Rapid assessment of the need for a detailed Pest Risk Analysis for *Fusarium oxysporum* f.sp. *lactucae*

Disclaimer: This document provides a rapid assessment of the risks posed by the pest to the UK in order to assist Risk Managers decide on a response to a new or revised pest threat. It does not constitute a detailed Pest Risk Analysis (PRA) but includes advice on whether it would be helpful to develop such a PRA and, if so, whether the PRA area should be the UK or the EU and whether to use the UK or the EPPO PRA scheme.

STAGE 1: INITIATION

1.What is the name of the pest?

Fusarium oxysporum f.sp. *lactucae*.

Synonyms: None.

Common names of the disease: Fusarium wilt and root rot of lettuce. (Fujinaga *et al*., 2001; cited in Scott *et al*., 2010).

Taxonomic position:
Kingdom: *Fungi*; Division: *Ascomycota*; Order: *Hypocreales*; Family: *Hypocreaceae*; Genus: *Fusarium*

Special notes on nomenclature or taxonomy: According to EPPO (2009) the wilt-form of the disease was first described in Japan in 1955. The original record in Japan (Matuo & Motohashi, 1967) has not been possible to obtain but is referred to by Garibaldi *et al*. (2002) who state that the wilt of lettuce in Japan was attributed to *F. oxysporum* f.sp. *lactucae*. The causal pathogen for the first findings in California was named *Fusarium oxysporum* f.sp. *lactucum* forma specialis nov. (Hubbard & Gerik, 1993). It is not clear why the US record is attributed to a new *forma specialis* but in other publications the pathogen is referred to as *F. oxysporum* f.sp. *lactucae*.

There are more than 70 pathogenic *forma specialis* of *F. oxysporum* that have been described (Armstrong & Armstrong, 1981; in Lievens *et al*., 2008). These are morphologically similar and their differentiation is based upon host specificity which requires host-range testing. Pathogenic *forma specialis* of *F. oxysporum* cause vascular wilt or root rot on more than 100 plant species. There are also non-pathogenic strains of this species for which no host plants have been described (as yet).

It is thought that *F. oxysporum* f.sp. *lactucae* is specific to lettuce (*Lactuca sativa*) and possibly lamb's lettuce (*Valerianella olitoria*). Lamb's lettuce was first detected as a host in Italy in 2003 but the authors suggested that it might warrant a new *forma specialis* designation (Garibaldi *et al*., 2004). It has not been redesignated to date.

There are three races of the *forma specialis* and, according to Scott *et al.* (2010), these all occur in Japan where the disease was first detected; outside of Japan all isolates tested have been race 1.

2. What is the pest's status in the EC Plant Health Directive (Council Directive 2000/29/EC) and in the lists of EPPO?
F. oxysporum f.sp. *lactucae* is not listed in the EC Plant Health Directive. (Anon., 2000).

The pathogen is on the EPPO Alert List to which it was added in September 2009 (EPPO, 2009).

3. What is the reason for the rapid assessment?
This rapid assessment was initiated at the request of a diagnostician at Fera who, given the importance of lettuce as crop in the UK, was concerned as to what action would be recommended should the pathogen be diagnosed on plant samples submitted to the Fera Plant Clinic.

STAGE 2: RISK ASSESSMENT

4. What is the pest's present geographical distribution?
The current geographic distribution of *F. oxysporum* f.sp. *lactucae* is described by EPPO (2009) as being present in Europe in Italy (Lombardia, Piemonte, Veneto and Emilia Romagna) and Portugal (first found in Entre Douro Minho). It has also been found in Asia in Iran, Japan (Hokkaido, Honshu and Kyushu), the Korea Repulic (Gyeonggi Province), and Taiwan. In North America it has been found in Arizona and California, USA. A record of *F. oxysporum* causing a wilt disease of lettuce in Brazil (Venturo & Costa, 2008) was not included in the EPPO Alert List because the *forma speciales* was not specified.

Table 1. Distribution of *F. oxysporum* f.sp. *lactucae*

Continent	Country	Date first found**
North America	USA *California* *Arizona*	 1990 2001
Central America	No record	-
South America	Brazil*	2000
Caribbean	No record	-
Europe	Italy Portugal	2001 2004
Africa	No record	-
Asia	Japan Iran Taiwan Korea Republic	1955 1995 1998 2006
Oceania	No record	-

*Unspecified *formae speciales*
**Original references were used for these dates with the exception of the findings in Asia and Portugal where EPPO (2009) was the source

5. Is the pest established or transient, or suspected to be established/transient in the UK?
Not as far as is known. However, there have been no surveys for this pathogen in field-grown or protected lettuce in the UK and trade in lettuce plants and lettuce seed is not specifically regulated under phytosanitary legislation within the EU (see 8.).

6. What are the pest's natural and experimental host plants; of these, which are of economic and/or environmental importance in the UK?
Lettuce (*Lactuca sativa*) and lamb's lettuce (*Valerianella locusta*) are the hosts *of F. oxysporum* f.sp. *lactucae*. EPPO (2009).

Lettuce is an important crop in the UK with a 'field-gate' value of £82 million in 2008 (Defra, 2008). The British Leafy Salads Association state on their website (BLSA, 2011) that there are five main types of '*wholehead salad*' grown in the UK thus:

- Iceberg
- Romaine (otherwise known as Cos)
- Gem
- Batavia
- Speciality lettuce (e.g. lollo rosso, oak leaf)

EPPO (2009) states that most cultivar groups of lettuce such as butterhead, iceberg, oak leaf, romaine and Batavia are susceptible to the pathogen. All of these are grown in the UK.

Lamb's lettuce is probably less significant as a crop in the UK; no data can be found for UK production.

7. If the pest needs a vector, is it present in the UK?
No vector is required.

8. What are the pathways on which the pest is likely to move and how likely is the pest to enter the UK?
The main pathways on which *F. oxysporum* f.sp. *lactucae* is likely to move are:

- Plants for planting and possibly seeds of *Lactuca sativa* and *Valerianella locusta*
- Contaminated soil attached to plants for planting (lettuce and other plants grown in fields or under protection where the pathogen is present) or machinery
- Soil associated with crops including vegetables harvested in fields where the pathogen occurs

There are no specific phytosanitary requirements in the EC Plant Health Directive (Anon., 2000) that would reduce the potential for entry of the pathogen into the UK or movement within the UK. In particular there are no pre-existing phytosanitary requirements for plants or seeds of *L. sativa* or *V. locusta*.

However, there is a requirement for plants for planting of both of these species produced within the EU to be accompanied by a Plant Passport when sold or moved for commercial growing-on. This is to ensure traceability. There are no such requirements for seed of either species. Plants for planting of these species originating from outside the EU would need to be accompanied by a Phytosanitary Certificate.

The BLSA advised that seed of lettuce is imported into the UK from Holland (i.e. the Netherlands), the USA (where the pathogen occurs) and '*other countries*'; with modules/plugs (seedlings in blocks of growing media) being brought in from Holland (the

Netherlands). (J. Dyas, BLSA, *personal communication*, May 2011). The source of seeds used in the Netherlands to raise seedlings is unspecified.

Fera's Plant Health and Seeds Inspectorate (PHSI) have advised that there is some movement of Dutch-produced lettuce modules/plugs into Kent which supports the comment from the BLSA. (T. Drewett, PHSI, *personal communication*, May 2011). Again the source of the seed used in the Netherlands is not known. Any other trade in EU-produced lettuce seedlings would not be apparent to the PHSI as lettuce crops are rarely inspected. There is no significant trade in third country lettuce seedlings with the majority being produced in the UK for UK lettuce producers. (D. McCann, PHSI, *personal communication*, May 2011).

Lettuce seedlings are raised from seed sown in modules made from compost (BLSA, 2011). Seedlings have the potential to be infected or contaminated with the pathogen if they are raised in contaminated modules or possibly if they have been raised from infected or contaminated seed as discussed below.

The PHSI have advised that lettuce seed used in the UK to raise seedlings originates mainly from the USA (where the pathogen occurs), as well as from Israel and Australia. Seed for commercial purposes is dressed (with an unspecified seed dressing), but for trial purposes is not dressed. Consignments comprise large quantities of seed (many 100,000s) and these are imported by a small number of businesses. (P. Bratby, PHSI, *personal communication*, May 2011).

Detection of the pathogen in/on lettuce seed as well as the potential for seed transmission has been investigated. Garibaldi *et al*. (2004a) assayed 27 samples of commercial seed of lettuce cultivars from an affected area in Lombardy (north-west Italy). Nine of 27 samples were found to be contaminated with the pathogen. Of 16 isolates obtained only one was isolated from disinfected seed (i.e. the remaining isolates would have been present on the seed surface, this single isolate would presumably be present within the seed). Personal communication from EPPO (F. Petter, May 2011) suggests that in 2008 the Italian plant health authorities tested 65 seed samples and only one was positive for the pathogen (it is not clear whether this was contaminated or infected seed). This positive sample was planted but no symptoms were observed in the crop. It should be noted that the general consensus in the literature is that symptoms of infection of lettuce by *F. oxysporum* f.sp. *lactucae* tend to develop during warmer cropping periods; however, no details were supplied in respect of the conditions prevailing during the investigation in Italy. So, the reason for the lack of symptom development from the infected/contaminated seed is not known.

In the UK, approval of pesticides for use as seed treatments in field-grown lettuce is limited to the insecticide imidacloprid (Anon., 2010); the same chemical has an off-label approval for use on protected lettuce (Anon., 2010a). Imidacloprid would have no effect on *F. oxysporum* f.sp. *lactucae* either as a seed contaminant or in infected seed.

It seems possible that the pathogen can be associated with lettuce seed, either as a contaminant or as true infection within the seed. However, the prevalence in seed from affected areas is probably intermittent and although transmission through to the growing crop is possible, it is dependent upon growing conditions, especially temperature, and possibly cultivar (there may be some resistance or tolerance in some cultivars).

As the pathogen is soil-borne and produces long-lived chlamydospores it may be present in soil originating in areas where the pathogen occurs and this could contaminate the different pathways listed below.

Noting that the full distribution of the pathogen in the EU is uncertain as there have been no official surveys (including in the UK) and there have been no phytosanitary requirements imposed to limit movement of the pathogen into or within the EU, the likelihood of entry from areas where the pathogen occurs is summarised below.

Likelihood of entry – all pathways originate in areas where *F. oxysporum* f.sp. *lactucae* occurs:

	Very unlikely	Unlikely	Moderately likely	Likely	Very likely
Plants for planting (lettuce/lamb's lettuce):				X	
Seeds (lettuce/lamb's lettuce):			X		
Soil associated with plants for planting:				X	
Soil associated with machinery:				X	
Soil associated with field vegetables:				X	

9. How likely is the pest to establish outdoors or under protection in the UK?

Establishment is likely in field-grown lettuce crops and very likely in crops grown under protection. The slight difference in judgement is because the literature suggests that higher temperatures facilitate disease development; these temperatures are only likely to occur during some of the UK outdoor growing season and are more likely to occur in crops grown under protection. Establishment may therefore be slower outdoors than under protection. In Italy, the first report of symptoms of infection of lettuce by *F. oxysporum* f.sp. *lactucae* was in commercial plastic greenhouses. Wilting of infected plants was observed in the spring and summer of 2001 when temperatures were between 26 and 35ºC (Garibaldi *et al*., 2002). EPPO (2009) suggests that the optimum soil temperature for infection/disease development is between 24 and 28ºC. Protected crops of lamb's lettuce exhibited wilting in June 2002 in Italy when temperatures ranged between 28 and 35ºC (Garibaldi *et al*., 2004). In Arizona, determination of soil temperatures that were conducive to disease development in the field for a range of lettuce cultivars showed that the most severe symptoms occurred in crops when the average soil temperature at 4 inches (10cm) depth was 65 to 85ºF (18 to 29ºC); however symptoms (less severe) still developed when the average soil temperatures at 4 inches depth (10cm) were 48 to 64ºF (9 to 18ºC) (Matheron & Porchas, undated). Ventura & Costa (2008) first observed wilting lettuce plants in fields in Brazil in 2000 when

temperatures (air presumably) were between 26 and 34ºC. *In vitro* testing of one isolate of the pathogen obtained from infected lettuce crops in California showed that mycelial growth occurred between 46 and 89 Fahrenheit (8 to 32ºC) with optimum growth at 82 Fahrenheit (28ºC) (Hubbard & Gerik, 1993). Scott *et al*. (2010) tested six isolates for *in vitro* growth and showed that growth was slow at 10ºC but increased up to 25ºC and then reduced at 30ºC. A high optimum temperature for mycelial growth *in vitro* would support the field observations of the disease developing during warmer cropping periods in other countries. However, the fact that the pathogen can grow at lower temperatures and that it also has a saprophytic stage would allow it to develop slowly and possibly unseen in UK lettuce crops. Soil temperatures in fields used for lettuce production in the UK can frequently get above 25ºC (ADAS, 1984) and this would encourage symptom development in infected crops. Scott *et al*. (2010) advise that the effect of temperature on disease development varies with the cultivar; a highly susceptible cultivar would suffer more damage when temperatures are higher.

As the pathogen produces long-lived hardy spores known as chlamydospores this would facilitate survival in field soil between successive crops and cropping seasons. UK lettuce crops are mainly field-grown and are continuously cropped with the first planting starting in February and the final harvest being in October. Although crop rotation is known to limit the build up of all pests and pathogens in the field, the Red Tractor scheme for field lettuce describes one year without growing lettuce as '*attainable*' but longer breaks are described as '*not always achievable*'. (Anon., 2010).

One study in Arizona that commenced in 2004 investigated the longevity of the pathogen in field plots in the absence of vegetation. One of the conclusions was that from an initially high level of introduced inoculum, three years without growing lettuce would be the minimum necessary to reduce the inoculum to below a threshold for economic damage (Gordon, undated). The author also suggested that it is not possible to determine a single threshold for damage to occur because lettuce cultivars vary in their susceptibility and the development of disease symptoms is favoured by high temperatures.

Once introduced, build-up of *F. oxysporum* f.sp. *lactucae* could occur in field crops of lettuce over time before disease symptoms were noticed. By this point it would be difficult to determine the distribution of the pathogen, since soil movement would have facilitated its spread.

Protected lettuce crops are grown all year round in the UK albeit on a much smaller scale than field lettuce. The BLSA (2011) advise that varieties produced in winter are bred to grow in the shorter day lengths, needing little heat, whilst those grown in summer are bred to cope with higher temperatures. Protected lettuce is still commonly grown in rotation with other crops in soil. Lettuce is sometimes planted through polyethene to control weeds and retain soil moisture. Some protected lettuce is grown in hydroponic systems. Once introduced via infected or contaminated planting material, the pathogen could build up in soil or could be moved from plant to plant within hydroponic systems.

Sterilisation of soil or hydroponic systems in protected environments might destroy the pathogen. The Red Tractor scheme for protected lettuce recommends steam sterilisation or treatment with dazomet when disinfection of soil is considered necessary in glasshouse environments (Anon., 2010a). The efficacy of these treatments against *F. oxysporum* f.sp. *lactucae* is not known. Commercial systems are available for disinfection of hydroponic solutions; again their efficacy against this particular pathogen has not been tested (see. e.g. HDC, 2000).

Sterilisation of field soil would be difficult (and expensive) to achieve due to the inability to delimit the areas where the pathogen might be present (i.e. reintroduction is likely from

surrounding areas). The Red Tractor scheme for field-grown lettuce makes no recommendation for sterilisation of field soil (Anon., 2010).

	Very unlikely	Unlikely	Moderately likely	Likely	Very likely
Establishment outdoors:				X	
Establishment under protection:					X

10. How quickly could the pest spread in the UK?
Natural spread is likely to be very slow or unlikely as the pathogen is not described as spreading through wind-blown spores (N.B. some other *Fusarium oxysporum* f.sp. pathogens sporulate on the host once the pathogen has infected the vascular system). This pathogen would be spread by movement of contaminated soil, water, contaminated or infected plants/seeds, and, possibly contaminated crops harvested in affected fields/protected crops.

	Very slowly	Slowly	Moderate pace	Quickly	Very quickly
Natural spread:	x				
In trade:				x	

11. What is the area endangered by the pest?
Areas of the UK where the host crops (lettuce and lamb's lettuce) are grown both in the field and under protection.

According to the BLSA (2011), in the UK there are ca. 14,000 acres (5665 ha) of salad farms, across the Vale of Evesham, the south Coast, East Anglia, Lancashire, Lincolnshire, the west Midlands and Hampshire.

12. What is the pest's economic, environmental or social impact within its existing distribution?
EPPO (2009) state that in northern Italy the pathogen is a limiting factor for commercial lettuce production with growers being unable to grow lettuce once their fields are infested. Up to 70% losses have been observed in contaminated fields. When soil temperatures are high (optimum 24-28ºC) whole crops may be destroyed.

No other data were available.

The economic impact in its existing distribution is considered very large. Because growers cannot grow lettuce in affected fields there may be a social impact depending upon whether growers can adapt to grow crops other than lettuce (it is presumed they could do so although it may require some investment depending upon the chosen crop). The environmental impact is considered to be very small as the pathogen only affects lettuce/lamb's lettuce and cannot be readily controlled by the use of pesticides (N.B. there are inconclusive data on fungicide efficacy – see 15).

	Very small	Small	Medium	Large	Very large
Economic:					x
Environmental:	x				
Social:		x			

13. What is the pest's potential to cause economic, environmental or social impacts in the UK?

The same ratings for the impacts in the existing distribution for the pathogen (see 12.) are given for the likely impacts in the UK. The susceptibility of UK lettuce varieties to infection by *F. oxysporum* f.sp. *lactucae* has not been tested. They may vary in susceptibility and disease development may occur more quickly in protected lettuce crops when warmer conditions occur than in field-grown lettuce. Summer crops (both field-grown and protected) may succumb to infection and disease development more easily when warmer soil temperatures occur.

Economic:	Very small		Small		Medium		Large		Very large	x
Environmental:	Very small	x	Small		Medium		Large		Very large	
Social:	Very small		Small	x	Medium		Large		Very large	

14. What is the pest's potential as a vector of plant pathogens?

F. oxysporum f.sp. *lactucae* is a plant pathogen with no capacity to act as a vector of other pathogens.

STAGE 3: PEST RISK MANAGEMENT

15. What are the risk management options for the UK?

Action for keeping the pest out of the UK

To date there have been no phytosanitary controls for any pest or pathogen on planting material (seeds and plants for planting) of lettuce or lamb's lettuce introduced to the UK. Thus the pathogen may have already entered lettuce-producing areas. Seed imported from the USA may be a pathway of entry and possibly from the Netherlands depending upon where they source their seed from. Non-UK raised plants for planting of lettuce are brought into the UK from the Netherlands. If these have been raised from seed from countries where the pathogen occurs (such as the USA) this may have already facilitated entry.

EPPO (2009) suggest that the use of healthy planting material (lettuce seeds and transplants) produced under certification schemes might be one tool to prevent spread of the pathogen in trade. However, testing of seed for the pathogen may be unreliable due to the possibly low level of infection or contamination that may be present. Chia *et al*. (2010) developed a nested PCR (nPCR) assay to detect the pathogen in lettuce seed. Infestation as low as 0.1% was detectable. In the same study, commercial seed lots were tested by direct plating or by the nPCR method but the pathogen was not detected. The authors commented that this was either because it was absent; or present, but below detectable limits.

Seedling testing would be destructive and may not necessarily determine that a consignment of modules was infected. If sampling of plants for testing was based upon symptom development in seedlings this would only be apparent at higher temperatures.

There are currently no protocols for reliable testing for this pathogen in seeds or planting material.

Options for control if the pest became established

If *F. oxysporum* f. sp. *lactucae* becomes established in field crops (the most commonly-grown crops) it would be difficult to determine how widespread it was since it may have been

present in the soil for some considerable time. It would therefore be impossible to delimit an outbreak for future management.

Lievens *et al*. (2008) suggest that there are no curative treatments for *F. oxysporum* f.sp. and that the most effective disease control efforts are directed at crop rotation, disinfestation of plant material, the use of resistant plant cultivars if available, and, soil fumigation. Biological control agents were also suggested but this seems largely experimental.

Crop rotation would probably require avoiding planting lettuce or lamb's lettuce for at least 5 years (EPPO, 2009) to avoid further infection and build-up of the pathogen in the soil. In the USA some growers plant lettuce crops in cooler periods to avoid disease development but in the UK the success of this would depend upon how susceptible the cultivars were that would be planted. Screening of lettuce cultivars for resistance/tolerance would be needed to identify those that were least susceptible. Soil sterilisation/hydroponic system sterilisation may be an option to use as part of an integrated programme of controls. Soil sterilisation has been investigated in Arizona, USA, with soil solarisation showing some promise for reducing disease incidence in lettuce in infested fields (Matheron & Porchas, 2010). Evaluation of fungicides as protective sprays for field-grown lettuce was undertaken in the same study but proved inconclusive due to the low levels of disease that developed.

16. Summary and conclusion of rapid assessment.
This rapid assessment shows:

Likelihood of entry is: Moderately likely to likely (if it hasn't already occurred)

Likelihood of establishment is: Very likely in protected lettuce; likely in field lettuce (if not already established)

Economic impact is expected to be: Potentially high

Endangered area: Areas where lettuce is grown in the UK both in fields and under protection.

Risk management: No statutory action is recommended. This is because:

- Seed and plants for planting of lettuce and lamb's lettuce have the potential to spread the pathogen in trade and trade has been never been restricted
- There have been no phytosanitary controls imposed on movement of lettuce or lamb's lettuce seeds or plants into the EU or within the EU since this pathogen was first identified in 1955
- The pathogen has been present in Europe since at least 2001 (Italy, 2001; Portugal 2004)
- Neither Italy or Portugal have (as far as we are aware) notified the findings of the pathogen to the EC and there has been no reported statutory action taken to limit spread in either country or beyond these countries
- The pathogen has been present in the USA since at least 1990
- Most of the <u>imported</u> seed used to produce plants for planting in the UK originates in the USA

- The main source of non-UK origin seedlings used in the UK is the Netherlands, but these are raised from seed of unknown origin/origins which may include countries where the pathogen occurs

- Detection of the pathogen in or on seed may not be easily achieved, similarly this may be difficult in infected seedlings

- The pathogen may also be transported in contaminated soil associated with other plants for planting, field vegetables, or machinery, so it could be introduced inadvertently if not already introduced

- If field crops of lettuce were detected as infected with *F. oxysporum* f.sp. *lactucae* it would be impossible to determine the full distribution of the pathogen in field soils due to it being soil-borne

- By the time symptoms were detected and proven to be caused by this pathogen it might have been present in field crops for some considerable time (years)

- Because of this, delimitation of a field outbreak with a view to containment to prevent further spread would not be feasible

- Eradication would not be achievable in field soils due to the long-lived nature of the chlamydospores and the inability to determine their full distribution

- Crops grown under protection may be easier to manage once the pathogen was detected causing disease

- Eradication/containment in protected crops would require removal of the whole crop and safe disposal of plant material; sterilisation of the soil or hydroponic system would have to be undertaken and any subsequent crops inspected and tested if symptomatic.

- No other country regulates *F. oxysporum* f.sp. *lactucae*

- Dating back to at least 1996, the UK (CSL, now part of Fera; and Fera) has not taken phytosanitary action against findings of *F. oxsyporum* on any other hosts including first findings, and has not identified these findings to *forma specialis*. This is presumably because as a species the different *forma specialis* are indistinguishable morphologically and can only easily be differentiated based upon their host range (for pathogenic species). There have been no diagnoses on lettuce or lamb's lettuce.

- One example of no action being taken on a new finding of a host-specific form on a commercial plant species was *Fusarium oxysporum* f.sp. *basilici* on imported seed of basil (*Ocicum basilicum*) which was diagnosed in 1997 by CSL (now part of Fera). This disease is now known to occur sporadically in the UK and causes severe crop losses. The HDC (2011) advise that the pathogen causes disease on basil in Russia, the USA, Italy, and France. However, despite its apparent limited distribution in the EU it has never been regulated.

- In the EU, of more than 70 *forma specialis* of *F. oxysporum* that are known to exist there is only one that is regulated: *F. oxysporum* f.sp. *albedinis* is listed in Annex IIAI of the EC Plant Health Directive (Anon., 2000). This pathogen is prohibited entry on plants on *Phoenix* spp. originating in Algeria and Morocco

- It is thought that *F. oxysporum* f.sp. *lactucae* is specific to lettuce and possibly lamb's lettuce (albeit this maybe a different *forma specialis*) so if it was diagnosed on these hosts at least it is likely that other species are not at risk.

It is recommended that no action be taken from the phytosanitary perspective and that any findings be managed by the grower.

Research may be needed to determine the susceptibility of UK cultivars of lettuce and possibly to refine methodologies for seed/seedling testing, sterilisation of field soils and protected crop soil/hydroponics, and, optimum timing of plantings to avoid disease development in UK field lettuce crops (i.e . in affected fields to grow lettuce only during cooler weather conditions.

17. Is there a need for a detailed PRA?
No.

Yes [ ] No [X]

If yes, select the PRA area (UK or EU) and the PRA scheme (UK or EPPO) to be used.

PRA area: UK or EU?	*Not applicable*	PRA scheme: UK or EPPO?	*Not applicable*

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