1456880	1470245
Grapes	4996765	5040451
<i>Total "potential hosts with grapes"</i>	6453645	6510696
<i>all fruits</i>	12871995	12790219

This represents approximately 12% of the total area of fruit production (without grapes) but nearly 50% with grapes

1.15a - Is transmission by a vector the only means by which the pest can spread naturally?

no

1.16 - 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

The fact that *D. suzukii* seems to favour cool and humid climate (e.g. in central coastal California) suggests that it probably has the potential to establish in many parts of the EPPO region.

1.17 - 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

Based on the current distribution of this pest (see 7) and the damage noted in North America, there is a strong probability that *D. suzukii* could cause significant yield loss and reduction in crop quality in the PRA area.

This pest could present a phytosanitary risk to the PRA area.

1.18 - Summarize the main elements leading to this conclusion.

Based on the current knowledge and distribution of this pest, its climatic requirements and the agricultural damage it can incur , there is a strong probability that *D. suzukii* could cause significant yield loss and reduction in crop quality in the PRA area.

Stage 2: Pest Risk Assessment Section B: Probability of entry of a pest

2.01a - Describe the relevant pathways and make a note of any obvious pathways that are impossible and record the reasons. Explain your judgement (edit in the part justification)

Possible pathways:

Fruits

D. suzukii lay eggs in fruit. Larvae develop in fruits and pupae usually develop in fruits. The most likely pathways for *D. suzukii* are consequently fruits of host species.

These commodities have been considered in detail in the entry part. Major host fruits and minor host fruits are separated.

D. suzukii has a wide host range (see question 6), nevertheless the EWG considered that a distinction should be made between hosts on which important damage is recorded and thus likely to be major pathways and other hosts:

Major hosts were considered to be:

Rubus armeniacus (Himalayan blackberries), *R. loganobaccus* (loganberries), *R. idaeus* (raspberries), *R. laciniatus* (evergreen blackberries), *R. ursinus* (marionberries), and other blackberries (*Rubus* spp.),

Vaccinium spp (blueberries), .

Fragaria ananassa (strawberries),

Prunus avium (sweet cherries),

P. persica (peaches),

P. armeniaca (apricots)

Minor hosts (or less preferred hosts) were considered to be:

P. domestica (plums),

Vitis vinifera (table and wine grapes).

It should be noted that fruits are the only pathway considered in the PRA conducted for Canada.

The EPPO expert working group considered that a separation between major hosts and minor hosts was useful. No such distinction is made in the Australian PRA .

Plants for planting

Kanzawa (1939) have described the life cycle of *D. suzukii*. It lays eggs in mature fruits. Larvae develop in fruits. Pupation in the fruit seems to be the most frequent form of pupation but some may form between the fruit and the growing media or creep into the soil.

From this information it can be deduced that the main risk for plants for planting is when soil is attached. Infestation could result from fruits that have fallen on the growing media or from pupae which have developed in the growing media.

Plants for planting transported bare rooted are consequently not considered as a likely pathway.

Description of the different commodities for host plants for planting

- Plants of woody trees e.g. *Prunus avium* (sweet cherries), *P. domestica* (plums), *P. persica* (peaches): in nurseries plants usually do not produce fruit as they are too young. Usually plants for planting of fruit trees for professional orchards are traded bare rooted. Fruit trees for private backyard gardens are usually traded in containers but given the poor fruit production the risk is considered negligible.

The risk of infestation of plants for planting of woody trees is consequently negligible.

- Plants for planting of *Rubus* spp two types of production are recorded for *Rubus*. *Plants produced in the field are usually traded bare rooted, the risk is consequently negligible.* Other plants for planting are less than two years old and will not set fruits so there is no risk of infestation (Nursery PEPIMAT French nursery specialized in small fruits, pers. comm. 2010).
- *Vaccinium* spp. plants for planting are usually traded in containers and may fruit in nurseries, consequently the growing media attached to the plants may be infested if the plants are produced outdoors.

Information is not sufficient to make a detailed evaluation of the entry part for these pathways (no detailed information on trade for these species, no information on the association or the concentration).

Soil/growing media

Soil from places of production where the pest is present may be infested, though possible, it was considered improbable. This pathway was not considered further

Cut flowers

The Expert Working Group did not consider cut flowers as a relevant pathway at its meeting in July. However, this pathway has been identified in the Australian PRA (Biosecurity Australia, 2010) although considered as presenting a very low risk. The species considered as potential hosts as cut flowers are *Styrax japonicus* and *Camelia japonica*. These species are not recorded as cut flowers in the booklet of the Flower Council of Holland which contains 756 cut flowers in demand (Flower Council of Holland, 2009). Furthermore it is reported that flowers are only known to be attacked by *D. suzukii* in the absence of host fruits. Flowers have only been recorded to be attacked in spring, after adults emerge from winter diapause and before fruits ripen in late spring (Mitsui *et al.* 2010). This pathway is consequently not considered further in this PRA.

Boxes and crates

Larvae and pupae usually remain in the fruit and fruits that are traded are likely to be free from symptoms of attack (so mainly infected with young larvae that will not leave the fruit). It cannot be completely ruled out that some larvae (the most mature) leave the infested fruit during the transportation and wander on the crates to search for a place where to pupate. However, the high humidity requirements for survival during the pupation stage makes that this is a very unlikely pathway.

Natural spread

Natural spread will be possible from areas where the pest has been detected in the EPPO region. This pathway has not been analysed in detail in the entry section but is considered in the management part.

Commodities that are not pathway

Bulbs and tubers: not relevant

Seeds not relevant

Cut branches without flowers: not relevant

Wood and wood products not relevant

[2.01b - List the relevant pathways that will be considered for entry and/or management. Some pathways may not be considered in detail in the entry section due to lack of data but will be considered in the management part.](#)

Pathway 1: Fruits of major host plants

2.03 - How likely is the pest to be associated with the pathway at the point(s) of origin taking into account the biology of the pest?

very likely

Level of uncertainty: low

Association of the pest with host fruits is very likely in areas where it is present. The pest lays eggs in maturing fruits, larvae and pupae develop in the fruits (Kansawa 1939)

2.04 - How likely is the pest to be associated with the pathway at the point(s) of origin taking into account current management conditions?

likely

Level of uncertainty: medium

A detailed study was performed in Japan by Kanzawa in 1939 on cherry.

For cherry in orchards, it was noted that 75 to 80 % of the fruits can be attacked, a variety such as Napoleon being most infested. The possible emergence number in one cherry fruit was also investigated in the laboratory by allowing multi oviposition on one fruit between 40 and 62 hatchings (the size of the adults was smaller than normal but they could reproduce normally). This indicates that several larvae can develop in one fruit.

In his email blog on *D. suzukii* Bolda (2010) states that it continues to be a pest in Japan where it is expanding its geographical and host range.

Kanzawa (1939) gives the following information for different fruits:

	Cultivar	Condition of Fruit	<i>D. suzukii</i> Emergence
Cherries	Various	Whole	Many
Mahaleb Cherry	-	Whole	Many
Somei Yoshino	(<i>P. yedonensis</i>)	Whole	Many
Wild Cherry	(<i>P. donarium</i>)	Whole	Many
Korean Cherry	(<i>P. japonica</i>)	Whole	Many
Japanese Raspberry	(<i>Rubus incises/R. microphyllus</i>)	Whole	Many
Threeleaf blackberry	(<i>Rubus triphyllus</i>)	Whole	Many
Strawberry	Fukuba	Whole	Many
Grapes	Black Hamburg	Whole	Many
Grapes	Gros Coleman	Whole	Many
Grapes	Golden Queen	Whole	Many
Grapes	Herbert	Whole	Few
Grapes	Foster's Seedling	Whole	Few
Grapes	Muscat of Alexandria	Whole	Many
Grapes	Muscat Hamburg	Whole	Many
Silver Berries	(<i>Elaeagnus multiflora</i>)	Whole	Few

	Cultivar	Condition of Fruit	<i>D. suzukii</i> Emergence
Mulberries	(<i>Morus alba</i>)	Whole	Few
Apples	-	Damaged	Few
Peaches	-	Dropped, Damaged	Many
Plums	Terada	Whole	Few
Persimmons	-	Ripen, Split	Few
Apricots	-	Dropped	Few

Table 2 Investigation on Fruit Collected in the Field (1934, 1935), Kanzawa, 1939.(major hosts in bold)

In California, Oregon and Washington (USA) average yield reductions attributed to *D. suzukii* range from 40% for blueberries, 50% for blackberries and raspberries and 33% for cherries. As it is directly linked to fruit infestation, it can be assumed that this directly relates to an equivalent concentration on the fruits. These figures depend on locations too. There is no specific information on infestation percentage in fruits.

It should be noted that cherry fruits in the northern states of North America are routinely checked for infection with *Rhagoletis* spp. before export (so for these fruits the likelihood of infestation is lower).

2.05 - Consider the volume of movement along the pathway (for periods when the pest is likely to be associated with it): how likely is it that this volume will support entry?

unlikely

Level of uncertainty: low

Volumes of imports into EU countries of fruits of host plants from countries where the pest occurs have been retrieved from EUROSTAT for the years 2007 to 2009 (volume in 100 kg).

Compared to the total volumes of imports of fruits, these imports usually represent less than 10% of the imports in the same category for all fruits. It ranges from 13 to 16% for *Vaccinium*. The volumes are consequently considered as minor with low uncertainty.

Table 3 Volumes of import for major fruits for the years 2007 to 2009 (volume in 100 kg source EUROSTAT).

PRODUCT	Origin	2007	2008	2009
Fresh cherries	Canada	13864	8311	12170
	China (people's republic of)	0	0	288
	India	0	0	2
	Japan	0	0	0
	Republic of south Korea	0	0	0
	Myanmar (Burma)	0	0	0
	United States	54250	41972	37683
	Total infested countries	68114	50283	50143
	Total imports (all origins)	601898	332922	438410
Fresh cherries	Percentage of total imports	11	15	11
Fresh strawberries	Canada	0	0	0

PRODUCT	Origin	2007	2008	2009
	China (people's republic of)	0	4	0
	India	0	6	0
	Japan	0	0	0
	Republic of south Korea	0	0	0
	Myanmar (Burma)	0	0	0
	United States	46475	37225	22034
	Total infested countries	46475	37235	22034
	Total imports (all origins)	404522	432940	430434
Fresh strawberries	Percentage of total imports	11	9	5
Other berries	Canada	0	0	0
	China (people's republic of)	107	248	255
	India	0	0	1
	Japan	0	0	0
	Republic of south Korea	0	0	0
	Myanmar (Burma)	0	0	0
	United States	11959	6677	5535
	Total infested countries	12066	6925	5791
	Total imports (all origins)	149162	114976	115023
	Percentage of total imports	8	6	5
Fresh vaccinium	Canada	3216	9182	5535
	China (people's republic of)	64	493	1068
	India	0	0	0
	Japan	0	0	0
	Republic of south Korea	0	0	0
	Myanmar (Burma)	0	0	0
	United States	17200	12599	12543
	Total infested countries	20480	22274	19146
	Total imports (all origins)	127625	138674	142456
Fresh vaccinium	Percentage of total imports	16	16	13

PRODUCT	Origin	2007	2008	2009
Fresh peaches	Canada	0	0	0
	China (people's republic of)	980	0	50
	India	0	0	0
	Japan	0	0	0
	Republic of south Korea	0	0	0
	Myanmar (Burma)	0	0	0
	United States	20982	17247	2311
	Total infested countries	21962	17247	2361
	Total imports (all origins)	416789	425390	358977
Fresh peaches	Percentage of total imports	5	4	1

2.06 - Consider the frequency of movement along the pathway (for periods when the pest is likely to be associated with it): how likely is it that this frequency will support entry?

moderately likely

Level of uncertainty: medium

Imports of the different fruits from infested countries occur mainly during summer months apart for *Vaccinium* which has a much wider period of import.

According to the rating guidance proposed by MacLeod & Baker (2003) Import can be considered as occasional to often depending on the fruits (up to 4 months of the year corresponds to occasionally, up to 8 months of the year corresponds to often)

Table 4 Repartition of the imports of fruits across the year 2009

Partner	period	Cherries	Strawberries	Raspberries..	Vaccinium
Canada	Jan. 2009	0	0	0	0
	Feb. 2009	0	0	0	0
	Mar. 2009	0	0	0	17
	Apr. 2009	0	0	0	29
	May. 2009	0	0	0	0
	Jun. 2009	0	0	0	170
	Jul. 2009	1210	0	0	668
	Aug. 2009	9990	0	0	0
	Sep. 2009	624	0	0	24
	Oct. 2009	0	0	0	2665
	Nov. 2009	346	0	0	1962
	Dec. 2009	0	0	0	0
China	Jan. 2009	0	0	0	250

Partner	period	Cherries	Strawberries	Raspberries..	Vaccinium
	Feb. 2009	0	0	0	500
	Mar. 2009	0	0	0	250
	Apr. 2009	0	0	0	0
	May. 2009	0	0	202	24
	Jun. 2009	0	0	53	44
	Jul. 2009	0	0	0	0
	Aug. 2009	188	0	0	0
	Sep. 2009	0	0	0	0
	Oct. 2009	0	0	0	0
	Nov. 2009	0	0	0	0
	Dec. 2009	100	0	0	0
United states	Jan. 2009	0	0	337	158
	Feb. 2009	0	108	451	0
	Mar. 2009	0	15	115	314
	Apr. 2009	5	75	68	1216
	May. 2009	2175	843	350	29
	Jun. 2009	2061	7233	384	714
	Jul. 2009	11134	3614	392	1045
	Aug. 2009	19608	3746	647	0
	Sep. 2009	2661	2789	763	451
	Oct. 2009	39	1812	1005	2387
	Nov. 2009	0	1691	745	5411
	Dec. 2009	0	108	278	818

2.07 - How likely is the pest to survive during transport or storage?

very likely

Level of uncertainty: low

Kanzawa (1939) reports experiments made regarding the sensitivity of eggs and larval stages to periods of temperature above and below freezing (0°C). At constant temperature of up to 1.66 °C for 96 hours or more cooling resulted in total mortality of spotted wing drosophila eggs and larvae. Bolda (blog article dated 2010-03-23) states that for success it is important that temperature remains constant for periods longer than 96 hours.

Precise temperature conditions for the transport of fruits are not known but it is very likely that the fruits concerned will be transported by air freight. 1.66°C is low and guaranteeing such constant temperature is likely to be a challenge given the loading and unloading procedures. In addition transport time is likely to be much less than 96 hours.

2.08 - How likely is the pest to multiply/increase in prevalence during transport or storage?

very unlikely

Level of uncertainty: low

Larvae and pupae are likely to be present in the fruit but if an adult emerges it will not be very active.

Kanzawa (1939) states adults remain motionless at 5°C and begin to crawl at 10°C which is likely to be above the transport temperature. So it is very unlikely that the pest will multiply during transport.

2.09 - Under current inspection procedures how likely is the pest to enter the PRA area undetected?

very likely

Level of uncertainty: low

Early infestations are difficult to detect nevertheless it also depends on the hosts. On cherries or Vaccinium infested fruits show small scars and indented soft spots on the fruit surface left by the females ovipositor (“stinger”) (Dreves *et al.* 2009). On other fruits (*Rubus* spp, *Fragaria*, *Prunus*) infestation is more difficult to detect due to the uneven or hairy surface. Eggs and respiratory tubes will be difficult to see.

2.10 - How likely is the pest to be able to transfer from the pathway to a suitable host or habitat ?

moderately likely

Level of uncertainty: medium

For the transfer to occur a sequence of events is necessary.

Several scenarios could happen (from the most likely to the less likely to aid transfer):

- Adults may escape from storage places and houses
- Fruits may be sold at the road in front of a fruit orchard (this is at least reported for cherries in the Netherlands, Potting pers. comm. 2011) . In the beginning of the season (when cherries are still not ripe) cherries from Southern Europe are sold at these stalls. For an emerging *D. suzukii* it would be easy to find a suitable oviposition site in the neighbouring orchard.
- Infested fruits are discarded to a compost pile and some adults may escape (compost piles are believed to be suitable as hibernation sites)
- Infested fruits are thrown away; garbage is not collected regularly and the pest may escape.
- Infested fruits are thrown away in a bin in a country with regular garbage collection and garbage is incinerated.

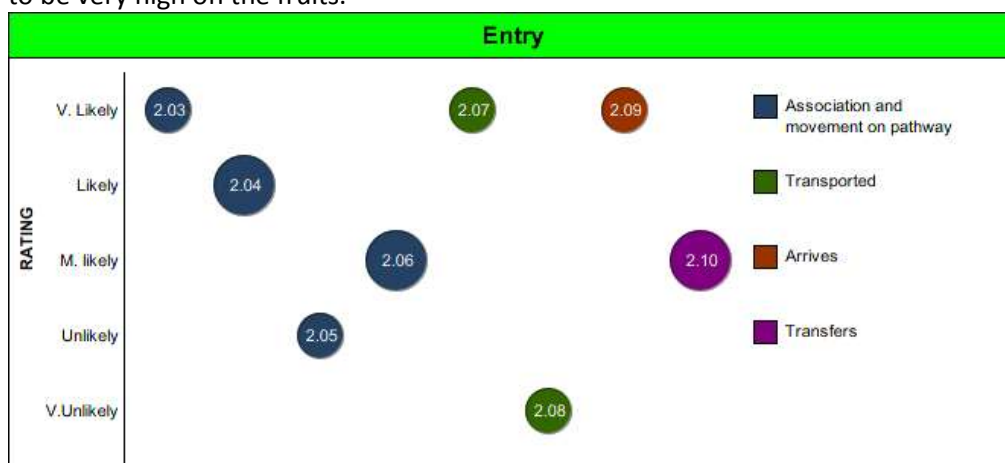
There is a high probability that the pest will escape and fly outdoors and it will be easy for the pest to find a suitable host as host plants are very common plants in backyard gardens. There is no information available as to whether pheromones are involved in the process of finding a mate.

2.11 - The probability of entry for the pathway should be described

likely

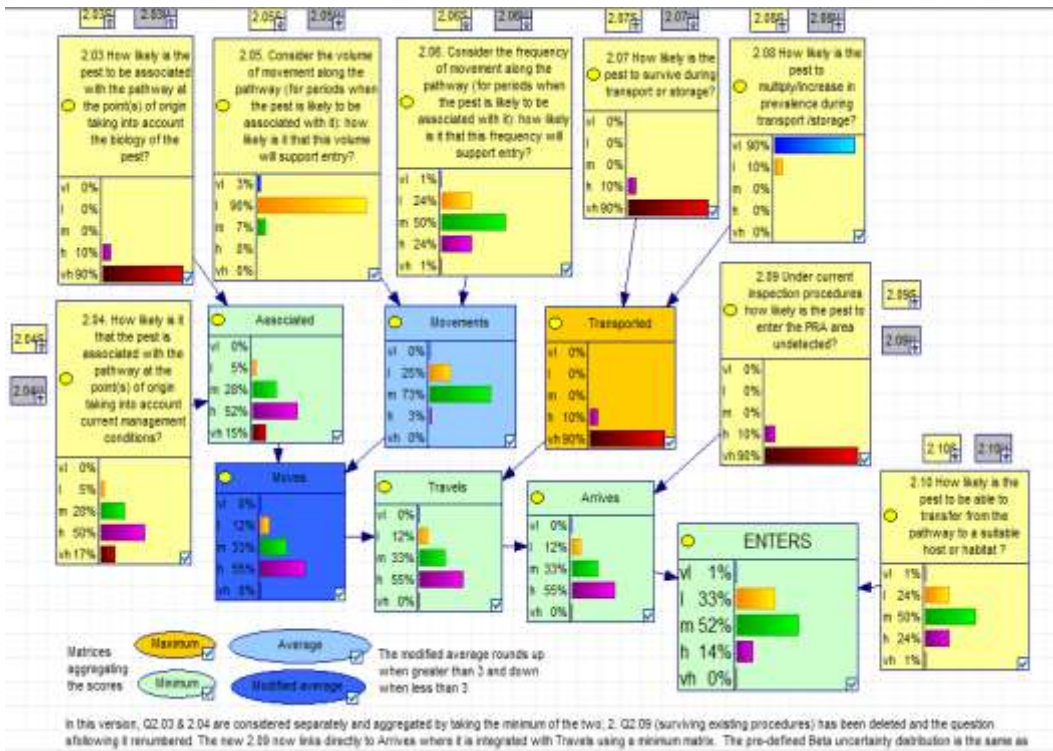
Level of uncertainty: low

The EWG considered that the risk of entry was likely with a low uncertainty for the main host fruits. The fact that the pest has established in Italy and France and was also introduced in the US and Canada was considered as a strong indication that the pest can enter easily. Volumes of imports are not large but the concentration of the pest is likely to be very high on the fruits.



Genie result

The genie programme has a slightly different result. Expert opinion towards likely risk of entry is linked to the fact that the pest has been recently introduced in different countries.



Pathway 2: Fruits of minor host plants

2.03 - How likely is the pest to be associated with the pathway at the point(s) of origin taking into account the biology of the pest?

moderately likely

Level of uncertainty: low

Based on the information available for hosts considered as less attractive, association of the pest with the fruits is moderately likely (the fly will mainly be attracted to these fruits if other fruits are not available). The pest lays eggs in maturing fruits, larvae and pupae develop in the fruits (Kansawa 1939)

2.04 - How likely is the pest to be associated with the pathway at the point(s) of origin taking into account current management conditions?

moderately likely

Level of uncertainty: medium

There is little information for other fruits. Regarding grapes and some other fruits, Kanzawa (1939) gives the following information :

Table 5 Extract Investigation on Fruit Collected in the Field (1934, 1935), Kanzawa, 1939.

	Cultivar	Condition of Fruit	<i>D. suzukii</i> Emergence
Grapes	Black Hamburg*	Whole	Many
Grapes	Gros Coleman *	Whole	Many
Grapes	Golden Queen *	Whole	Many
Grapes	Herbert	Whole	Few
Grapes	Foster"s Seedling	Whole	Few
Grapes	Muscat of Alexandria*	Whole	Many
Grapes	Muscat Hamburg*	Whole	Many
Mulberries	(<i>Morus alba</i>)	Whole	Few
Plums	Terada	Whole	Few

*thin skin grapes.

The information published by Kanzawa in 1939 for grapes is not confirmed by current observations in California. The pest is present in cherry orchards in the vicinity of vineyards and no damage has been recorded in these vineyards so far (Hauser, pers. comm. 2010).

2.05 - Consider the volume of movement along the pathway (for periods when the pest is likely to be associated with it): how likely is it that this volume will support entry?

moderately likely

Level of uncertainty: low

Volumes of imports into EU countries of fruits of host plants from countries where the pest occurs have been retrieved from EUROSTAT for the years 2007 to 2009 (volume in 100 kg)

Compared to the total volumes of imports of fruits these imports usually represent less than 10% of the imports in the same category for all fruits.

The volumes can be considered as minor with low uncertainty.

Table 6 Volumes of imports (in 100 kg) into EU countries of fruits of minor host plants from countries where the pest occurs (source EUROSTAT)

Fresh grapes	Canada	0	153	0
	China (people's republic of)	1195	737	0
	India	279464	407098	362017
	Japan	0	0	2
	Republic of south Korea	0	8	0
	Myanmar (Burma)	0	0	0
	United States	96713	103972	103830
	Total infested countries	377372	511968	465849
	Total imports	6194043	6543002	6136393
Fresh grapes	Percentage of total imports	6	8	8
Fresh plums	Canada	0	0	0
	China (people's republic of)	1	1	1
	India	0	0	0
	Japan	0	0	0
	Republic of south Korea	0	0	0
	Myanmar (Burma)	0	0	0
	United States	4348	1249	1403
	Total infested countries	4349	1250	1404
	Total imports (all origins)	875512	895765	825457
Fresh plums	Percentage of total imports	0,5	0,1	0,2

2.06 - Consider the frequency of movement along the pathway (for periods when the pest is likely to be associated with it): how likely is it that this frequency will support entry?

likely

Level of uncertainty: low

Repartition of imports of the different fruits for the different infested countries is mainly spread during summer months.

According to the rating guidance proposed by MacLeod & Baker (2003) frequency of importation can be considered as often.

Table 7 Repartition of the imports of fruits across the year 2009

Partner	period	Grapes	Plums
India	Jan. 2009	0	0
	Feb. 2009	1249	0
	Mar. 2009	42677	0
	Apr. 2009	202994	0

Partner	period	Grapes	Plums
	May. 2009	114052	0
	Jun. 2009	675	0
	Jul. 2009	120	0
	Aug. 2009	0	0
	Sep. 2009	0	0
	Oct. 2009	0	0
	Nov. 2009	250	0
	Dec. 2009	0	0
United states	Jan. 2009	0	0
	Feb. 2009	0	0
	Mar. 2009	0	0
	Apr. 2009	9	0
	May. 2009	0	421
	Jun. 2009	792	827
	Jul. 2009	4732	0
	Aug. 2009	8550	0
	Sep. 2009	10357	13
	Oct. 2009	24692	142
	Nov. 2009	38894	0
	Dec. 2009	15804	0

2.07 - How likely is the pest to survive during transport or storage?

likely

Level of uncertainty: low

(same text as previous pathway)

Kanzawa (1939) reports experiments made regarding the sensitivity of eggs and larval stages to periods of temperature above and below freezing (0°C). At constant temperature of up to 1.66 °C for 96 hour or more cooling resulted in total mortality of spotted wing drosophila eggs and larvae. Bolda (blog article dated 2010-03-23) states that for success it is important that temperature remains constant for periods longer than 96 hours.

Precise temperature conditions for the transport of fruits are not known but it is very likely that the fruits concerned will be transported by air freight. 1.66°C is low and guaranteeing such constant temperature is likely to be a challenge given the loading and uploading procedures.

2.08 - How likely is the pest to multiply/increase in prevalence during transport or storage?

very unlikely

Level of uncertainty: low

(same text as previous pathway)

Larvae and pupae are likely to be present in the fruit but if an adult emerges it will not be very active.

Kanzawa (1939) states adults remain motionless at 5°C and begin to crawl at 10°C which is likely to be above the transport temperature. So it is very unlikely that the pest will multiply during transport. In addition transport time is likely to be much less than 96 hours.

2.09 - Under current inspection procedures how likely is the pest to enter the PRA area undetected?

very likely
Level of uncertainty: low

Level of uncertainty: low

Early infestation are difficult to detect nevertheless it also depends on the hosts. On fruits such as *Prunus* infestation is more difficult to detect due to the hairy surface. Eggs and respiratory tubes will be difficult to see.

2.10 - How likely is the pest to be able to transfer from the pathway to a suitable host or habitat ?

moderately likely
Level of uncertainty: medium

(same text as previous pathway)

For the transfer to occur a sequence of event should occur.

Several scenarios could happen (from the most likely to the less likely to aid transfer):

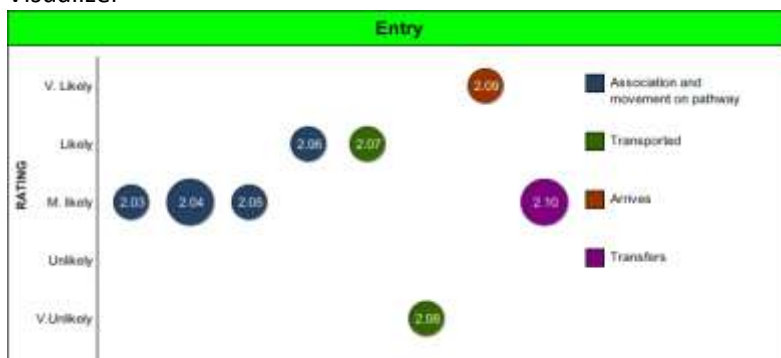
- Adults may escape from storage places and houses
- Fruits may be sold at the road in front of a fruit orchard (this is at least reported for cherries in the Netherlands, Potting pers. comm. 2011) . In the beginning of the season (when cherries are still not ripe) cherries from Southern Europe are sold at these stalls. For an emerging *D. suzukii* it would be easy to find a suitable oviposition site in the neighbouring orchard.
- Infested fruits are discarded to a compost pile and some adults may escape (compost piles are believed to be suitable as hibernation sites)
- Infested fruits are thrown away; garbage is not collected regularly and the pest may escape.
- Infested fruits are thrown away in a bin in a country with regular garbage collection and garbage is incinerated.

There is a high probability that the pest will escape and fly outdoors and it will be easy for the pest to find a suitable host as host plant are very common plants in backyard gardens. There is no information available as to whether pheromones are involved in the process of finding a mate.

2.11 - The probability of entry for the pathway should be described

moderately likely
Level of uncertainty: medium

Visualizer

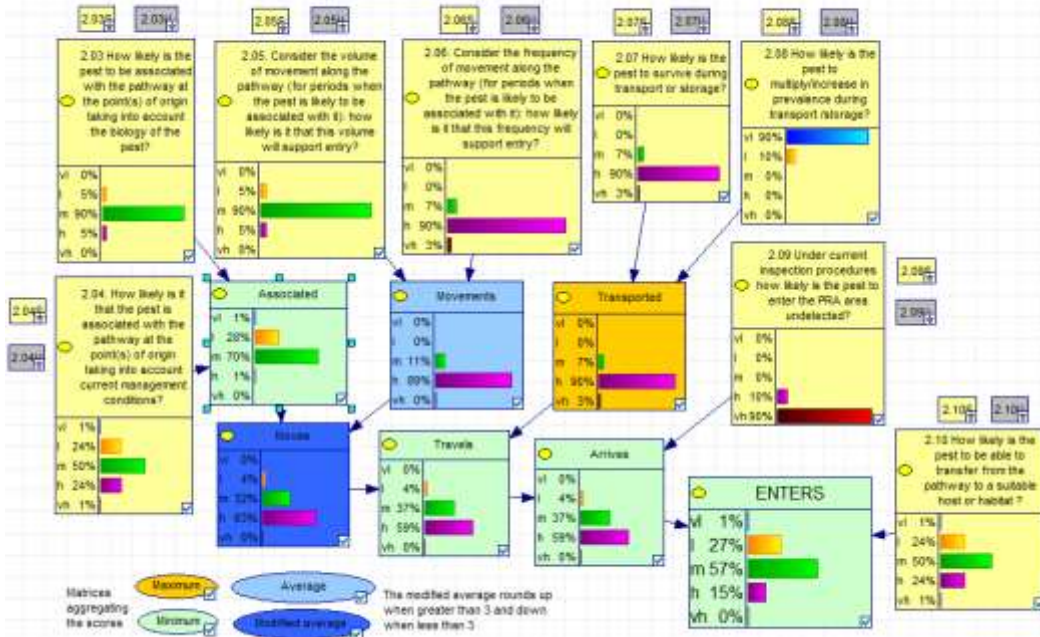


Genie

Same conclusion than assessors

Draft modified matrix model structure for Entry - Pratique6 (11/04/11)

1. Choose an uncertainty distribution-----> Uncertainty distribution 2. Choose Scores S and Uncertainties U (right-click S or U and set decision)



2.13b - Describe the overall probability of entry taking into account the risk presented by different pathways and estimate the overall likelihood of entry into the PRA area for this pest (comment on the key issues that lead to this conclusion).

likely
Level of uncertainty: medium

The overall probability of entry is moderately likely with a medium uncertainty as a lean result of the two pathways

Stage 2: Pest Risk Assessment Section B: Probability of establishment

Host plants and suitable habitats

3.00.01A - Is the factor likely to have an influence on the limits to the area of potential establishment ?

yes

3.00.01B - Is the factor likely to have an influence on the suitability of the area of potential establishment ?

yes

Alternate hosts and other essential species

3.00.02A - Is the factor likely to have an influence on the limits to the area of potential establishment ?

no

3.00.02B - Is the factor likely to have an influence on the suitability of the area of potential establishment ?

no

3.00.02C - Justifications for No answers

D. suzukii has no alternate hosts or other essential species.

Climatic suitability

3.00.03A - Is the factor likely to have an influence on the limits to the area of potential establishment ?

yes

3.00.03B - Is the factor likely to have an influence on the suitability of the area of potential establishment ?

yes

Other abiotic factors

3.00.04A - Is the factor likely to have an influence on the limits to the area of potential establishment ?

no

3.00.04B - Is the factor likely to have an influence on the suitability of the area of potential establishment ?

no

3.00.04C - Justifications for No answers

No other abiotic factors are important in determining the establishment potential of *D. suzukii*

Competition and natural enemies

3.00.05A - Is the factor likely to have an influence on the limits to the area of potential establishment ?

no

3.00.05B - Is the factor likely to have an influence on the suitability of the area of potential establishment ?

no

3.00.05C - Justifications for No answers

Competition and natural enemies are not likely to influence the limits to the area of potential establishment. There are also little data available that could help to determine whether natural enemies will have an influence on the suitability of establishment but the effect is likely to be very low. The outbreaks in Europe have shown that the presence of potential natural enemies was not sufficient to prevent establishment. However, Grassi (personal communication) in 2009 reared one unidentified pupal parasitoid from *D. suzukii* on raspberries in Trentino, Italy. The situation might be different in other parts of the PRA area, e.g. there could be competition with *Rhagoletis* on cherry. There are no data on biological control but it is mentioned in the Japanese literature that larvae of *D. suzukii* were naturally parasitized by a species belonging to the genus *Phaenopria* (Hymenoptera: Diapriidae) (EPPO 2010), *Ganaspis xanthopoda* (Hymenoptera: Cynipidae), *Asobara japonica* and *Asobara tabida* (Hymenoptera: Braconidae) (Mitsui et al, 2007; Mitsui & Kimura, 2010). The *Ganaspis* species reared from *D. suzukii* is genetically different but morphologically similar to *G. xanthopoda* (Kimura pers. comm.) *Ganaspis* species and *Asobara tabida* are widespread in Europe; *G. xanthopoda* is a "tramp" species with a wide distribution (Melk & Govind, 1999). Pupal parasitism was not recorded. The overall parasitisation rate, predominantly from urban and wild sites using banana baits, was low (4.2% Mitsui et al., 2007) but this does not include the added effect of pupal parasitoids. Parasitoid rates in natural *Drosophila* populations are highly variable, e.g. 12% in a Dutch woodland to 39-85% in Tunisia (Janssen et al. 1988).

There may be potential for biocontrol in fruit crops such as blueberries with generalist rove beetles such as *Atheta*

coriaria. However, there is as yet, little information available (pers comm. Tracy Hueppelsheuser, 2010). For competition there is no information in the literature. To date there is no evidence of competition in North America where other fruit flies are present. Despite the potential for competition and parasitism, the EWG considered the uncertainty to be low.

The managed environment

[3.00.06A - Is the factor likely to have an influence on the limits to the area of potential establishment ?](#)

no

[3.00.06B - Is the factor likely to have an influence on the suitability of the area of potential establishment ?](#)

yes

[3.00.06C - Justifications for No answers](#)

The managed environment is not likely to influence the limits to the area of potential establishment.

Protected Cultivation

[3.00.07A - Is the factor likely to have an influence on the limits to the area of potential establishment ?](#)

no

[3.00.07B - Is the factor likely to have an influence on the suitability of the area of potential establishment ?](#)

yes

[3.00.07C - Justifications for No answers](#)

D. suzukii has not been recorded in protected cultivation. Some of its hosts, e.g. strawberries, are widely grown under protected cultivation in Europe but, even if *D. suzukii* was to attack such protected crops, these are all situated in areas where the species is likely to survive on wild *Rubus* species and any other berry crops in the vicinity. Therefore, protected cultivation is not likely to change the limits to the area suitable for establishment.

Host plants and suitable habitats

[3.01 - Identify and describe the area where the host plants or suitable habitats are present in the PRA area outside protected cultivation.](#)

Potential hosts are present throughout the region except in extremely cold areas at high altitudes and latitudes and in the arid regions of Asia.

Climatic suitability

[3.03 - Does all the area identified as being suitable for establishment in previous question\(s\) have a suitable climate for establishment?](#)

No (Based on the area assessed as being suitable for establishment in previous questions, identify and describe the area where the climate is similar to that in the pest's current area of distribution. Describe how this affects the area identified where hosts, suitable habitats and other essential species are present.)

Visual examination of the Köppen-Geiger climate zones, hardiness zones and degree day maps shows that the climate in its current area of distribution is largely similar to that in the PRA area where hosts are present. Only northern areas of Europe and Russia where hosts are present are unsuitable. In many areas, there are sufficient accumulated degree days for numerous generations to be completed in the summer. Although 250 degree days is required for development from egg to adult, a simple division of the annual degree days to obtain a map of the number of generations possible in an area was not considered very appropriate because (a) an additional period is usually required by insects before adults are ready to oviposit, (b) considerable individual variation can be expected with overlapping generations occurring and (c) the grid cells summarise and interpolate climate measured at weather stations and many locations within each grid cell will have different temperature accumulations. Although the higher the degree day accumulation above 10°C, the greater the number of generations expected, the species cannot tolerate high temperatures if humidities are low and, in the southern Mediterranean areas, the species may survive only in irrigated crops. Information from Trentino-Alto Adige region suggests that the species can be abundant even in areas where the degree day accumulations indicate that only one or two generations per year can

be completed.

The pest overwinters as adult consequently cold winters are not favourable for its survival however, Kimura (pers. comm.) considers that in Hokkaido, severe winter causes high mortality but population survives in habitats associated with human habitation and is increased by entry with fruit imports from elsewhere in Japan.

See Appendix 3 for a detailed analysis and maps.

3.08 - By combining the cumulative responses to previous questions with the response to question 3.07, identify the part of the PRA area where the presence of host plants or suitable habitats and other factors favour the establishment of the pest.

Hosts are very widespread in the EPPO region except for the extreme north and the **arid areas of Asia and in most of these areas, the climate is suitable for establishment. Apart** from climate, no other biotic or abiotic factor limits distribution. Currently, *D. suzukii* is found in areas with the extremely cold temperatures of -35°C that occur in hardiness zone 4, however, based on Kimura (pers. comm.), in these areas, survival may depend on the availability of suitable over-wintering habitats associated with human habitation. *D. suzukii* is also currently limited to areas where the annual degree day accumulation above a base temperature of 10°C does not exceed 500 (fig. 11 in Annex 1) although one generation is still likely to occur in areas where the annual degree day accumulation above a base temperature of 10°C exceeds 250 (Fig.13 in Annex 1). The extent to which Fig. 11 or Fig. 13 is more representative of the area suitable for establishment is difficult to determine without more information on the northern limits to its distribution in mainland Asia. For the same reasons, neither CLIMEX nor Maxent provide additional insights into the potential northern limit to the distribution in Europe and Asia. However, the information from Hokkaido (Kimura, pers. comm.) suggests that this northern limit will be closely related to human habitation and the overwintering habitats it provides.

Host plants and suitable habitats

3.09 - How likely is the distribution of hosts or suitable habitats in the area of potential establishment to favour establishment?

very likely
Level of uncertainty: low

Cultivated and wild hosts of *D. suzukii* are very widespread and common throughout the area suitable for establishment

Production figures for Europe, North Africa, West Asia (Source FAO Stat accessed 2010/07/02 detailed table are presented in Appendix 2)

Table 8 Preferred host crops

Fruit	Surface ha 2007	Surface ha 2008
Cherries	265756	280447
Strawberries	207760	195010
Raspberries	92784	82167
Blueberries	17365	17504
Current	139890	115548
Other berries	38632	38964
Apricot	282160	271968
Peaches and nectarines	412533	468637
Total (hosts)	1455880	1470245

Total all fruits (including non-hosts)	12871995	12790219
--	----------	----------

This represents approximately 12% of the total area of fruit production.

Potential hosts are present all over the region (see detailed tables in Appendix 2 below showing surfaces harvested in 2008 for different major host crops).

Table 9 Other host crops

Fruit	Surface ha 2007	Surface ha 2008
Grapes	4996765	5040451
Total "hosts + Grapes	6453645	6510696
all fruits	12871995	12790219

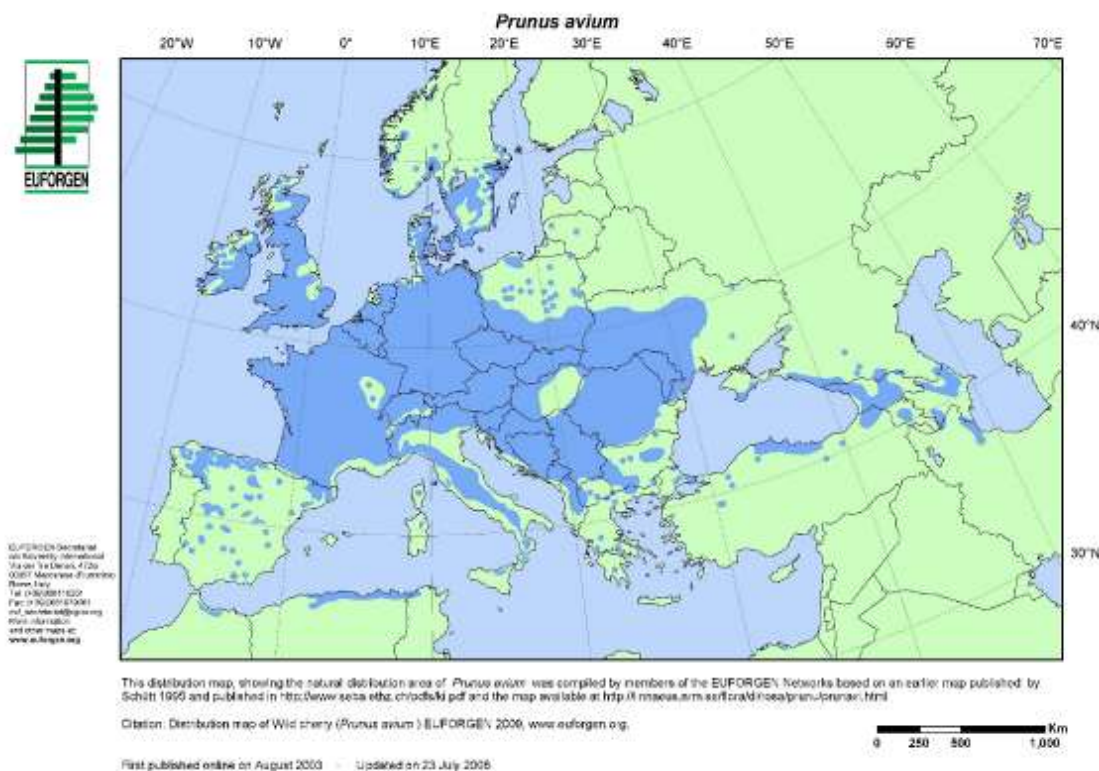
With vineyards this represents 50% of the total of fruit production.

Ornamental species

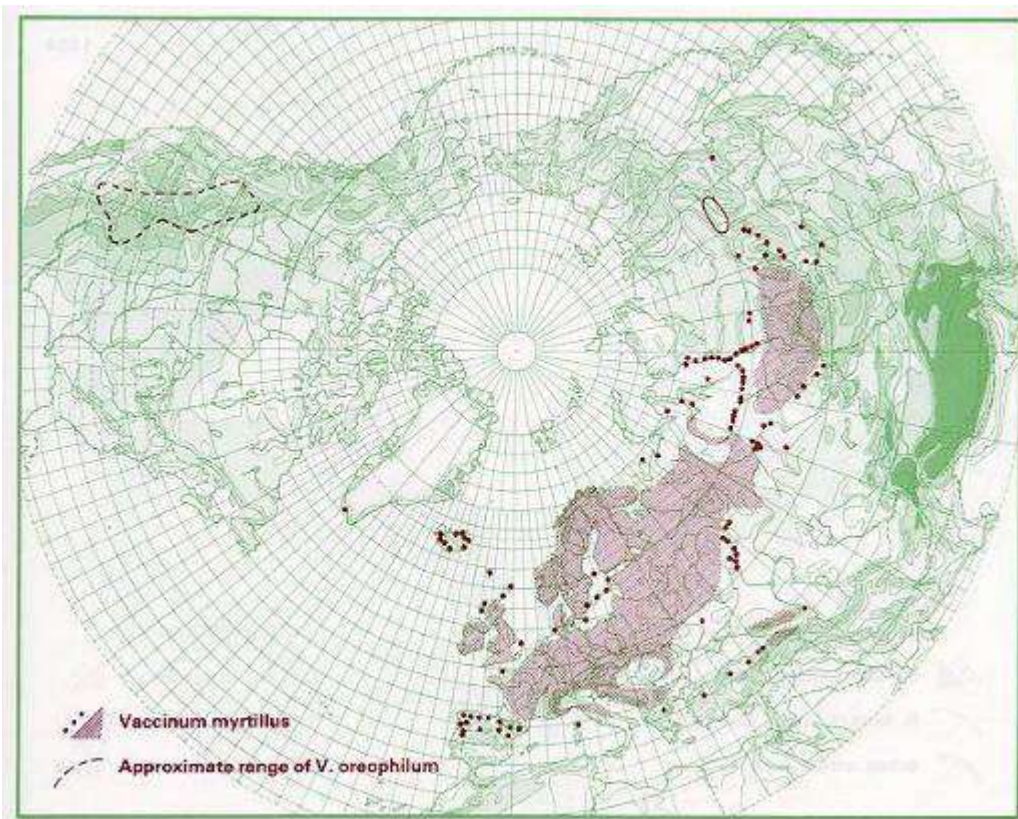
Prunus are widely grown and used for ornamental purposes in the PRA area (Cullen, 1995).

Wild species

Wild species of host plants are widely distributed in the wild in the PRA area e.g. *Prunus avium* (EUFORGEN, 2009)



Distribution map for *Vaccinium myrtillus*



Source: <http://linnaeus.nrm.se/flora/di/erica/vacci/vaccmyrv.jpg>

Climatic suitability

3.11 - Based on the area of potential establishment already identified, how similar are the climatic conditions that would affect pest establishment to those in the current area of distribution? (please note that a Risk Mapping decision support scheme is in preparation)

largely similar

Level of uncertainty: low

Visual examination of the Köppen-Geiger climate zones, hardiness zones and degree day maps shows that the climate in its current area of distribution is largely similar to that in the PRA area where hosts are present. Only northern areas of Europe and Russia where hosts are present are unsuitable. In many areas, there are sufficient accumulated degree days for numerous generations to be completed in the summer. Although 250 degree days is required for development from egg to adult, a simple division of the annual degree days to obtain a map of the number of generations possible in an area was not considered very appropriate because (a) an additional period is usually required by insects before adults are ready to oviposit, (b) considerable individual variation can be expected with overlapping generations occurring and (c) the grid cells summarise and interpolate climate measured at weather stations and many locations within each grid cell will have different temperature accumulations. Although the higher the degree day accumulation above 10°C, the greater the number of generations expected, the species cannot tolerate high temperatures if humidities are low and, in the southern Mediterranean areas, the species may survive only in irrigated crops. Information from Trentino-Alto Adige region suggests that the species can be abundant even in areas where the degree day accumulations indicate that only one or two generations per year can be completed.

The pest overwinters as adult consequently cold winters are not favourable for its survival however, Kimura (pers. comm.) considers that in Hokkaido, severe winter causes high mortality but population survives in habitats associated with human habitation and is increased by entry with fruit imports from elsewhere in Japan.

See Appendix 3 for a detailed analysis and maps.

The managed environment

3.14 - How favourable for establishment is the managed environment in the area of potential establishment?

very highly favourable

Level of uncertainty: medium

Susceptible crops are grown in monoculture. The high density of planting in orchards and fruit fields (e.g. strawberries) favour the establishment of the pest. Host plants can also be found in the wild or in amenity areas in the vicinity of orchards and can therefore act as reservoir of the pest, even if management measures are applied in cultivated orchards .

Little information was available to the EWG on the management of the crop by producers i.e. whether they can favour or not establishment. It is known that with regard to soft fruit crops, cultural practices such as covering are used to prolong the cropping season (e.g. in Tayside, Scotland), thereby potentially increasing host availability to *D. suzukii*. However, the EWG had no specific information or evidence to suggest that such practices had influenced *D. suzukii* populations. Conversely, for *D. suzukii* management, there may be scope to use either late or early fruiting varieties or exploit growing area altitude, once more is known about specific outbreaks in a particular location.

Answers gathered with the guidance (arguments have been used to produce the supporting information presented above):

The time of the year that the relevant crop is grown and its phenology are congruent with the life cycle of the pest

The relevant crop is grown under protected conditions

The crop are cultivated in monoculture (or the hosts are perennial plants)

Soil preparation has no influence on the establishment of the pest

The method or type of planting has a positive influence on the establishment of the pest

Other practice(s) has (have) no influence on the establishment

Other hosts that are required or favour establishment are present

The time or method of harvest has a positive influence on the establishment of the pest

Not relevant

artificial fire regimes have no influence establishment of the pest

construction activities and management road sides have no influence on pest establishment

The pest is not a pest plant or management of water courses has no influence the establishment of the pest plant

3.15 - How likely is the pest to establish despite existing pest management practice?

very likely

Level of uncertainty: low

Pest establishment did occur in Italy and France despite of current pest management practices.

Organic orchards, private gardens and amenity areas are more favourable to establishment due to reduced plant protection product use.

In many orchards and soft fruit crops few insecticides are used particularly before harvest. Most of the listed insecticides in fruit production are not effective against *D. suzukii* or cannot be used at the most efficacious moment due to the regulated pre-harvest interval. *D. suzukii* oviposits on ripe fruits in the later stages of development, just before harvest which therefore hampers the control the pest with insecticides.

Specific information was gathered from France (Alpes Maritimes) on the pest management practices in strawberry production (Risso, pers comm. to Reynaud, 2010). Most strawberry production in this area is under integrated pest management. In integrated pest management production few plant protection products are used. In conventional strawberry production growers only apply plant protection products when they detect the pest and not as a preventive pest management programme. Insecticide treatments in strawberry are mainly targeting thrips infestations. Spinosyn (spinosad) was used against thrips in 2010 with a temporary authorization (this plant protection product is about to be authorized. Spinosad has showed some efficacy under trial conditions in North America.

Protected Cultivation

3.16 - Is the pest likely to establish in protected cultivation in the PRA area?

No

Level of uncertainty: low

D. suzukii has never been recorded on fully protected crops, i.e. glasshouse situations. However, the opportunity for the infestation of greenhouses (e.g. tomatoes, protected berries) exists. Raspberries are produced under tunnels in many locations, however, these are open tunnel situations. In California infestations has been seen under these situations.

3.17 - How likely are the reproductive strategy of the pest and the duration of its life cycle to aid establishment?

very likely

Level of uncertainty: low

This species is a typical r-strategist with high fluctuations in abundance in unstable or unpredictable environments. Under these conditions, r-selection predominates as the ability to reproduce quickly is crucial. Under good climatic and resource conditions, SWD has a high reproduction rate up to 15 generations (Kanzawa 1935). A small number of adults should be sufficient to build up a large population over the growing season. The distribution in USA and Canada underline this potential.

The adult appears to be able to survive long periods under cold conditions and with limited resources.

The rapid life cycle in summer temperatures; potential for many adults to emerge from one infested fruit (over 60); and the low relatedness of these individuals (each female lays only 2-3 eggs on a fruit) means that one fruit could carry the basis for a new population without a severe genetic bottleneck occurring (Damus 2010).

3.18 - Is the pest highly adaptable?

Yes, highly or very highly adaptable

Level of uncertainty: low

The native habitat of this fly ranges in Asia from northern China and southern Siberia to northern India, and then south-east to Hainan island in China. It is also known in Taiwan, Korea, Thailand and Burma. It has also been introduced to Hawaii, the USA (Florida, California, Oregon and Washington) and is now present in Canada (British Columbia: from Delta to Chilliwack) (Kanzawa 1939, Damus 2010).

In Europe there were introductions in Italy (South Tirol – a valley in the Alps) in 2009 and a notification of Spain (130 km from the south west of Barcelona) in 2010 (Baufeld, et al. 2010).

However, the pest is restricted by severe winter conditions (frost) and high summer temperatures (above 32 °C). (pers. comm: Smyth 2010)

3.19 - How widely has the pest established in new areas outside its original area of distribution? (specify the instances, if possible; note that if the original area is not known, answer the question only based on the countries/continents where it is known to occur)

widely

Level of uncertainty: medium

The pest was introduced to a minimum of two continents in several countries (for the USA the state records were considered as individual records).

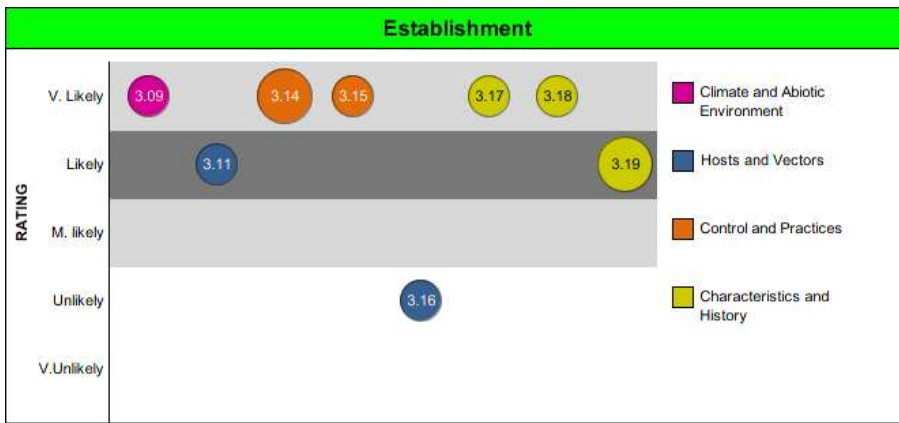
There is no information about Asia. But probably also in Japan/China depending on where the species is native.

3.20 - The overall probability of establishment should be described.

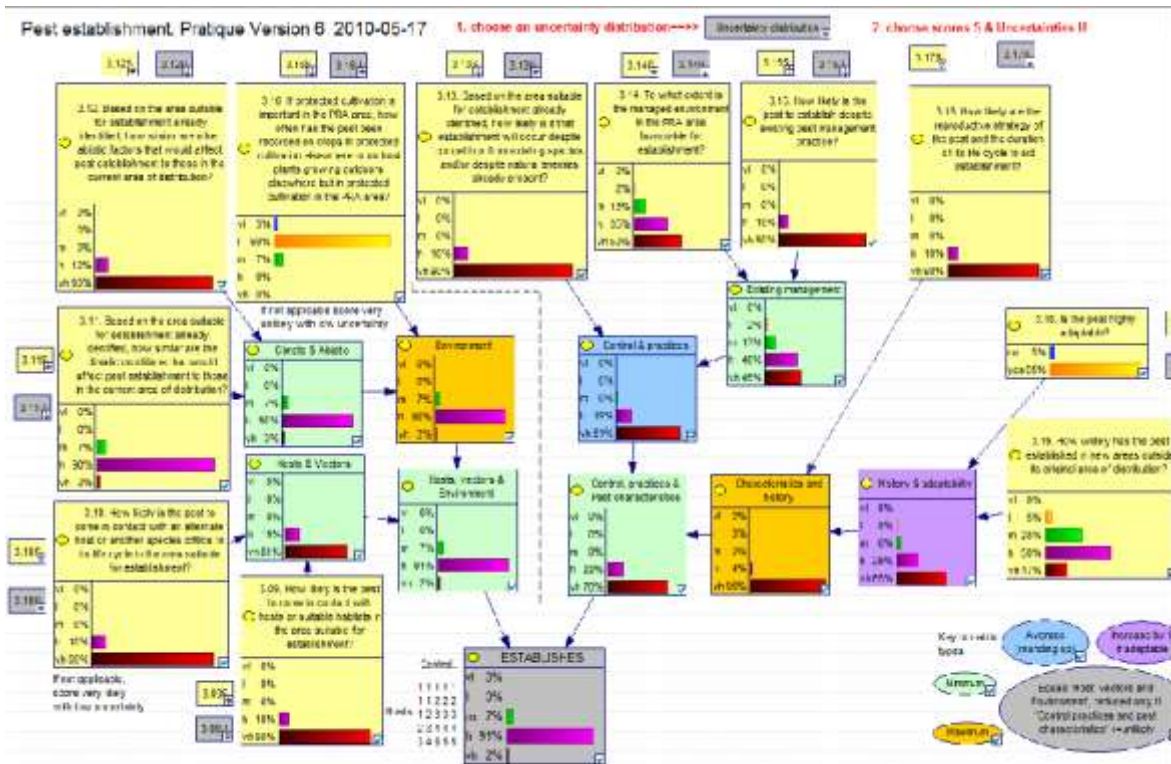
high

Level of uncertainty: low

The risk of establishment was considered to be high with a low uncertainty. This is due to the fact that host plants are widely present in the PRA area (cultivated but also backyard plants). Climatic conditions are suitable (only northern areas of Europe and Russia where hosts are present are unsuitable). The management practices can be adapted but the experience so far in the parts of the PRA area where the pest has established was that they could not prevent *D. suzukii* establishment. The EWG debated whether this should be considered very high but as the PRA area included parts where climate is not suitable (see above), the final conclusion was high.



Genie

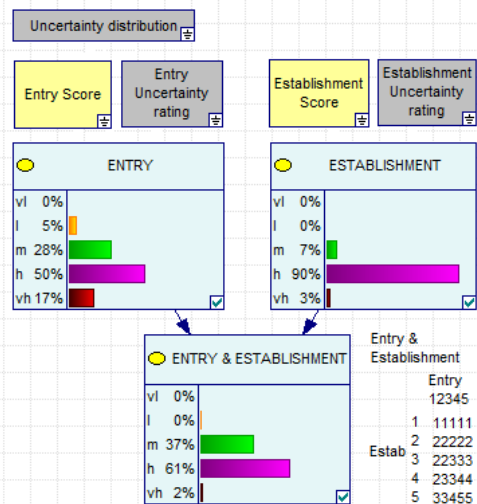


This model structure has some new elements that are released. 1. The end user question 3.17 is now associated with 3.18 using an average ratio as both refer to the characteristics of the pest. 2. In addition, 3.19 is associated with 3.12 as both refer to

Stage 2: Pest Risk Assessment Section B: Conclusion of introduction
c1 - Conclusion on the probability of introduction.

The probability of entry is moderate and of establishment high. Probability of introduction is consequently considered high.

Integrating scores for entry and establishment based on overall scores/uncertainties for each provided by the assessors



Stage 2: Pest Risk Assessment Section B: Probability of spread

4.01 - What is the most likely rate of spread by natural means (in the PRA area)?

high rate of spread

Level of uncertainty: high

The EWG considered it difficult to give a precise indication on spread capacity of *D. suzukii* and considered natural spread as moderately likely with a medium uncertainty.

There is no specific data available on the potential flight capacity of *D. suzukii*. Studies made on other species of Drosophilidae indicate a flight distance up to 45 km per generation (Johnston, 1976). In the closely related *Drosophila melanogaster*, directional flights to preferred habitats of several hundred meters have been recorded (Coyne *et al.*, 1987). During the same study, another species *D. pseudoobscura* was caught in many remote desert locations as far as 26 km from the nearest likely breeding site (Coyne *et al.*, 1987).

Migration from low to high altitude is reported (Mitsui *et al.*, 2010) but no indication of distances involved is given in the article. The fly can also be transported by wind current.

The presence of natural barriers such as arid areas, mountain ranges, climatic differentials and possible long distances between hosts may prevent long-range natural spread of *Drosophila suzukii*. Availability of host plants will facilitate spread.

4.02 - What is the most likely rate of spread by human assistance (in the PRA area)?

very high rate of spread

Level of uncertainty: low

Undetected infested fruits can travel long distance and this is considered to have been the most likely pathway of introduction into new areas (Hauser *et al.*, 2009).

4.03 - Describe the overall rate of spread

very high rate of spread

Level of uncertainty: low

Spread noted so far is a consequence of both human and natural spread. Human spread is very likely but the natural spread capacity is uncertain. The EWG decided to rate the probability of spread as 'high', though not 'very high', for that reason.

Drosophila suzukii was first reported in North America in 2008 in California and by 2009 was widespread in a range of hosts from Oregon, Washington (Hauser *et al.*, 2009) and British Columbia (BCMAL, 2009). This demonstrates the ability of *Drosophila suzukii* to spread if suitable hosts are present and climatic conditions are favourable. The pest has also spread in France (EPPO, 2010c).

4.04 - What is your best estimate of the time needed for the pest to reach its maximum extent in the PRA area?

Level of uncertainty: high

5 to 10 years

4.05 - Based on your responses to questions 4.01, 4.02, and 4.04 while taking into account any current presence of the pest, what proportion of the area of potential establishment do you expect to have been invaded by the organism after 5 years?

Level of uncertainty: high

80%

Stage 2: Pest Risk Assessment Section B: Eradication, containment of the pest and transient populations

5.01 - Based on its biological characteristics, how likely is it that the pest could survive eradication programmes in the area of potential establishment?

very likely

Level of uncertainty: low

Considering the life cycle with up to 15 generations (Kanzawa, 1935), the fast development time (8 to 14 days in optimal conditions), some 400 eggs laid per female (maximum of 992 eggs/female), duration of oviposition of 55 days (maximum of 99 days) (Kanzawa, 1939) and high insect mobility (see question 4.01), it is very unlikely that it will be possible to eradicate the pest in infested areas without natural barriers. If the infestation is detected early in a small and restricted area (like a valley) with low abundance and well implemented measures there is a chance for eradication.

5.02 - Based on its biological characteristics, how likely is it that the pest will not be contained in case of an outbreak within the PRA area ?

likely

Level of uncertainty: low

Movement of the pest with infested fruits will be difficult to control in the PRA area as early infestations are difficult to detect. Determining containment measures will be difficult given that natural spread capacity is undetermined.

5.03 - Are transient populations likely to occur in the PRA area through natural migration or entry through man's activities (including intentional release into the environment) or spread from established populations?

No

Level of uncertainty: low

Not relevant

Stage 2: Pest Risk Assessment Section B: Assessment of potential economic consequences

6.01 - How great a negative effect does the pest have on crop yield and/or quality of cultivated plants or on control costs within its current area of distribution?

massive

Level of uncertainty: medium

In less than two years, *D. suzukii* spread along the West Coast of North America, from California's Central Valley to British Columbia (Lies, 2009) and damage has been recorded. Several berry growers in California, Oregon and Washington have reported up to 100% crop losses in some fields. In Willamette Valley (Oregon) peach growers experienced losses of up to 80 percent in some orchards (Herring, 2009). In 2009, California lost some one-third of its cherry crop from Davis to Modesto. Crop losses up to 20 percent were seen in Oregon raspberries (Herring, 2009). In addition, the spotted wing drosophila has been found infesting the fruit of raspberry, blackberry, blueberry, and strawberry plantings on the central coast. It was estimated that one-quarter of late season blueberries and raspberries in Oregon were destroyed (Lies, 2010).

However it should be noted that recent experience in California has demonstrated that damage can be quite sporadic. The pest is quite sensitive to local climate factors and damage is determined by whether or not conditions are optimal. Therefore different patterns of damage are seen.

Bolda *et al.* (2009a) produced an economic impact study of the effect of *D. suzukii* on the three main fruit production States in the US, California (Ca), Oregon (Or) and Washington (Wa). The study uses both a mean assumption of 20 % yield loss and then examines actual maximum yield losses observed in 2008 as illustrated below.

Table 10 Revenue losses associated with *D. suzukii* (Bolda *et al.*, 2009)

Crop	2008 total crop value (\$ million) for states: Ca, Or, Wa.	Revenue losses (\$ million) based on 20 % yield loss	Revenue losses (\$ million) based on 2008 maximum observed US loss figures
Strawberry	1571.5	314.3	33.4 (2.1 % loss)
Blueberry	141.9	28.4	56.7 (40 % loss)
Raspberry and blackberry	313.3	62.7	156.6 (50 % loss)
Cherries	550.3	105.9	174.8 (32 % loss)

These figures demonstrate the variable nature of *D. suzukii* infestation, host preference and the range of the extent in terms of repercussions on crop losses. However, this may change rapidly as the pest exploits and develops on other hosts in its environment.

In the part of the PRA area where the pest has been detected the situation is as follows:

In 2010 losses of up to 80% occurred in strawberry crops of the Alpes Maritimes region of southern France (pers. comm. Reynaud, 2010). Similar losses have also been quoted in raspberries in the Trentino-Alto Adige region (pers. comm. Grassi, 2010).

Regarding *D. suzukii* damage in Asia, there is clear evidence of *D. suzukii* infestation of blueberry in Kisarazu City, Chiba Prefecture, Japan (Uchino, 2005). Blueberries from three areas out of five investigated areas of the province showed *D. suzukii* damage. In the PRA prepared by biosecurity Australia it is reported that *D. suzukii* has been recorded to be the main pest damaging cherry in Fukushima Prefecture (Sasaki and Sato, 1995a). Damage levels are low at the start of harvest and have been recorded to reach a maximum of 77% by the end of the season (Sasaki and Sato, 1995a). Investigation by the EWG shows that crops prone to damage such as cherry and late ripening berry fruits, tend not to be important crops in Japan and areas of China in which *D. suzukii* occur (pers. comm. M. Kimura, Hokkaido University, 2010). In addition Kumura commented that even if serious damage occurs it is not likely to

be widely reported.

In 1980 the species was collected on a single Hawaiian island and was then observed to spread to several other Islands of Hawaii, though without any reports of it causing damage. It is likely that this is due to the fact that there are few suitable commercial host crops in this location (Hauser *et al.*, 2009).

Uncertainty level: medium. The EWG based this decision on the information that was available, but acknowledged that there was limited information available for some regions such as China, where it is known that *D. suzukii* could affect thin skinned fruit crops and consequently the level of uncertainty regarding damage level in the area where the pest is present is medium.

6.02 - How great a negative effect is the pest likely to have on crop yield and/or quality of cultivated plants in the PRA area without any control measures?

massive

Level of uncertainty: low

Based on the information available regarding significant damage already occurring within the PRA area, the EWG felt that the likelihood of 'massive' negative effects on crop yield was high, and with 'low' uncertainty.

It was noted that recent experiences in North America since 2008 have shown that the impact of *D. suzukii* on local agriculture tends to decrease, although the conditions each year cause variations in populations, increased awareness, improved monitoring, and treatments may have reduced populations (Hueppelsheuser & Hauser, pers. comm., 2010).

6.03 - How great a negative effect is the pest likely to have on yield and/or quality of cultivated plants in the PRA area without any additional control measures?

major

Level of uncertainty: low

Based on experience in areas where *D. suzukii* infestation has resulted in crop damage, control may be feasible, though not necessarily easy and additional measures will be necessary. Strategies for control aim to reduce the general *D. suzukii* population by adapting a system based on monitoring, good cultural sanitation, and insecticide use when necessary. Monitoring is key, if any level of control is to be attained in order to control the insect before eggs are laid. Spotted wing drosophilae can be monitored using trapping systems.

6.04 - How great a negative effect is the pest likely to have on yield and/or quality of cultivated plants in the PRA area when all potential measures legally available to the producer are applied, without phytosanitary measures?

major

Level of uncertainty: low

Based on the information available about *D. suzukii* control and the practical difficulties involved, the EWG concluded that without phytosanitary measures, control would be very difficult. Uncertainty was considered low.

Based on experience in areas where *D. suzukii* infestation has resulted in crop damage, control may be feasible, though not necessarily easy. Strategies for control aim to reduce the general *D. suzukii* population by adapting a system based on monitoring, good cultural sanitation, and insecticide use when necessary. Monitoring is key, if any level of control is to be attained in order to control the insect before eggs are laid. Spotted wing drosophilae can be monitored using trapping systems.

There are three component parts to a management program and it is crucial that the timings of these activities are applied in conjunction with the information collected from monitoring activities:

1. Sanitation.

Any fruit that remains in the field or orchard serves as a food source and allows eggs and larvae to fully develop and serves as a fly production source. When feasible, fruit from the crop site should be removed and destroyed either by burial or disposal in a closed container. This will reduce the pest numbers. Composting is not a reliable way to destroy eggs and larvae in fruit.

2. Area-wide management.

Management practices carried out over a wide area are essential. Even if precise flight distances are unknown, *D. suzukii* is considered to be able to fly some kilometres within a territory. It is important for every grower within and next to a fly-infested area to participate, because a single, unmanaged field or orchard will serve as a source of infestation to nearby susceptible crops. Attention should also be given to meadows with scattered fruit trees, abandoned orchards and private gardens, all of which provide additional hosts.

3. Plant protection products

Active substances such as organophosphates, pyrethroids, and spinosyns have been shown to be very effective in reducing numbers of *D. suzukii* adults and are expected to give coverage for 7-10 days. As always, plant protection products must be used in line with the instructions on the product label in particular the maximum delays before harvest

The fruit is most susceptible to attack after it has coloured and developed some sugar. If monitoring indicates pest presence at this time, an insecticide spray should be applied to protect the fruit during this time. If monitoring indicates a high population earlier in the season, an earlier spray to reduce populations may be warranted in addition to a pre-harvest application. Post-harvest application to host crops can also be considered to decrease fly numbers.

D. suzukii is often not noticed until fruit is being harvested. Sprays at this time will not protect the crop, because larvae are already in the fruit. There are no effective tools for controlling larvae within the fruit (the eggs are laid in the fruit so the larvae are never found outside the fruit).

6.05 - How great an increase in production costs (including control costs) is likely to be caused by the pest in the PRA area in the absence of phytosanitary measures?

moderate

Level of uncertainty: high

The EWG was confident that increased associated costs would be incurred at least in the first years of infestations, but given the inexperience with the pest the level of uncertainty was considered high. Costs will be incurred for labour and materials associated with monitoring, sanitation management, and additional targeted applications of plant protection products. Due to limited experience in areas experiencing *D. suzukii* infestations, there is some uncertainty regarding exactly how expensive control and management strategies may be. Optimal control management strategies are yet to be well defined and these may or may not incur increased costs in terms of chemical use and/or labour.

Experience and associated costs of *D. suzukii* control to date: British Columbia (Hueppelsheuser, pers. comm., 2010):

From limited experience of *D. suzukii* control in berry crops in British Columbia, it is estimated that some 1-3 insecticide sprays, i.e. 1-2 spring and/or pre-harvest sprays, and 1 post harvest spray will be required (although this has yet to be demonstrated in a full season of *D. suzukii* exposure). To some extent, *D. suzukii* numbers may be suppressed in conventional agricultural systems in which growers already use some relevant insecticides (e.g. cherries, managed for Cherry fruit fly (*Rhagoletis* spp.)). Many growers in North America use GF-120, a commercial attract-and-kill product that has been shown to kill *D. suzukii* but is not effective in reducing the fly population. Cherry growers therefore need to ensure some broadcast canopy sprays are integrated into their rotation, based on fly trapping information. In this case, there will not necessarily be more insecticide applications, though they are likely to be different. Therefore increase in control costs for cherry is limited.

There may be costs associated with obtaining registrations for important plant protection products. British Columbia for example has emergency registrations for malathion, cypermethrin, spinatoram, and spinosad for berries, stone fruit, and grapes for *D. suzukii* in 2010, though many of these products were already registered for at least some fruit crops for other pests.

Associated costs of trapping: BC currently has some 4 trapping projects, hiring about 7 summer students, plus support activities from the provincial and federal government (insect identification, laboratory space, vehicles, supervision). The projects are funded by a combination of grower organization research and development funding and government funds. Cost for supplies: some 600 traps have been placed, costing \$1.5 each, plus the cost of bait

solution (yeast+sugar or cider vinegar 1-2 oz per trap; cost for the whole season has yet to be calculated). Some of the projects are expected to continue, albeit refined, though this is not yet certain. Additionally, private consultants are also trapping so there is some cost being borne by the growers themselves.

6.06 - Based on the total market, i.e. the size of the domestic market plus any export market, for the plants and plant product(s) at risk, what will be the likely impact of a loss in export markets, e.g. as a result of trading partners imposing export bans from the PRA area?

massive

Level of uncertainty: high

In Canada *Drosophila suzukii* is not currently regulated, though a recent pest categorization has determined that it meets the official definition of a quarantine pest by IPPC criteria (Damus, 2010). It has been declared a quarantine pest by New Zealand (Anonymous, 2009). It is unlikely to be declared a quarantine pest in the United States and the state of California has announced it will not undertake control or regulatory actions on this fly (Damus, 2010) mainly because of the rapid spread of the pest.

In Australia, cherry import from the USA is currently regulated under Public Quarantine Alert PQA0665 (effective from 18 May 2010), requiring consignments to be subject to pre-export fumigation and sampling. See:

http://www.aqis.gov.au/icon32/asp/ex_topiccontent.asp?TopicType=Quarantine+Alert&TopicID=23069

A draft PRA has recently been published and recommendations for import regulation are made.

D. suzukii is not known to be regulated elsewhere, and therefore it is unlikely that under the current regulatory status that there will be losses to export markets. In addition, the trade volume of relevant fruit commodities outside Europe is low (EUROSTATS consulted for the export from European countries in 2008 and 2009 to Australia for various host fruits very limited exports recorded, few 41 T of Grapes in 2008 and 94 T of small fruits).

The main potential risk of losses of export market is if countries in the EPPO region establish restrictions to protect their fruit production and then this could affect the countries where the pest is present. This has not happened so far although the pest is recorded since 2009.

6.07 - To what extent will direct impacts be borne by producers?

moderate extent

Level of uncertainty: medium

Drosophila suzukii causes massive damage to a number soft fruits and vegetables like strawberries, cherries etc.

Application of the decision tree shows that analysis of indirect impacts makes sense. The net economic short term effect is not caused by an export ban. In the case a single soft fruit would have been affected, consumers have the possibility to shift to other soft fruits. However, in this case many soft fruits are affected. Therefore consumers have almost no possibility to shift to other products, but they have the possibility to postpone consumption.

The question 'Do consumers have possibilities to use alternatives or to postpone consumption?' is the critical question.

- In the case this question is answered with 'no', the result is that the consumers mainly bear the indirect impacts. Because this pest is a severe threat, it is likely that prices will increase.
- In the case the question is answered with 'yes', the result is that the direct impacts will mainly be borne by the affected producers. Soft fruit production takes more than one year, so shifting to alternatives takes a long period. According to the rating guidance, question 6.07 gets the score 'moderate'.

For the example the second option has been chosen

6.08.0A - Do you consider that the question on the environmental impact caused by the pest within its current area of invasion can be answered? (Read the note)

no, and the assessor is certain that, in any case, the environmental impact will be lower than the economic impact (e.g. a purely agricultural pest not known to occur in other environments)

In the area where the pest has been introduced, no environmental damage is noted. It is a clear agriculture pest.

6.08 - How important is the environmental impact caused by the pest within its current area of invasion?

N/A

Level of uncertainty: low

6.09 - How important is the environmental impact likely to be in the PRA area?

N/A

Level of uncertainty: low

mainly an agricultural pest

6.10 - How important is social damage caused by the pest within its current area of distribution?

minimal

Level of uncertainty: low

no social impact recorded

6.11 - How important is the social damage likely to be in the PRA area?

minimal

Level of uncertainty: medium

Social damage is not presumed to be higher than in the area of origin. However, the EWG felt that there could be an effect on wild fruit picking which is socially important in parts of the region. This may be the case especially for blueberries which are collected from the wild by private persons to a big extent (although this is dependant from local legislation picking fruits in the wild may not be allowed).

As your responses to question 6.04 and 6.05 were "major" or "massive" or any of the responses to questions 6.06, 6.09 and 6.11 is "major" or "massive" or "very likely" or "certain", and the answers given to these questions do not have a high level of uncertainty, questions 6.12 to 6.14 are skipped.

6.15a - Describe the overall economic impact (*sensus stricto*)

major

Level of uncertainty: low

The EWG concluded that the potential for economic consequences due to *D. suzukii* incursions were major, with 'low' uncertainty.

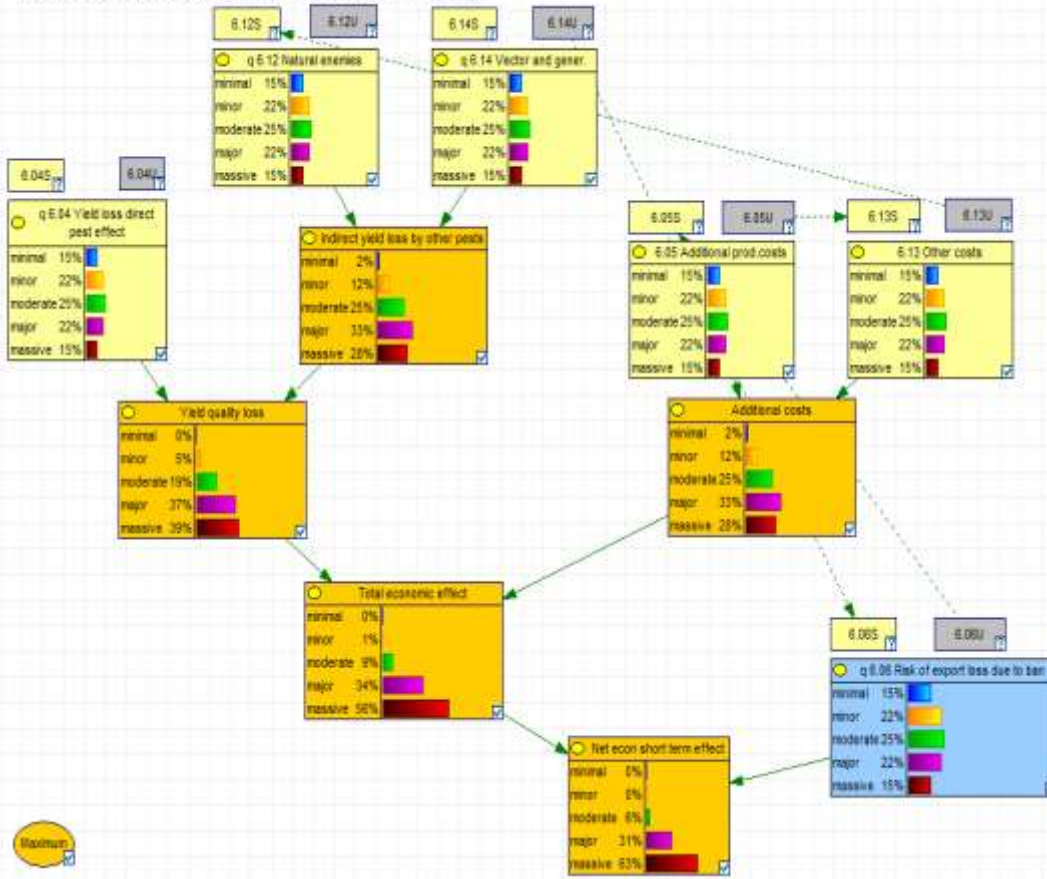
The strongest factor determining this decision was the fact that there is already evidence of extremely high crop yield losses where this pest establishes. Notwithstanding that there are some uncertainties:

- limited information regarding damage in Asia although it is suspected that susceptible crops are not widely grown.
- uncertainty regarding whether establishment will be possible, for example, in Northern Europe.
- The potential economic costs associated with control and management.

Despite the above uncertainties, the EWG was confident that when establishment occurs, damage is almost certainly going to be high initially. Management and experience, or even the fact that growers could change their agricultural systems and grow different crops altogether, may well reduce damage levels in the future.

An additional consideration was that the EWG did not consider that grapes could be regarded to be a major host. However, there is some uncertainty over this point and the possibility of infestation potential could not be ruled out. In such case the potential for economic damage in the region is higher.

matrix method by: John Holt (Imperial College, London)
 application: Wil Hennen (LEI/WUR, The Hague)
 conceptual model: Johan Bremmer (LEI/WUR, The Hague)



6.15b - With reference to the area of potential establishment identified in Q3.08, identify the area which at highest risk from economic, environmental and social impacts. Summarize the impact and indicate how these may change in future.

For information, the conclusion given at Q6.09 was: N/A

For information, the conclusion given at Q6.11 was: minimal

major
Level of uncertainty: low

Stage 2: Pest Risk Assessment Section B: Degree of uncertainty and Conclusion of the pest risk assessment

c2 - Degree of uncertainty : list sources of uncertainty

Major uncertainties are

Whether grapes could be regarded to be a major host. In such case the possibility of infestation potential could not be ruled out. This is likely to be determined by skin thickness, i.e. the variety.

Whether establishment will be possible in some parts of the PRA area, for example, in Northern Europe.

The potential economic costs associated with control and management

Little information regarding damage in China (but this is often difficult to access information from China)

Rate of natural spread

Other uncertainties

Transfer from fruits to host plants (this is a very common uncertainty for transfer from fruits to host plants and as the pest has been found in invaded areas in crops transfer is possible)

Concentration of the pest on the fruits (has an influence on the risk of entry but the pest has already entered so this uncertainty is less important)

Importance of social and environmental damage

c3 - Conclusion of the pest risk assessment

The pest is capable of establishing in the region and can cause economic damage (damage is noted already in the PRA area). The experience in North America and also France shows that the pest is able of very rapid spread.

Stage 3: Pest Risk Management

A decision has to be made to determine whether the risk from any pest/pathway combination is an acceptable risk. This decision will be based on the relationship between the level of risk identified in the pest risk assessment stage (i.e. the combination of the probability of introduction and the potential economic impact) and the importance/desirability of the trade that carries the risk of introduction of the pest.

7.01 - Is the risk identified in the Pest Risk Assessment stage for all pest/pathway combinations an acceptable risk?

no

The pest is capable of establishing in the region and can cause economic damage (damage is noted already in the PRA area). The experience in North America and also France shows that the pest is able of very rapid spread.

7.05 - Is natural spread one of the pathways?

The pathways identified in the entry section were:

Fruits of major host plants

Fruits of minor host plants

yes

7.03 - Is the pest already entering the PRA area by natural spread or likely to enter in the immediate future?

The answer to question 4.01 was: high rate of spread

yes

7.04 - Is natural spread the major pathway?

no

7.05 - Could entry by natural spread be reduced or eliminated by control measures applied in the area of origin?

yes

Level of uncertainty: medium

Complementary answer:

possible measures: control measures in the area of origin in collaboration with the NPPO concerned

7.30 - Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest?

Q.	Standalone	System Approach	Possible Measure	Uncertainty
7.05	X		possible measures: control measures in the area of origin in collaboration with the NPPO concerned	medium

yes

Control in other EPP0 countries will delay spread within the region

7.31 - Does each of the individual measures identified reduce the risk to an acceptable level?

Q.	Standalone	System Approach	Possible Measure	Uncertainty
7.05	X		possible measures: control measures in the area of origin in collaboration with the NPPO concerned	medium

no

Level of uncertainty: low

This will delay spread but not prevent it.

7.32 - For those measures that do not reduce the risk to an acceptable level, can two or more measures be combined to reduce the risk to an acceptable level?

Q.	Standalone	System Approach	Possible Measure	Uncertainty
7.05	X		possible measures: control measures in the area of origin in collaboration with the NPPO concerned	medium

no

Level of uncertainty: low

7.33 - If the only measures available reduce the risk but not down to an acceptable level, such measures may still be applied, as they may at least delay the introduction or spread of the pest. In this case, a combination of phytosanitary measures at or before export and internal measures (question 7.29) should be considered.

Such measures will delay spread.

7.34 - Estimate to what extent the measures (or combination of measures) being considered interfere with international trade.

No interference with trade

Level of uncertainty: low

7.35 - Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences.

Such measures are cost effective for the countries where the pest is not present. It may increase the price of exported products.

Level of uncertainty: low

7.36 - Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences?

yes

Pathway 1: Fruits of major host plants

7.06 - Is the pathway that is being considered a commodity of plants and plant products?

yes

7.09 - If the pest is a plant, is it the commodity itself?

no (the pest is not a plant or the pest is a plant but is not the commodity itself)

7.10 - Are there any existing phytosanitary measures applied on the pathway that could prevent the introduction of the pest? (if yes, specify the measures in the justification)

no

Level of uncertainty: low

The information presented below is based on the information available at the EPPO Secretariat on phytosanitary regulations of member countries .

In EU countries and countries with EU like legislation a phytosanitary certificate is not required for the importation of *Rubus* fruits. A Phytosanitary certificate is required for fruits of *Prunus*, and *Vaccinium* but no specific requirements that would be appropriate for *D. suzukii* are in place.

For North African countries no specific measures seem to be required (Morocco has requirements for *Prunus* fruits but these target a fungi *Monilinia fructicola* so they are not appropriate, Algeria requirements for the genus *Prunus* but targeting *Quadraspidiotus perniciosus*, no specific requirements found for Tunisia).

For Israel, import of fruits of *Rubus* is authorised from European countries only but no specific requirements that would be appropriate for *D. suzukii* are in place. For other fruits an import permit is required (Ministry of Agriculture and rural development, Plant Import Regulation, 2009).

For Turkey requirements exist for *Prunus* fruits but these target a fungus *Monilinia fructicola* so they are not appropriate.

No specific requirements could be identified in the legislation of Russia or other CIS countries available at EPPO.

7.11 - Are the measures likely to change in the foreseeable future?

no or no judgement

Level of uncertainty: low

7.13 - Can the pest be reliably detected by visual inspection at the place of production (if the answer is yes specify the period and if possible appropriate frequency, if only certain stages of the pest can be detected answer yes as the measure could be considered in combination with other measures in a Systems Approach)?

yes in a System Approach

Level of uncertainty: low

Complementary answer:

visual inspection at the place of production

The most efficient method for first detection is by trapping. Traps should be placed when the temperature is consistently over 10°C, and/or when fruit starts to form, at least one month prior to fruit ripening. For first detections, place traps in field edges, hedgerows (i.e. near wild hosts) and amongst crops. Traps are hang in the plant canopy or set firmly in the ground within the plant row, in a shady location. Approximately two traps per field should be placed. These should be checked at least weekly. Aera wide trapping is recommended.

7.14 - Can the pest be reliably detected by testing at the place of production? (if only certain stages of the pest can be detected by testing answer yes as the measure could be considered in combination with other measures in a Systems Approach)

no

Level of uncertainty: low

Not relevant

7.15 - Can infestation of the commodity be reliably prevented by treatment of the crop?

yes in a System Approach

Level of uncertainty: low

Complementary answer:

specified treatment of the crop

There are three component parts to a management program and it is crucial that the timings of these activities are applied in conjunction with the information collected from monitoring activities:

1. Sanitation.

Any fruit that remains in the field or orchard serves as a food source and allows eggs and larvae to fully develop and serves as a fly production source. When feasible, remove all fruit from the crop site and destroy either by burial or disposal in a closed container. This will reduce the pest numbers. Composting is not a reliable way to destroy eggs and larvae in fruit.

2. Area-wide management.

Management practices carried out over a wide area are essential. *D. suzukii* is able to fly some kilometres within a territory. It is important for every grower within and next to a fly-infested area to participate, because a single, unmanaged field or orchard will serve as a source of infestation to nearby susceptible crops. Attention should also be given to meadows with scattered fruit trees, abandoned orchards and private gardens, all of which provide additional hosts.

3. Plant protection products

Active substances such as organophosphates, pyrethroids, and spinosyns have been shown to be very effective in reducing numbers of *D. suzukii* adults and are expected to give coverage for 7-10 days. As always, plant protection products must be used in line with the instructions on the product label. The fruit is most susceptible to attack after it has coloured and developed some sugar. If monitoring indicates pest presence at this time, apply an insecticide spray to protect the fruit during this time. If monitoring indicates a high population earlier in the season, an earlier spray to reduce populations may be warranted in addition to a pre-harvest application. Consider a post-harvest application to host crops to decrease fly numbers.

D. suzukii is often not noticed until fruit is being harvested. Sprays at this time will not protect the crop, because larvae are already in the fruit. There are no effective tools for controlling larvae within the fruit (the eggs are laid in the fruit so the larvae are never found outside the fruit).

7.16 - Can infestation of the commodity be reliably prevented by growing resistant cultivars? (This question is not relevant for pest plants)

no

Level of uncertainty: low

Not relevant

7.17 - Can infestation of the commodity be reliably prevented by growing the crop in specified conditions (e.g. protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water, etc.)?

yes as standalone measure

Level of uncertainty: low

Complementary answer:

specified growing conditions of the crop

For some of the crops (e.g. mainly small fruit production), the plants can be grown under nets with a special mesh size (0,98 mm) (Kawaze & Uchino, 2005). Traps should be placed to control any possible infestation.

7.18 - Can infestation of the commodity be reliably prevented by harvesting only at certain times of the year, at specific crop ages or growth stages?

no

Level of uncertainty: low

7.19 - Can infestation of the commodity be reliably prevented by production in a certification scheme (i.e. official scheme for the production of healthy plants for planting)?

no

Level of uncertainty: low

Note that in this question pest spread capacity is considered without prejudice to any other measure that can be recommended. For some pests, growing the plant in specific conditions can prevent natural spread (e.g. production in a glasshouse may provide protection against pest with high capacity for natural spread). These measures should have been identified in question 7.17.

7.20 - Based on your answer to question 4.01 (high rate of spread with high uncertainty), select the rate of spread.

high rate of spread

Level of uncertainty: high

Complementary answer:

pest-free area

7.21 - The possible measure is:

Can this be reliably guaranteed?

yes

Level of uncertainty: low

The expert working group considered that a pest free place of production can only be guaranteed with physical protection (see question 3.22). Given the spread capacity a pest free place of production will be difficult to maintain in an infested area without physical protection (see also the comment on the necessity to have an area wide management of the pest in question 3.20).

Consequently pest free area only (following ISPM no. 4) was considered as a possible measure.

7.22 - Can the pest be reliably detected by a visual inspection of a consignment at the time of export, during transport/storage or at import?

yes in a System Approach

Level of uncertainty: low

Complementary answer:

visual inspection

As explained in question 1.9 early infestations are difficult to detect nevertheless it also depends on the hosts. On cherries or *Vaccinium* infested fruits show small scars and indented soft spots on the fruit surface left by the females ovipositor ("stinger") (Dreves *et al.* 2009). Nevertheless similar symptoms can have other cause fruits should be cut open.

On other fruits (*Rubus* spp, *Fragaria*, *Prunus*) infestation is more difficult to detect due to the uneven or hairy surface. Eggs and respiratory tubes will be difficult to see.

7.23 - Can the pest be reliably detected by testing of the commodity (e.g. for pest plant, seeds in a consignment)?

no

Level of uncertainty: low

7.24 - Can the pest be effectively destroyed in the consignment by treatment (chemical, thermal, irradiation, physical)?

yes as standalone measure

Level of uncertainty: high

Complementary answer:

specified treatment

Chemical treatments:

There are no chemical treatments for controlling larvae within the fruit (the eggs are laid in the fruit so the larvae are never found outside the fruit).

Cold treatment:

For cherries cold treatment is possible provided that fruits are kept 96 hours continuously at 1.66 degrees (Kanzawa, 1939). For other fruits no information is available. **It should be noted that these are laboratory results which have not been verified in commercial consignment conditions.** In addition small fruits are usually traded quickly as they do not keep for long periods which is unlikely to be compatible with the duration mentioned for cherry.

Other treatments

Controlled atmosphere should be investigated but no data is available for the moment for *D. suzukii*.

There is no information on the efficacy of irradiation on *D. suzukii*. Information on to what extent irradiation is used in EPPO countries was not available to the EWG. In the EU, few countries allow the irradiation of fruits (see the list of Member States' authorisations of food and food ingredients which may be treated with ionising radiation (2009/C 283/02)). In addition the treatment, should be conducted in an approved irradiation facility (see Commission Decision of 7 October 2004) so irradiation is not a feasible measure for all EU trading partners. As irradiation only sterilize insects and does not kill them, presence of living insects remains a concern for some countries.

7.25 - Does the pest occur only on certain parts of the plant or plant products (e.g. bark, flowers), which can be removed without reducing the value of the consignment? (This question is not relevant for pest plants)

no

Level of uncertainty: low

7.26 - Can infestation of the consignment be reliably prevented by handling and packing methods?

yes in a System Approach

Level of uncertainty: low

Complementary answer:

specific handling/packing methods

Handling and packing of fruits include sorting of damaged fruits; Visual inspection during the packing process is possible as well as sorting of soft fruits in cold water bath. However this should be used as a confirmation of other measures.

7.27 - Can the pest be reliably detected during post-entry quarantine?

no

Level of uncertainty: low

Not practical for fruits

7.28 - Could consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice?

yes

Level of uncertainty: medium

Complementary answer:

import under special licence/permit and specified restrictions

Processing the fruits will eliminate the pest but it must be guaranteed that the pest cannot escape from the processing plant and that wastes are strictly controlled. Transport from the entry point to the processing plant should also ensure that the pest cannot escape. The Panel on Phytosanitary Measures considered that such measures should be only allowed on a case by case basis and data should be provided by the company requesting such imports.

7.29 - Are there effective measures that could be taken in the importing country (surveillance, eradication, containment) to prevent establishment and/or economic or other impacts?

no

Level of uncertainty: low

Surveillance will be difficult as the pest is not easy to detect.

As explained in question 1.21 in a small and restricted area (like a valley) with low abundance and well implemented measures there is a chance for eradication. However, considering the life cycle with up to 15 generations (Kanzawa

1935); the fast development time (8 to 14 days in optimal conditions); some 400 eggs laid per female (maximum of 992 eggs/female); duration of oviposition of 55 days (maximum of 99 days) (Kanzawa 1939); and high insect mobility, it is very unlikely that it will be possible to eradicate the pest in a larger infested area without natural barriers.

As explained in question 1.32 movement of the pest with infested fruits will be difficult to control in the PRA area as early infestations are difficult to detect. Determining containment measures will be difficult given that natural spread capacity is undetermined.

7.30 - Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest?

Q.	Standalone	System Approach	Possible Measure	Uncertainty
7.05	X		possible measures: control measures in the area of origin in collaboration with the NPPO concerned	medium

yes

7.31 - Does each of the individual measures identified reduce the risk to an acceptable level?

Q.	Standalone	System Approach	Possible Measure	Uncertainty
7.05	X		possible measures: control measures in the area of origin in collaboration with the NPPO concerned	medium

no

Level of uncertainty: low

- **Measures not considered sufficient on their own**

Visual inspection (for certain fruits)
Treatment of the crop

- **Measures that could be sufficient on their own but have limitations**

Specified treatment for certain fruits (e.g. cold treatment for cherries) **however such measures have not been verified for commercial consignments.**

Import for processing provided that it can be guaranteed that no escape of flies possible. **The Panel on Phytosanitary Measures considered that such measures should be only allowed on a case by case basis and data should be provided by the company requesting such imports.**

- Measures that are considered sufficient as single measures

- Specified growing conditions: provided that the host can be grown under protected conditions, the plants should be grown in screened greenhouses (or under a net) with a mesh lower than 0,98 mm. Visual inspection and trapping are verification procedures which can be applied during handling and packing at the place of production.
- Pest free area

7.32 - For those measures that do not reduce the risk to an acceptable level, can two or more measures be combined to reduce the risk to an acceptable level?

Q.	Standalone	System Approach	Possible Measure	Uncertainty
7.05	X		possible measures: control measures in the area of origin in collaboration with the NPPO concerned	medium

yes

Level of uncertainty: low

A possible combination of measures in a Systems Approach could be

- Consignment originating from an Area of low pest prevalence
- Surveillance of the crop based on trapping
- Treatments of the crop
- Inspection during packing and handling
- Cold treatment

However the Panel on Phytosanitary measures considered that such combination should only be considered upon request of an exporting country which should then provide the necessary information to allow a proper evaluation of such combination.

7.34 - Estimate to what extent the measures (or combination of measures) being considered interfere with international trade.

The trade in the commodities originating from outside the EPPO region is limited so impact on such trade should be minor. However if restrictions are implemented within the EPPO region impact is likely to be high (e.g. for strawberry, cherries..).

Level of uncertainty: high

7.35 - Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences.

no elements to answer

Level of uncertainty: high

7.36 - Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences?

yes

- **Measures that are considered sufficient as single measures**
 - Specified growing conditions (growing the plants under a net or in screened greenhouses and trapping to verify pest freedom)
 - Pest Free Area (following ISPM no. 4)

- **Other measures that can be considered on a case by case basis and upon request**
 - Import for processing provided that it can be guaranteed that no escape of flies is possible
 - A possible combination of measures in a systems approach could be
- Consignment originating from an area of low pest prevalence
 - Surveillance of the crop based on trapping
 - Treatments of the crop
 - Inspection during packing and handling
 - Cold treatment (but see comment just below)
 - Cold treatments for cherry fruits; data are needed for the efficacy on other fruits than cherry and for cherry data on efficacy of the treatment for commercial consignments are lacking.
 - There is no data available for other treatments (controlled atmosphere, irradiation), such treatment can be considered upon request.

7.41 - Consider the relative importance of the pathways identified in the conclusion to the entry section of the pest risk assessment

Major host present more risk of introduction than minor hosts.

7.42 - All the measures or combination of measures identified as being appropriate for each pathway or for the commodity can be considered for inclusion in phytosanitary regulations in order to offer a choice of different measures to trading partners. Data requirements for surveillance and monitoring to be provided by the exporting country should be specified.

Notes:

only the least stringent measure (or measures) capable of performing the task should be selected. Thus, if inspection is truly reliable, it should not be necessary to consider treatment or testing. Note also that some measures may counteract each other; for example the requirement for resistant cultivars may make detection more difficult. It may be that some or all of these measures are already being applied to protect against one or more other pests, in which case such measures need only be applied if the other pest(s) is/are later withdrawn from the legislation. The minimum phytosanitary measure applied to any pest is the declaration in phytosanitary regulations that it is a quarantine pest. This declaration prohibits both the entry of the pest in an isolated state, and the import of consignments infested by the pest. If other phytosanitary measures are decided upon, they should accompany the declaration as a quarantine pest. Such declaration may occasionally be applied alone, especially: (1) when the pest concerned may be easily detected by phytosanitary inspection at import (see question 6.13), (2) where the risk of the pest's introduction is low because it occurs infrequently in international trade or its biological capacity for establishment is low, or (3) if it is not possible or desirable to regulate all trade on which the pest is likely to be found. The measure has the effect of providing the legal basis for the NPPO to take action on detection of the pest (or also for eradication and other internal measures), informing trading partners that the pest is not acceptable, alerting phytosanitary inspectors to its possible presence in imported consignments, and sometimes also of requiring farmers, horticulturists, foresters and the general public to report any outbreaks.

7.43 - In addition to the measure(s) selected to be applied by the exporting country, a phytosanitary certificate (PC) may be required for certain commodities. The PC is an attestation by the exporting country that the requirements of the importing country have been fulfilled. In certain circumstances, an additional declaration on the PC may be needed (see EPP0 Standard PM 1/1(2) Use of phytosanitary certificates).

7.44 - If there are no measures that reduce the risk for a pathway, or if the only effective measures unduly interfere with international trade (e.g. prohibition), are not cost-effective or have undesirable social or environmental consequences, the conclusion of the pest risk management stage may be that introduction cannot be prevented. In the case of pest with a high natural spread capacity, regional communication and collaboration is important.

7.45 - Summarize the conclusions of the Pest Risk Management stage.

List all potential management options and indicate their effectiveness.

Uncertainties should be identified.

Measures that are considered sufficient as single measures

- Specified growing conditions (growing the plants under a net or in screened greenhouses and trapping to verify pest freedom)
- Pest Free Area (following ISPM no. 4)

Other measures that can be considered on a case by case basis and upon request

- Import for processing provided that it can be guaranteed that no escape of flies is possible
- A possible combination of measures in a systems approach could be
 - Consignment originating from an area of low pest prevalence
 - Surveillance of the crop based on trapping
 - Treatments of the crop
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 - Cold treatment (but see comment just below)
- Cold treatments for cherry fruits; data are needed for the efficacy on other fruits than cherry and for cherry data on efficacy of the treatment for commercial consignments are lacking.
- There is no data available for other treatments (controlled atmosphere, irradiation), such treatment can be considered upon request.