

CSL PEST RISK ANALYSIS FOR *NEOTOXOPTERA FORMOSANA*

STAGE 1: PRA INITIATION

1. What is the name of the pest?

Neotoxoptera formosana (Takahashi) Homoptera Aphididae onion aphid

Notes on taxonomy:

This organism was originally described as *Fullawayella formosana* Takahashi (Takahashi, 1921). Blackman and Eastop (2000) provide a key to *Neotoxoptera* spp. and other aphids found on *Allium* spp. Barbagallo and Ciampolini (2000) describe the morphological details that can be used to distinguish between *N. formosana, N. oliveri* and *N. violae*. Carver (1980) provides a key to Australian *Neotoxoptera*. The life cycle is poorly known, it is apparently anholocyclic[1]. It is possible that the sexual forms are known by a different name.

A photograph of the pest is provided at:
http://www.agri.pref.hokkaido.jp/boujosho/sinhassei/html/h14/image/1404.jpg
http://photos.eppo.org/index.php/album/93-neotoxoptera-formosana

2. What is the reason for the PRA?

This current PRA updates information about the geographic distribution of *Neotoxoptera formosana* contained in a PRA from December 2001.

A PRA for *N. formosana* was first conducted in August 1994 (Malumphy & Baker, 1994) after Finland intercepted *N. formosana* on onion sets (bulbs) imported from the Netherlands. The PRA was revised and updated when *N. formosana* was found on containerised Welsh onions (*Allium fistulosum*) growing at RHS Wisley in Sept. 1999 (Cannon *et al*., 2000; MacLeod, 2000). Halstead (2000) claimed that this was the first record of *N. formosana* on growing plants in Europe although Leclant (1999) suggests *N. formosana* is part of the French fauna, although rare (see 12.).

3. What is the PRA area?

This PRA considers only the UK as the PRA area since the organism is already present in Europe (see 11).

STAGE 2: PEST RISK ASSESSMENT

4. Does the pest occur in the PRA area or does it arrive regularly as a natural migrant?

Neotoxoptera formosana does not usually occur in the UK although it was trapped in 40ft aerial suction traps at Kirton, Lincolnshire in May 2002 and

[1] The species produces only asexual females i.e. females reproduce by parthenogenesis.

from Silwood Park in October 2005 (Rothamstead Research data). It is not known to be a migrant.

5. Is there any other reason to suspect that the pest is already established in the PRA area?

Neotoxoptera formosana has twice been found in UK aerial suction traps. Although such finds could be chance detections of individuals carried in air currents from continental Europe, they could also indicate that the organism is already established in the UK. However, if *N. formosana* had become established in the UK, more frequent finds would be expected.

Action was taken against an outbreak of *N. formosana* on *Allium* spp. at RHS Wisley in October 1999 (see 12.). Although action appeared successful at the time, the pest was again found on *Allium* at Wisley in May 2000 having probably overwintered on garlic cloves in a cold frame (Cannon *et al*., 2000). Infested plants were chemically treated and the pest is now considered eradicated at Wisley (R. Cannon, pers. comm.)

6. What is the pest's status in the Plant Health Directive (Council Directive 2000/29/EC[2]) ?

Neotoxoptera formosana is not included in the Plant Health Directive.

7. What is the pest's list status in the European and Mediterranean Plant Protection Organisation (EPPO)? (www.eppo.org)

EPPO List:	A1 regulated pest list	No	A2 regulated pest list	No	Action list	No	Alert list	Deleted

Neotoxoptera formosana was added to the EPPO Alert List in April 2000 at the suggestion of the UK[3] (EPPO, 2001a). The organism was discussed at the 37th meeting of the EPPO Panel on Phytosanitary Measures (Paris, 8th – 11th March 2005). Since the organism was already in France, Italy and the Netherlands and little damage was reported the Panel concluded that it should not be proposed for regulation and it was removed from the Alert List (EPPO, 2005).

8. What are the pests' host plants?

As the common name suggests, *Neotoxoptera formosana* feeds on onions and other *Allium* species (Blackman & Eastop, 1988). Table 1 lists hosts.

Table 1: *Neotoxoptera formosana* host plants

Scientific name	common name
Allium ascalonicum	spring onion, shallot
Allium cernum	-
Allium cepa	onion
Allium bakeri	-
Allium chinense	rakkyo
Allium. fistulosum	Welsh onion

[2] http://europa.eu.int/eur-lex/en/consleg/pdf/2000/en_2000L0029_do_001.pdf
[3] http://www.eppo.org/QUARANTINE/Alert_List/Insects/neotfo.html

Allium neopolitanum	-
Allium porrum	leek
Allium sativum	garlic
Allium schoenoprasum	chives
Allium tuberosum	garlic chives

Neotoxoptera formosana is also listed as an insect found on beans in Hawaii[4] although it is unlikely that beans are actually true hosts.

9. What hosts are of economic and/or environmental importance in the PRA area?

Allium crops and especially onions (*A. cepa*) are important hosts in the UK. Annex 1 summarises recent production statistics for onions and leeks. Since 1995/96 the UK area of onions and leeks has averaged approximately 13,000 ha with a value of just under £100 million (derived from Defra, Basic Horticultural Statistics, 2006. See Annex 1.).

10. If the pest needs a vector, is it present in the PRA area?

No vector is required. This is a free-living organism.

11. What is the pest's present geographical distribution?

Neotoxoptera formosana is probably of Asian origin but it is now distributed in North and South America, Europe, Australia and New Zealand.

Table 2: Distribution of *Neotoxoptera formosana*

North America:	USA (California, Colorado, Hawaii, New York, North Carolina, Pennsylvania, Utah) Mexico. Records of its occurrence in Canada are mistaken and refer only to interceptions on imports (CFIA, 2001; EPPO, 2001b).
Central America:	Absent – no records
South America:	Brazil (Brazilia Goias, Sao Paulo). First recorded in Chile in 1994
Europe:	France, Italy, Netherlands (intercepted in Finland; an incursion in Germany is being eradicated (EPPO Reporting Service, 2007), UK outbreak has been eradicated).
Africa:	St Helena
Asia:	Japan (Honshu Osaka, Tokyo), China (Suzechuen), Taiwan, Korea (Suwan, Taegwanzyong)
Oceania:	Australia[5] (New South Wales, Australian Capital Territory, Canberra, Tasmania, Adelaide, South Australia, Victoria Western Australia), Papua New Guinea, New Zealand.

N. formosana has been present in France since 1984 and is always rare (Leclant, 1999; Bartlett 2005, CSL data, unpublished). An interception of *N. formosana* by Finland on onion bulbs from the Netherlands suggests that it may have been present in the Netherlands in 1994. Van Dijk (1993) reported that various *Allium* species grown in pots in the open and in a glasshouse at DLO-Plant Protection Institute, Wageningen (NL), were at times found heavily

[4] http://www.extento.hawaii.edu/kbase/crop/crops/beans.htm
[5] http://www.ento.csiro.au/aicn/name_s/b_1625.html

infested with *N. formosana*, *Myzus ascolinicus* or *M. Cymbalariae.* In July 2000, *N. formosana* was reported for the first time in Italy. It was found on *A. schoenoprasum* (chives) grown under glass as a continuous crop (Barbgallo & Ciampolini, 2000; EPPO Reporting Service 2001). *N. formosana* was reported in two fields of chives in Germany (Baden-Württemberg) in August 2007 for the first time.

12. How likely is the pest to enter the PRA area[6]?

very Unlikely		Unlikely		Moderate likelihood	✓	Likely		very Likely	

The UK imports *Allium* spp. from many countries around the world including Australia, Chile, China, New Zealand and the USA where *N. formosana* is recorded. *N. formosana* has entered the UK previously (see 2. and 4.). Evidence of it being carried in international trade is provided by Finland who previously intercepted it on onion bulbs imported from The Netherlands (Anon., 1994; Blackman & Eastop, 2000).

N. formosana has been found at RHS Wisley, Surrey UK (Sept. 1999) with no clear import connection, although Halstead (2000), speculated that *N. formosana* may have been introduced on bulbs of other *Allium* species.

N. formosana was again found at RHS Wisley in May 2000 on *Allium* sp. Plants were sprayed with insecticides and *N. formosana* is considered eradicated at Wisley (Cannon, pers. comm.).

In May 2002 an alate aphid was caught in a 40ft aerial suction trap at Kirton, Lincs. Another specimen was captured in a similar suction trap at Silwood Park in October 2005 (Rothamstead Research data).

In December 2003 the UK intercepted a consignment of French onions infested with *N. formosana.*

13. How likely is the pest to establish outdoors in the PRA area?

very Unlikely		Unlikely		Moderate likelihood		Likely	✓	very Likely	

The outbreak at Wisley shows that *N. formosana* can establish in Britain on *Allium* crops (particularly on neglected, weedy crops) and on common, wild *Allium* spp. Its presence in Tasmania suggests that it could survive in a cool maritime climate such as the UK.

14. How likely is the pest to establish in protected environments in the PRA area?

very Unlikely		Unlikely		Moderate likelihood		Likely	✓	very Likely	

[6] Pest entry includes an assessment of the likelihood of transfer to a suitable host (ISPM No. 11, FAO, Rome)

Neotoxoptera formosana can be a glasshouse pest. In Italy it was first reported as a pest found in high numbers on glasshouse grown chives (*A. schoenoprasum*). It has also been reported as a pest on garlic in glasshouses in Brazil (de Albuquerque Melo Filo et al., 2005). In addition, *N. formosana* can be found on bulbs in store (Blackman & Eastop, 1984) so could probably survive in *Allium* stores throughout the PRA area.

15. How quickly could the pest spread within the PRA area?

very Slowly		Slowly		Moderate pace		Quickly	✓	very Quickly	

The winged adults have a high dispersal potential and *N. formosana* is parthenogenetic so each adult female has the potential to produce an outbreak. *N. formosana* has apparently spread fairly quickly in Australia. Before 1974, it was not recorded there although it is now widespread (EPPO, 2001a). Since *N. formosana* is probably native to the Asian region, its spread to North America, South America and parts of Oceania during the twentieth century, could have occurred via trade in *Allium* bulbs.

As a pest that can be found in bulb stores, there is a risk that *N. formosana* could spread rapidly within the PRA area during movement of bulbs in trade.

16. What is the pest's potential to cause economic and/or environmental damage in the PRA area?

very Small		Small	✓	Medium		Large		very Large	

N. formosana has been in France since 1984 (Leclant, 1999) and has not been reported causing damage. However, reports of damage, such as wilting, yellowing and desiccation of glasshouse grown chives have come from Italy (Barbagallo & Ciampolini, 2000). *N. formosana* sometimes forms large colonies on leaves (Hori & Komatsu, 1997). In general, aphid populations can build up rapidly to damaging levels and introduced species can be particularly detrimental in the absence of their natural enemies. This may have been the case when *N. formosana* was found in Germany for the first time, patches of chives within two fields were destroyed[7]. Of note is the fact that although present in North America, there is no American literature referring to it as a pest.

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

Although *N. formosana* can be damaging in its own right, its role as a virus vector provides the key threat. Low populations of *N. formosana* can be damaging due to their virus vector ability. In Japan, *Neotoxoptera formosana*

[7] http://photos.eppo.org/albums/pests/Insects/Neotoxoptera_formosana/Neotoxoptera_formosana02.jpg

has been shown to transmit *Garlic latent virus* (GarLV) from *A. fistulosum* or *A. chinense* to *A. chinense* at the rate of 10-30% (Sako *et al.*, 1990). It can also transmit *Alstroemeria mosaic virus* (AlMV) (Yasuda *et al*., 1998). It can also transmit an unidentified virus that produces mosaic symptoms, leaf curling, yellowing and dwarfing in garlic (Abiko *et al*., 1980). Jensen (1949) reported low level transmission of *Papaya ringspot potyvirus.*

Dr Eastop (formerly of the Natural History Museum) has had field experience of the onion aphid in Australia. He found it to be frequent in packing stations where enormous populations occurred on onions in storage, particularly when they were just beginning to sprout. The aphids were not observed in well maintained crops and were mostly a problem of poorly cultivated, neglected and weedy crops. They have a cryptic habit and can be difficult to find when present at low densities.

STAGE 3: PEST RISK MANAGEMENT

18. How likely is the pest to be excluded from the PRA area?

	very Likely		Likely		Moderate likelihood		Unlikely		very Unlikely	
Outdoors:						✓				
In protection						✓				

Neotoxoptera formosana has twice been found in UK aerial suction traps (see 5.) Such finds could be chance detections of individuals carried in air currents from continental Europe, or could indicate that the organism is already established in the UK.

When considering the prospects of exclusion of the onion aphid, two other aphid species must be taken in to account. *Neotoxoptera violae* (Pergande), the violet aphid (present in Asia), and *Neotoxoptera oliveri* (Essig), the marigold aphid (present in Asia, USA and Portugal), are closely related biologically and morphologically to *N. formosana.* The literature on these species has been confused in the past due to difficulties of identification of the wingless forms. All three are potential virus vectors.

19. How likely are outbreaks to be eradicated?

very Likely		Likely		Moderate likelihood	✓	Unlikely		very Unlikely	

If detected at an early stage, outbreaks could be eradicated. However, if introduced and distributed widely it would be very difficult to eradicate primarily because wild *Allium* spp. could provide reservoirs of aphids which could continually re-infest crops after control measures have been taken. Of note is the apparent failure to eradicate *N. formosana* from RHS Wisley when first detected in Sept. 1999.

20. What management options are available for containment and control?

There are no reports of *N. formosana* being resistant to insecticides therefore standard aphicidal treatments should be sufficient. Potenza *et al*., (2005) reported that lambdacyhalothrin and chlorpyriphos were 99% effective against *N. formosana* on Welsh onions (*Allium fistulosum*).

Further work that would reduce uncertainties		
Section of PRA	**Uncertainties**	**Further work that would reduce uncertainty**
Taxonomy	None. However care is needed to distinguish between other species in the genus.	None.
Pathway	Some papers note that this can be a pest in bulb stores although there have been few findings during international trade.	Contact Canada and enquire how frequently *N. formosana* is intercepted from the USA.
Distribution	Current distribution within NL, France and Italy is uncertain.	Contact other EU / EPPO states to ask for information about presence of the pest.
Hosts	A single report from Hawaii suggests “beans” can be hosts. There are no other records to support this.	Experimental work to determine whether any bean species are true hosts is required.
Establishment	Suitability of climate throughout the UK/ EU for establishment.	Experimental data to determine the thermal biology of the pest.
Spread	Rate of spread if moved in trade.	Determine trade routes and possible spread patterns.
Impact	There are no specific data available describing host damage.	Experiment with laboratory cultures on hosts to assess damage.
Management	None.	Examine possible pesticide resistance.

21. Summary / Conclusions

Neotoxoptera formosana is an aphid pest of a number of commercial horticultural crops. It has a narrow host range and it represents a potential risk to the UK *Allium* industry. It can transmit viruses that cause plant damage and stunting although it is not a very efficient vector. There are no reports of serious damage in the literature although enormous populations can build up on *Allium* in storage.

There is evidence that it is capable of being carried in trade internationally, although this is not common. It is able to survive in the UK climate. It can also survive in protected cultivation. As a parthenogenic species, an individual female can initiate population growth. Despite its presence in the USA and

Australia, there is little information in the literature, suggesting it is a minor pest, or a pest that is already well managed in these places. Within Europe the organism can become a local pest as noted in Italy, and in Germany for the first time in 2007, although it is not reported as a pest in France despite it having been present since 1984.

Since this organism is present in France, Italy, Germany and the Netherlands and is not causing a major problem there is little likelihood that it will become an EU listed quarantine pest, nevertheless eradication of isolated outbreaks detected in the UK could be worthwhile.

References

Abiko K, Watanabe Y, Nishi Y. 1980. [Studies on garlic mosaic. I. Causal virus. *Bulletin of the Vegetable and Ornamental Crops Research Station, A.* **7**, 139-147.

de Albuquerque Melo Filho P, Nepomuceno Dusi A, Lucio Costa C, de Oliveira Resende R. 2005. Colonization of garlic plants by *Neotoxoptera formosana* in Distrito Federal, Brazil. Horticultura Brasileira. Sociedade de Olericultura do Brasil, UNESP - FCA, **23**: 4, 929-930.

Anon. 1994. Report from Agricultural Research Centre, 6 May 1994, 94/0438

Barbagallo S, Ciampolini M. 2000. The onion aphid, *Neotoxoptera formosana* (Takahashi), detected in Italy, *Bolletino di Zoologia Agraria at di Bachicoltura*, Serie II, **32** (3), 245-258.

Blackman RL, Eastop VF. 1984. *Aphids on the worlds crops*: an identification and information guide, 1st Edition, Wiley, Chichester, 466pp

Blackman RL, Eastop VF. 2000. *Aphids on the worlds crops*: an identification and information guide, 2nd Edition, Wiley, Chichester, 466pp

CAB International 2001. Crop Protection Compendium, Wallingford.

Cannon RJC, Hammon R, Bartlett P. 2000. The onion aphid *Neotoxoptera fomosana*, CSL Plant Pest Notice No. 29.

Carver M. 1980. *Neotoxoptera* Theobald and *Pterocallis* Passerini (Homoptera: Aphididae) in Australia. *Journal of the Australian Entomological Society*, **19**, (2), 139-142.

CFIA 2001. Onion aphid, *Neotoxoptera formosana*, does not occur in Canada, Canadian Food Inspection Agency http://www.pestalert.org/viewArchNewsStory_print.cfm?nid=82

van Dijk P. 1993. Survey characterisation of potyviruses and their strains on *Allium* species. *Netherlands Journal of Plant Pathology*, **99** (Supplement 2), 1-48.

EPPO 2001a *Neotoxoptera formosana* (Homoptera, Aphididae) – onion aphid. EPPO Alert list datasheet. http://www.eppo.org/QUARANTINE/Alert_List/Insects/neotfo.html

EPPO 2001b *Neotoxoptera formosana* does not occur in Canada. *EPPO Reporting Service*, 2001/097.

EPPO Reporting Service 2001c. First Report of *Neotoxoptera formosana* in Italy. *EPPO Reporting Service*, 2001/051.

EPPO 2005. 37th meeting of the Panel on Phytosanitary Measures Paris, 2005-03-08/11 http://archives.eppo.org/MEETINGS/2005_meetings/phyto_measures.htm

EPPO Reporting Service 2007. Incursion of *Neotoxoptera formosana* in Germany *EPPO Reporting Service* 2007/147

Guo RH, Qing GH. 2001. Occurrence of the onion aphid *Neotoxoptera formosana* in Xichang and the effect of temperature on it. *Entomological Knowledge*. **38**: 4, 300-30.

Halstead AJ. 2000. An onion aphid, *Neotoxoptera formosana* (Takahashi) (Hemiptera: Aphididae), new to Britain. *British Journal of Entomology & Natural History*, **13**, (2), 94

Hori M, Komatsu H. 1997. Repellency of rosemary oil and its components against the onion aphid, *Neotoxoptera formosana* (Takahashi) (Homoptera: Aphididae). *Applied Entomology & Zoology*. **32**, (2), 303-310

Jensen DD. 1949. Papaya ringspot virus and its insect vector relationships. *Phytopathology*, **39**, 212-220.

Leclant F. 1999. Les pucerons des plantes cultivées. Clefs d'identification. II Cultures maraîchères. Acta/INRA 98pp.

MacLeod A. 2000 Pest Risk Analysis (PRA) on *Neotoxoptera formosana.* Unpublished internal report.

Potenza MR, Jocys T, Nakaoka Sakita M, Ramos ACO, Oliveira RCG. 2005. Avaliacao de produtos naturais para o controle do pulgao *Neotoxoptera formosana* (Hemiptera: Aphididae) em cebolinha (*Allium fistulosum*) *Arq. Inst. Biol. Sao Paulo* **72** (2) 1-64, #72

Sako I, Taniguchi T, Osaki T, Inouye T. 1990. Transmission and translocation of garlic latent virus in rakkyo (*Allium chinense* G. Don)]. *Proceedings of the Kansai Plant Protection Society*. **32**, 21-27.

Sorin M. 1971. Two new species of Aphididae from Japan (Homoptera). *Mushi*. **45**, (3), 59-63.

Stary P, Rodriguez F, Remaudiere G. 1994. Plant-aphid-parasitoid association (Hom., Aphidoidea; Hym., Aphidiidae) in central area of Chile. *Agricultura Tecnica (Santiago)*. **54**, (1), 46-53.

Takahashi R. 1921. Aphididae of formosa. Part 1. *Agr. Exp. Sta. Govt. Formosa Rrep.* **20**: 1-97 [29].

Vasicek A, Rossa F, la Paglioni A. 2001. Biological and populational parameters of two *Neotoxoptera* Theobald species (Homoptera: Aphidoidea) on chives (*Allium schoenoprasum* L.) under laboratory conditions. *Revista de la Facultad de Agronomia* (Universidad de Buenos Aires). Facultad de Agronomia, Universidad de Buenos Aires, Buenos Aires, Argentina. 21: 2, 99-104.

Yasuda S, Saka K, Natsuaki KT. 1998. Characterisation and serodiagnosis of alstroemeria mosaic potyvirus. *Japanese Journal of tropical Agriculture*, **42**, (2), 85-93.

Name of Pest Risk Analyst: Alan MacLeod
Address: Central Science Laboratory, Sand Hutton, York, YO41 1LZ UK.
Date: 05 /10/2007

ANNEX 1: *Allium* data from DEFRA Basic Horticultural Statistics 2006

http://statistics.defra.gov.uk/esg/publications/bhs/2006/default.asp

1) Area planted (ha)

CROP YEAR	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06		
Onions, Dry Bulb	8,202	9,325	8,845	9,529	9,228	9,058	8,603	8,387	8,480	8,592	8,561		
Onions, Green	2,146	2,455	2,313	2,298	2,549	1,739	1,363	1,318	1,987	1,808	2,069		
Leeks	3,042	2,617	2,477	2,776	2,645	1,978	2,068	1,717	2,010	2,005	1,696	Mean	
	13,390	14,396	13,634	14,603	14,422	12,775	12,034	11,422	12,477	12,404	12,326	13,080	ha

2) Tonnes harvested (000 tonnes)

CALENDAR YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005		
Onions, Dry Bulb	224.7	284.5	335.9	342.0	391.4	392.7	374.9	283.4	373.6	340.9	383.4		
Onions, Green	24.1	28.4	26.2	25.3	26.1	19.0	13.3	11.3	16.4	10.5	21.1		
Leeks	61.5	53.9	45.9	52.3	50.9	44.3	44.3	38.0	35.9	40.2	49.8	Mean	
	310.3	366.8	408.0	419.5	468.4	456.0	432.5	332.7	425.8	391.7	454.3	406	000 tonnes
yield (tonnes /ha)	27	31	38	36	42	43	44	34	44	40	45		
	11	12	11	11	10	11	10	9	8	6	10		
	20	21	19	19	19	22	21	22	18	20	29		

3) Value of Home prodn marketed (£'000)

CALENDAR YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005		
Onions, Dry Bulb	57,605	38,799	48,595	66,173	42,671	34,405	44,691	32,012	43,002	44,090	33,591		
Onions, Green	31,755	32,803	33,094	30,471	29,502	21,387	18,094	14,560	20,784	13,148	26,152		
Leeks	31,844	35,141	22,945	24,306	26,476	25,182	30,507	28,252	30,170	30,686	39,670		
	121,202.6	106,743.7	104,634.9	120,950.6	98,649.0	80,974.1	93,292.1	74,823.6	93,956.1	87,924.2	99,411.8	98,415	£'000
Value per tonne													
Onions, Dry Bulb	256	136	145	194	109	88	119	113	115	129	88	136	£/tonne
Onions, Green	1,318	1,153	1,261	1,204	1,130	1,126	1,360	1,293	1,270	1,252	1,242	1,237	£/tonne
Leeks	517	653	500	465	520	569	689	744	841	763	797	642	£/tonne