Importation of Pepper (*Capsicum* spp.) Fruit from New Zealand into the United States

Qualitative, Pathway-Initiated Pest Risk Assessment

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United States Department of Agriculture
Animal and Plant Health Inspection Service
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A. Introduction

This pest risk assessment was prepared for the Animal and Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture by the Ministry of Agriculture and Forestry in New Zealand to examine plant pest risks associated with the importation into the United States of fresh pepper fruit (*Capsicum* spp.) from New Zealand. This is a qualitative pest risk assessment, that is, estimates of risk are expressed in qualitative terms such as high or low as opposed to numerical terms such as probabilities or frequencies.

International plant protection organisations e.g., North American Plant Protection Organisation (NAPPO) and the International Plant Protection Convention (IPPC) of the United Nations Food and Agriculture Organisation (FAO), provide guidance for conducting pest risk analyses. The methods we used to initiate, conduct and report this plant pest risk assessment are consistent with guidelines provided by NAPPO, IPPC and FAO. Our use of biological and phytosanitary terms (e.g., introduction, quarantine pest) conforms with the NAPPO *Compendium of Phytosanitary Terms* (Hopper, 1996) and the *Definitions and Abbreviations* (Introduction Section) in *International Standards for Phytosanitary Measures, Section 1 - Import Regulations: Guidelines for Pest Risk Analysis* (FAO, 1996).

Pest risk assessment is one component of an overall pest risk analysis. The *Guidelines for Pest Risk Analysis* provided by FAO (1996) describe three stages in pest risk analysis. This document satisfies the requirements of FAO Stages 1 (initiation) and 2 (risk assessment).

B. Risk Assessment

1. Initiating Event: Proposed Action

This pest risk assessment is commodity-based, and therefore "pathway-initiated"; we initiated the assessment in response to the request for USDA authorisation to allow imports of a particular commodity presenting a potential plant pest risk. In this case, the importation of fresh pepper fruit (*Capsicum* spp.) from New Zealand into the U.S. is a potential pathway for introduction of plant pests. Quarantine 56 (7 CFR 319.56) provides a general regulatory authority for importation of fruits and vegetables.

2. Assessment of Weediness Potential of *Capsicum spp.*

Table 1 shows the results of our weediness screening for *Capsicum* spp. These findings did not require us to initiate a pest-initiated pest risk assessment for *Capsicum* spp..

Table 1: Process for Determining Weediness Potential of Commodity

Commodity: *Capsicum* spp. (Capsicum, pepper, bell pepper, red pepper, green pepper)

Phase 1: *Capsicum* spp. is widely grown in the United States as a commercial crop.

Phase 2: Is the species listed in:

YES *Geographical Atlas of World Weeds* (Holm, 1979)
NO *World's Worst Weeds* (Holm, 1977)
NO *Report of the Technical Committee to Evaluate Noxious Weeds; Exotic Weeds for Federal Noxious Weed Act* (Gunn & Ritchie, 1982)
NO *Economically Important Foreign Weeds* (Reed, 1977)
NO *Weed Science Society of America list* (WSSA, 1989)
NO Is there any literature reference indicating weediness *(e.g.., AGRICOLA, CAB, Biological Abstracts, AGRIS*; search on "species name" combined with "weed").

Phase 3: Conclusion:

The genus is widely prevalent in the Unites States and the answer to one of the above questions is yes. Holm (1979) is the only author to record *Capsicum spp.* as a weed in Australia and India (present and behaves as a weed but its rank of importance is unknown) and in Indonesia (present in the flora of the country but confirming evidence is needed that the plant behaves as a weed). Commercial pepper is currently imported from many countries and imports from New Zealand are unlikely to present any increased weed potential than the pepper currently produced in the United States.

3. Previous Risk Assessment, Current Status and Pest Interceptions

Capsicum spp. botanical fruit with stems and leaves for ornamental use (PDC 01/97-01, page 3.20 of the USDA Plant Import Manual: Non-propagative) are currently enterable from New Zealand and Canada. *Capsicum* spp. fruit is currently enterable from Australia (from Tasmania only), Belgium, Belize, Canada, Japan (to Hawaii, Guam), Korea (to Guam), Mexico, Micronesia (to Guam), Netherlands, New Zealand (to Hawaii), Poland, Trinidad and Tobago (to NA), West Indies (Antigua and Barbuda, Bahamas, Barbados, Cayman Islands, Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines).

Three previous decisions regarding requests for importation of *Capsicum* fruit for consumption from New Zealand into the United States are on record:

1961	*Capsicum* fruit to Hawaii	**Recommendation:** Entry denied because of lack of treatment for *Halotydeus destructor* Tucker.
1973	*Capsicum* fruit to Los Angeles	**Recommendation:** Entry denied because of lack of treatment for Lepidopteran pests including *Heliothis armigera, Chrysodeixis chalcites.* Also mentioned: *Halotydeus destructor*, *Heteronychus arator, Cupsicona simplex.*
1986	*Capsicum* fruit to all ports	**Recommendation:** Entry denied because of the occurrence of *Epiphyas postvittana*, *Helicoverpa armigera, Chrysodeixis chalcites, Achaea janata, Spodoptera litura.* Also mentioned: *Halotydeus destructor*.

Since the last evaluation of imports of fresh *Capsicum* fruit from New Zealand in 1986, the format for our risk assessment process has changed substantially. These changes were necessary to attain consistency with the international standards cited in Section **A. Introduction**. Because of the fundamental changes in the risk assessment process, we determined that the previously conducted assessments were no longer adequate and we undertook to produce this document.

Table 2. Selected pest interception records for *Capsicum* fruit, 1985-2000[1]

Date	Pest	Host	Origin[2]	Location
1989	*Frankliniella* sp.	*C. annuum*	NL	Cargo
1990	*Frankliniella* sp.	*C. annuum*	NL	Cargo
1992	*Frankliniella* sp.	*C. annuum*	NL	Cargo
1993	*Frankliniella* sp.	*C. annuum*	NL	Cargo
1997	*Frankliniella* sp.	*C. annuum*	NL	Cargo
1999	Gelichiidae, species of	*C. annuum*	SV	Baggage
1998	Gelichiidae, species of	*C. annuum*	NL	Cargo
1996	Gelichiidae, species of	*C. annuum*	PE	Baggage
1989	Gelichiidae, species of	*C. annuum*	GT	Baggage
1991	*Helicoverpa* sp.	*C. annuum*	KR	Baggage
1992	*Helicoverpa* sp.	*C. annuum*	KR	Baggage

Table 2. Selected pest interception records for *Capsicum* fruit, 1985-2000[1]				
Date	**Pest**	**Host**	**Origin**[2]	**Location**
1997	*Helicoverpa* sp.	*C. annuum*	KR	Baggage
1996	*Helicoverpa* sp.	*C. annuum*	NL	Cargo
1997	*Helicoverpa* sp.	*C. annuum*	PE	Baggage
1997	*Helicoverpa* sp.	*C. annuum*	TW	Baggage
1999	*Helicoverpa* sp.	*C. annuum*	TR	Baggage
1994	*Helicoverpa* sp.	*C. annuum*	YU	Baggage
1990	*Helicoverpa* sp.	*C. annuum*	KR	Baggage
1992	*Helicoverpa* sp.	*C. annuum*	PH	Baggage
1996	Pentatomidae, species of	*C. annuum*	JM	Cargo
1989	Pentatomidae, species of	*C. frutescens*	DO	Cargo
1995	*Planococcus minor*	*C. frutescens*	LC	Cargo
1989	Pyralidae, species of	*C. annuum*	MX	Cargo
1992	Pyralidae, species of	*C. annuum*	NL	Cargo
1999	Pyralidae, species of	*C. annuum*	NL	Cargo
1988	*Spodoptera* sp.	*C. annuum*	JM	Cargo
1994	*Spodoptera* sp.	*C. annuum*	JO	Baggage
1991	*Spodoptera* sp.	*C. annuum*	MX	Cargo
1999	*Spodoptera* sp.	*C. annuum*	NL	Cargo
1998	Thripidae, species of	*C. annuum*	IL	Cargo
1995	Thripidae, species of	*C. annuum*	NL	Cargo
1986	Tortricidae, species of	*C. annuum*	MX	Cargo
1989	Tortricidae, species of	*C. annuum*	NL	Cargo
1996	Tortricidae, species of	*C. annuum*	BE	Cargo

[1] Information retrieved from the USDA Port Information Network (PIN 309) database
[2] Country codes: BE- Belgium; DO- Dominican Republic; GT- Guatemala; KR- Republic of Korea; IL- Israel; JM- Jamaica; JO- Jordan; LC- Saint Lucia; MX- Mexico; NL- Netherlands; PE- Peru; PH-

Philippines; SV- El Salvador; TR- Turkey; TW- Taiwan; YU- Yugoslavia

4. Pest Lists: Pests Associated with *Capsicum* spp. in New Zealand

Table 3 shows our pest list for *Capsicum* spp. in New Zealand.

Table 3: Pest List: *Capsicum* spp. from New Zealand

Pest[1]	Distribution[2]	Plant Part Affected[3]	Quarantine Pest	Likely to Follow Pathway	Comments	Reference(s)
Insects						
Agrius convolvuli L. Lepidoptera: Sphingidae	NZ	L	Yes	No	Not reported on *Capsicum* in New Zealand	Hill, 1987
Agrotis ipsilon (Hufnagel) Lepidoptera: Noctuidae	NZ, US	L, S, F	No	Yes		Stoetzel, 1989
Aphis gossypii (Glover) Hemiptera: Aphididae	NZ, US	L, S, Fl	No			Stoetzel, 1989
Aulacorthum solani (Kaltenbach) Hemiptera: Aphididae	NZ, US	L, S	No	No	Biotypes of *A. solani* have been reported, but in a comparative study by Damsteegt *and Voegtlin*, 1990, populations collected in New Zealand most closely resembled California populations biologically and morph-ologically.	Damsteegt *and Voegtlin*, 1990; Stoetzel, 1989

Table 3: Pest List: *Capsicum* spp. from New Zealand

Pest[1]	Distribution[2]	Plant Part Affected[3]	Quarantine Pest	Likely to Follow Pathway	Comments	Reference(s)
Ceroplastes sinensis Del Guercio Hemiptera: Coccidae	NZ, US (CA, NC, VA)	L, S	No	No		CABI, 1999; Penman, 1976
Chrysodeixis eriosoma (Doubleday) Lepidoptera: Noctuidae	NZ, US (HI)	L, F	Yes	No	Listed in USDA Catalog of Intercepted Pests as actionable	CABI, 1999; Chapman, 1976; Stoetzel, 1989
Epiphyas postvittana (Walker) Lepidoptera: Tortricidae	NZ, US (HI)	L, F	Yes	No	Internal feeder, but *Capsicum* is not listed as a primary host; listed in USDA Catalog of Intercepted Pests as actionable	USDA Pest Interception records
Frankliniella occidentalis (Pergande) Thysanoptera: Thripidae	NZ, US	L, Fl	No	Yes		CABI, 1999; Stoetzel, 1989
Helicoverpa armigera Hubner Lepidoptera: Noctuidae	NZ	L, Fl, F	Yes	Yes	Internal feeder, *Capsicum* is listed as a primary host; listed in USDA Catalog of Intercepted Pests as actionable	CABI, 1999; Chapman, 1976; Zhang, 1994
Macrosiphum euphorbiae (Thomas) Hemiptera: Aphididae	NZ, US	L	No	No		Chapman, 1976; Stoetzel, 1989
Myzus persicae (Sulzer) Hemiptera: Aphididae	NZ, US	L	No	No		Chapman, 1976; Stoetzel, 1989

Table 3: Pest List: *Capsicum* spp. from New Zealand						
Pest[1]	**Distribution[2]**	**Plant Part Affected[3]**	**Quarantine Pest**	**Likely to Follow Pathway**	**Comments**	**Reference(s)**
Nezara viridula (Linnaeus) Hemiptera: Pentatomidae	NZ, US	L, S, F	No	Yes		Chapman, 1976; Stoetzel, 1989
Phthorimaea operculella Zeller Lepidoptera: Gelichiidae	NZ, US	L, S, F, R	No	Yes		CABI, 1999; Davis, 1964; Stoetzel, 1989; Zhang, 1994
Pseudococcus longispinus (Targioni-Tozzetti) Hemiptera: Pseudococcidae	NZ, US	L, S, Fl, F	No	Yes		CABI, 1999; Stoetzel, 1989
Saissetia coffeae (Walker) Hemiptera: Coccidae	NZ, US	L, S, F	No	Yes		CABI, 1999; Penman, 1976; Stoetzel, 1989
Sceliodes cordalis Doubleday Lepidoptera: Pyralidae	NZ	S, F	Yes	Yes		Davis, 1964; Hely, *et al.*, 1982
Spodoptera litura Fabricius Lepidoptera: Noctuidae	NZ, US (Hawaiian Is. chain)	L, S, F	Yes	Yes	U.S. distribution limited to Pearl and Hermes Reef in Hawaiian Is. Chain. Occurs in NZ, but not reported on *Capsicum*. Primarily a leaf eater and stem cutter, occasionally feeds on fruit. Multiple interception records on *Capsicum* fruit exist.	CABI, 1999; Ferro, 1976; USDA, 1982; Zhang, 1994

Table 3: Pest List: *Capsicum* spp. from New Zealand

Pest[1]	Distribution[2]	Plant Part Affected[3]	Quarantine Pest	Likely to Follow Pathway	Comments	Reference(s)
Thrips obscuratus (Crawford) Thysanoptera: Thripidae	NZ	L, S, Fl, F	Yes	Yes	Multiple interception records exist for *T. obscuratus* on shipments of *Fragaria*, *Prunus persica, Rubus* and *Vaccinium* fruit from New Zealand.	Mclaren and Walker, 1998; Mound and Walker, 1982
Thrips tabaci Lindeman Thysanoptera: Thripidae	NZ, US	L, S, Fl, F	No	Yes		CABI, 1999; Stoetzel, 1989
Trialeurodes vaporariorum (Westwood)	NZ, US	L	No	No		CABI, 1999; Stoetzel, 1989
Mites						
Aculops lycopersici (Massee) Acari: Eriophyidae	NZ, US	L, S, F	No	Yes		CABI, 1999; Chapman, 1976; Stoetzel, 1989
Calacarus carinatus (Green) Acari: Eriophyidae	NZ, US (CA, FL, GA)	L	No	No		Baker, *et al.*, 1996; CIE, 1974
Polyphagotarsonemus latus (Banks) Acari: Tarsonemidae	NZ, US	L, S, Fl, F	No	Yes		CABI, 1999; Stoetzel, 1989
Tetranychus ludeni Zacher Acari: Tetranychidae	NZ, US (CA, MO, LA)	L,S	No	No	Not reported on pepper in the U.S.	Baker and Tuttle, 1994; CABI, 1999
Tetranychus urticae Koch Acari: Tetranychidae	NZ, US	L, S	No	No		Baker and Tuttle, 1994; CABI, 1999; Stoetzel, 1989
Gastropods						

Table 3: Pest List: *Capsicum* spp. from New Zealand						
Pest[1]	**Distribution[2]**	**Plant Part Affected[3]**	**Quarantine Pest**	**Likely to Follow Pathway**	**Comments**	**Reference(s)**
Cryptomphalus aspersus (Müller) (Syn.: *Helix aspersa* Műller) Mollusca	NZ, US	L, S, F	Yes	No	*C. aspersus* is a quarantine pest for the States of FL and AL and is an actionable pest for shipments to those two States	CABI, 1999; Ebeling, 1959; USDA, 1999
Fungi						
Alternaria alternata (Fr.:Fr.) Keissl. Fungi Imperfecti: Hyphomycetes	NZ, US	Fl, F	No	Yes		CABI, 1999; Farr, *et al.*, 1989; Jones, *et al.*,1991
Alternaria longipes (Ellis & Everh.) E. Mason Fungi Imperfecti: Hyphomycetes	NZ, US	L, S, Sd	No	Yes		CABI, 1999; Farr, *et al.*, 1989
Alternaria solani Sorauer Fungi Imperfecti: Hyphomycetes	NZ, US	L, S, F	No	Yes		CABI, 1999; CMI, 1983; Farr, *et al.*, 1989
Aspergillus flavus Link:Fr. Fungi Imperfecti: Hyphpmycetes	NZ, US	L, S, R, F, Sd	No	Yes	Aspergillus spp. are saprophytes but will affect stored fruits and tubers, as opportunistic pathogens, and damage and subsequently grow on living tissue.	CABI, 1999; Farr, *et al.*, 1989
Aspergillus fumagatus Fresen. Fungi Imperfecti: Hyphomycetes	NZ, US	R, F, Sd	No	Yes		CABI, 1999; CMI, 1966; Farr, *et al.*, 1989

Table 3: Pest List: *Capsicum* spp. from New Zealand

Pest[1]	Distribution[2]	Plant Part Affected[3]	Quarantine Pest	Likely to Follow Pathway	Comments	Reference(s)
Aspergillus niger Tiegh. Fungi Imperfecti: Hyphomycetes	NZ, US	L, S, R, Fl, F, Sd	No	Yes	Aspergillus spp. are saprophytes but will affect stored fruits and tubers, as opportunistic pathogens, and damage and subsequently grow on living tissue.	CABI, 1999; Farr, *et al.*, 1989
Botryotinia fuckeliana (de Barry) Whetzel Anamorph: *Botrytis cinerea* Ascomycetes: Sclerotiniaceae	NZ, US	L, S, Fl, F, Sd	No	Yes		CABI, 1999; Farr, *et al.*, 1989
Cochliobolus lunatus R.R.Nelson & Haasis Anamorph: *Curvularia lunata* (Wakker) Boedjin Ascomycetes: Pleosporaceae	NZ, US	L, S, Fl, Sd	No	Yes		CABI, 1999; Farr, *et al.*, 1989
Colletotrichum acutatum Simmonds ex Simmonds Fungi Imperfecti: Coelomycetes	NZ, US	L, S, F	No	Yes		Black, *et al.*, 1991; CABI, 1999; Farr, *et al.*, 1989
Colletotrichum circinans (Berk.) Voglino Fungi Imperfecti: Coelomycetes	NZ, US	L, S	No	No		CABI, 1999; Farr, *et al.*, 1989
Colletotrichum coccodes (Wallr.) Hughes Fungi Imperfecti: Coelomycetes	NZ, US	L, S, F	No	Yes		Black, *et al.*, 1991; CABI, 1999; Farr, *et al.*, 1989
Corticium rolfsii Curzi Teleomorph: *Athelia rolfsii* Basidiomycetes: Corticiaceae	NZ, US	L, S, R, Fl, F, Sd	No	Yes		CABI, 1999; Farr, et al., 1989; Pennycook, 1989

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Pest[1]	Distribution[2]	Plant Part Affected[3]	Quarantine Pest	Likely to Follow Pathway	Comments	Reference(s)
Corynespora cassiicola (Berk. & M.A. Curtis) C.T. Wei Fungi Imperfecti: Hyphomycetes	NZ, US	L, S, R, Fl	No	No		CMI, 1971; Farr, *et al.*, 1989
Diaporthe phaseolorum var. *phaseolorum* (Cook & Ellis) Sacc. Anamorph: *Phomopsis phaseoli* Ascomycetes: Valsaceae	NZ, US	L, S, F	No	Yes		CMI, 1972; Farr, *et al.*, 1989
Didymella lycopersici Cooke Anamorph: *Phoma lycopersici*) Loculoascomycetes: Dothideales	NZ, US	L, S, F	No	Yes		CABI, 1999; Farr, *et al.*, 1989
Erysiphe cichoracearum DC. Anamorph: *Oidium asteris-punicei* Ascomycetes: Erysiphaceae	NZ, US	L, S	No	No		CABI, 1999; Farr, *et al.*, 1989
Fusarium equiseti (Corda) Sacc. Teleomorph: *Gibberella intrigant* Fungi Imperfecti: Hyphomycetes	NZ, US	S, R	No	No		CMI, 1978; Farr, *et al.*, 1989
Fusarium oxysporum Schlechtend.:Fr. Fungi Imperfecti: Hyphomycetes	NZ, US	S, R, F	No	Yes		CABI, 1999; Farr, *et al.*, 1989
Gibberella fujikuroi (Sawada) Ito in Ito & K. Kimura Anamorph: *Fusarium moniliforme* Ascomycetes: Hypocreaceae	NZ, US	L, S, R, F, Sd	No	Yes		CABI, 1999; Farr, *et al.*, 1989

Table 3: Pest List: *Capsicum* spp. from New Zealand						
Pest[1]	**Distribution[2]**	**Plant Part Affected[3]**	**Quarantine Pest**	**Likely to Follow Pathway**	**Comments**	**Reference(s)**
Glomerella cingulata (Ston.) Spauld. & Schrenk Anamorph: *Colletotrichum gloeosporioides* Ascomycetes: Phyllachoraceae	NZ, US	L, S, Fl, F	No	Yes		CABI, 1999; Farr, *et al.*, 1989; Pennycook, 1989
*Lasiodiplodia theobromae (*Pat.) Griffon & Maubl. Fungi Imperfecti: Coelomycetes	NZ, US	L, S, Fl, F, Sd	No	Yes		CABI, 1999; CMI, 1985; Farr, *et al.*, 1989
*Macrophomina phaseolina (*Tassi) Goidanich Fungi Imperfecti: Coelomycetes	NZ, US	L, S, R, Sd	No	Yes		CABI, 1999; Farr, *et al.*, 1989
Phoma destructiva Plowr. Fungi Imperfecti: Coelomycetes	NZ, US	L, S, F	No	Yes		CABI, 1999; Farr, *et al.*, 1989
Phoma exigua var. *exigua* Desmaz. Fungi Imperfecti: Coelomycetes	NZ, US	L, S, R	No	No		CABI, 1999; Farr, *et al.*, 1989; Pennycook, 1989
Phoma leveillei Boerema & Bollen Fungi Imperfecti: Coelomycetes	NZ, US (NC)	L, S	No	No	In U.S., reported only colonizing soil and young *Heterodera glycines* cysts in NC;	Gintis, *et al.*, 1982; Johnston, 1981; Sutton, 1980
Phoma plurivora Johnston Fungi Imperfecti: Coelomycetes	NZ	L, S	Yes	No	*Capsicum* is not a primary host; considered saprophytic to weakly parasitic	Johnston, 1981

Table 3: Pest List: *Capsicum* spp. from New Zealand						
Pest[1]	**Distribution[2]**	**Plant Part Affected[3]**	**Quarantine Pest**	**Likely to Follow Pathway**	**Comments**	**Reference(s)**
Phoma pomorum Thuem. Fungi Imperfecti: Coelomycetes	NZ, US	L	No	No		Farr, *et al.*, 1989; Sutton, 1980
Phytophthora cryptogea Pethybr.& Lafferty Oomycetes: Pythiaceae	NZ, US	L, S, R	No	No		CABI, 1999; Farr, *et al.*, 1989; Pennycook, 1989
Phytophthora nicotianae Breda de Haan var. *parasitica* (Dastur) Oomycetes: Pythiaceae	NZ, US	L, S, F, R	No	Yes		CABI, 1999; Farr, *et al.*, 1989
Pleospora herbarum (Pers.:Fr.) Rabenh. Anamorph: *Stemphylium herbarum* Ascomycetes: Pleosporaceae	NZ, US	L, S, R	No	No		CMI, 1967; Farr, *et al.*, 1989
Rhizopus arrhizus A. Fischer Zygomycetes: Mucoraceae	NZ, US	F	No	Yes		CABI, 1999; Farr, *et al.*, 1989
Rhizopus stolonifer (Ehrenb.:Fr.) Vuill. Zygomycetes: Mucoraceae	NZ, US	F	No	Yes		CMI, 1977; Farr, *et al.*, 1989
Sclerotinia minor Jagger Ascomycetes: Sclerotiniaceae	NZ, US	L, S, F, R, Sd	No	Yes		Davis, *et al.*, 1997;Farr, *et al.*, 1989; Pennycook, 1989
Sclerotinia sclerotiorum (Lib) de Bary Ascomycetes: Sclerotiniaceae	NZ, US	L, S, F, R, Sd	No	Yes		CABI, 1999; Farr, *et al.*, 1989; Pennycook, 1989
Stemphylium lycopersici (Enjoji) W. Yamamoto Fungi Imperfecti: Hyphomycetes	NZ, US	L	No	No		Farr, *et al.*, 1989; Jones, *et al.*,1991

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Pest[1]	Distribution[2]	Plant Part Affected[3]	Quarantine Pest	Likely to Follow Pathway	Comments	Reference(s)
Thanatephorus cucumeris (A.B. Frank) Donk Anamorph: *Rhizoctonia solani* Basidiomycetes: Ceratobasidiaceae	NZ, US	L, S, R, Fl, F, Sd	No	Yes		CABI, 1999; Farr, *et al.*, 1989
Verticillium albo-atrum Reinke & Berthold Fungi Imperfecti: Hyphomycetes	NZ, US	L, S	No	No		CABI, 1999; Farr, *et al.*, 1989
Verticillium dahliae Kleb. Fungi Imperfecti: Hyphomycetes	NZ, US	L, S	No	No		CABI, 1999; Farr, *et al.*, 1989; Pennycook, 1989
Verticillium tricorpus Isaac Fungi Imperfecti: Hyphomycetes	NZ, US(WA)	L, S, R	No	No	Not reported on *Capsicum* in the U.S.; a single report of its presence in the U.S. exists. Our only reference to its presence in NZ is the pest list provided by MAF for this document.	CMI, 1970; Farr, *et al.*, 1989

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Pest[1]	Distribution[2]	Plant Part Affected[3]	Quarantine Pest	Likely to Follow Pathway	Comments	Reference(s)
Bacteria						
Clavibacter michiganensis subsp. *michiganensis* (Smith) Davis et al. Actinomycetales: Microbacteriaceae	NZ, US	L, S, F	No	Yes	Not reported on pepper in NZ	CABI, 1999; Bradbury, 1986
Erwinia carotovora pv. *carotovora* (Jones) Bergey *et. al.* Zymobacteria: Enterobacteriaceae	NZ, US	L, S, R	No	No		CABI, 1999; Bradbury, 1986
Erwinia chrysanthemi Burkholder, McFadden & Dimock Zymobacteria: Enterobacteriaceae	NZ, US	L, S, R	No	No	Not reported on pepper in NZ	CABI, 1999; Bradbury, 1986
Pseudomonas cichorii (Swingle) Stapp Zymobacteria: Pseudomonadaceae	NZ, US	L, S	No	No		Bradbury, 1986
Pseudomonas marginalis (Brown) Stevens Zymobacteria: Pseudomonadaceae	NZ, US	L, R, F	No	Yes	Not reported to occur on pepper in NZ	CABI, 1999; Bradbury, 1986
Pseudomonas syringae van Hall Zymobacteria: Pseudomonadaceae	NZ, US	L, S, Fl, F	No	Yes		CABI, 1999; Bradbury, 1986
Pseudomonas syringae pv. *syringae* van Hall Zymobacteria: Pseudomonadaceae	NZ, US	L, S, R, Fl, F, Sd	No	Yes		CABI, 1999; Bradbury, 1986
Pseudomonas syringae pv. *tomato* (Okabe) Young, Dye & Wilkie Zymobacteria: Pseudomonadaceae	NZ, US	L, F	No	Yes		CABI, 1999; Bradbury, 1986
Pseudomonas viridiflava (Burkholder) Dowson Zymobacteria: Pseudomonadaceae	NZ, US	L, S, R, F, Sd	No	Yes		CABI, 1999; Bradbury, 1986

Table 3: Pest List: *Capsicum* spp. from New Zealand						
Pest[1]	**Distribution[2]**	**Plant Part Affected[3]**	**Quarantine Pest**	**Likely to Follow Pathway**	**Comments**	**Reference(s)**
Ralstonia solanacearum (Smith) Yabuuchi et al. Syn.: *Pseudomonas solanacearum* Burkholderiales: Burkhoderiaceae	NZ, US	L, S, R, F, Sd	No	Yes		CABI, 1999; Bradbury, 1986
Xanthomonas campestris pv. *vesicatoria* (Doidge) Dye Zymobacteria: Xanthomonadaceae	NZ, US	L, S, Fl, F, Sd	No	Yes		CABI, 1999; Bradbury, 1986
Viruses						
Alfalfa mosaic alfamovirus Bromoviridae	NZ, US	L, F, Sd	No	Yes		Black, *et al.*, 1991; Brunt, *et al.*, 1996; Fletcher, 1983
Beet western yellows luteovirus Luteovirus	NZ, US	L	No	No		Brunt, *et al.*, 1996; CABI, 1999
Broad bean wilt fabavirus Comoviridae	NZ, US	L, S, F, Sd	No	Yes	Our only reference to its presence in NZ is the pest list provided by MAF for this document.	Brunt, *et al.*, 1996; CABI, 1999
Cucumber mosaic cucumovirus Bromoviridae	NZ, US	L, S, F	No	Yes		Black, *et al.*, 1991; Brunt, *et al.*, 1996; CABI, 1999
Pepper mild mottle tobamovirus Tobamovirus	NZ, US	L, S, F, Sd	No	Yes	Our only reference to its presence in NZ is the pest list provided by MAF for this document.	Black, *et al.*, 1991; Brunt, *et al.*, 1996; CABI, 1999

Table 3: Pest List: *Capsicum* spp. from New Zealand

Pest[1]	Distribution[2]	Plant Part Affected[3]	Quarantine Pest	Likely to Follow Pathway	Comments	Reference(s)
Potato leafroll luteovirus Luteovirus	NZ, US	L	No	No		Brunt, *et al.,* 1996; Chamber-lain, 1946
Potato X potexvirus Potexvirus	NZ, US	L	No	No		Brunt, *et al.,* 1996
Potato Y potyvirus Potyviridae	NZ, US	L, F	No	No		Black, *et al.,* 1991; Brunt, *et al.,* 1996
Ribgrass mosaic tobamovirus Tobamovirus	NZ, US	L	No	No		Brunt, *et al.,* 1996; CMI, 1975
Tobacco leaf curl bigeminivirus Geminiviridae	NZ, US	L	No	No		Brunt, *et al.,* 1996; CABI, 1999
Tobacco mild green mosaic tobamovirus Tobamovirus	NZ, US	L, S	No	No	Our only reference to its presence in NZ is the pest list provided by MAF for this document.	Brunt, *et al.,* 1996; CMI, 1989
Tobacco mosaic tobamovirus Tobamovirus	NZ, US	L, S, F, Sd	No	Yes		Brunt, *et al.,* 1996; Šutić, *et al.*, 1999
Tobacco necrosis necrovirus Necrovirus	NZ, US	L, S, R	No	No		Brunt, *et al.,* 1996; CABI, 1999
Tobacco rattle tobravirus [strain] Tobravirus	NZ, US	L, S	No	No		Brunt, *et al.,* 1996; CABI, 1999
Tobacco streak ilarvirus Bromoviridae	NZ, US	L, S, Fl, F, Sd	No	Yes	Seed transmission shown in green bean and soybean	Brunt, *et al.,* 1996; CABI, 1999
Tomato mosaic tobamovirus Tobamovirus	NZ, US	L, S, F, Sd	No	Yes		Black, *et al.,* 1991; Brunt, *et al.,* 1996

Tomato spotted wilt tospovirus Bunyaviridae	NZ, US	L, S, F	No	No		Brunt, *et al.*, 1996; CABI, 1999

Table Footnotes

1 Pest names for pathogens and nematodes according to Farr *et al.*, 1989, Bradbury, 1986 and Brunt, *et al.,* 1996.

2 Only distribution in New Zealand and the United States is considered. Distribution codes: NZ=New Zealand, US=United States, AL=Alabama, CA=California, FL=Florida, HI=Hawaii, LA=Louisiana, MO=Missouri, NC=North Carolina, VA=Virginia, WA=Washington.

3 Plant part affected: (L = Leaf); (S = Stem); (Fl = Flower); (F= Fruit); ® = Root); (Sd = Seed)

5. List of Quarantine Pests

Our list of quarantine pests for commercial shipments of *Capsicum* spp. fruit from New Zealand is provided in Table 4. Should any of these pests be intercepted on commercial (or any other) shipments of *Capsicum* spp., quarantine action may be taken.

Table 4: Quarantine Pests: Pepper Fruit *(Capsicum* spp.*)* from New Zealand

Arthropods	*Agrius convolvuli* L.
	Chrysodeixis eriosoma (Doubleday)
	Epiphyas postvittana (Walker)
	Helicoverpa armigera Hubner
	Sceliodes cordalis Doubleday
	Spodoptera litura Fabricius
	Thrips obscuratus (Crawford)
Gastropods	*Cryptomphalus aspersus* (Müller)
Fungi	*Phoma plurivora* Johnston

6. Quarantine Pests Likely to Follow Pathway (Quarantine Pests Selected for Further Analysis)

We analyzed in detail only those quarantine pests that can reasonably be expected to follow the pathway, i.e., be included in commercial shipments of *Capsicum* spp. Other organisms in this assessment, not chosen for further scrutiny, may be potentially detrimental to the agricultural production systems of the United States. However, there were a variety of reasons for not subjecting them to further analysis: they are associated mainly with plant parts other than commodity; they may be associated with the commodity (however, it was not considered reasonable to expect these pests to remain with the commodity during processing); or, they have been intercepted, as biological contaminants, by PPQ Officers during inspections of these commodities and would not be expected to be found frequently with commercial shipments. Pests not analyzed further remain legitimate quarantine pests and should they be detected in shipments of fresh

Capsicum fruit from New Zealand, quarantine action may be taken.

Capsicum spp. are not listed among the primary and secondary hosts for *Agrius convolvuli* L. (CAB International, 1999). The same reference indicates that *A. convulvuli* is a leaf-feeding pest. Since this pest is not regularly found on *Capsicum* and does not attack the plant part shipped as the commodity, it was not expected to follow the pathway and was not selected for further analysis.

Chrysodeixis eriosoma (= *C. chalcites*) is present only in the State of Hawaii in the United States and is listed as an actionable pest in the USDA Catalogue of Intercepted Pests. Chapman, 1976 indicates that *C. eriosoma* attacks tomatoes and several other solanaceous hosts. The larvae cause damage by chewing pieces out of the foliage or fruits of the host plant (Chapman, 1976), but they do not generally bore or tunnel into the fruit. A single interception of *C. eriosoma* on tomato fruit from New Zealand has been recorded, but because they are surface feeders and primarily pests of tomatoes, the pest was not expected to follow the pathway and was not analyzed further.

Cryptomphalus aspersus is distributed throughout much of the southern United States and the Pacific Coast north to British Columbia (USDA, 1999). Importation of *C. aspersus* for human consumption is permitted except into California and Florida which have quarantines prohibiting entry of this pest. *Capsicum* is not considered a primary host of *C. aspersus*, but the species is polyphagous. Infested nursery stock is thought to be the most important pathway for the movement of *C. aspersus,* but it is regularly intercepted on fruits and vegetables and their packaging (USDA, 1999). Because of its distribution in the United States and the secondary nature of its association with *Capsicum* fruit, *C. aspersus* was not selected for further analysis.

Neither Zhang (1994) nor pest data sheets for *Epiphyas postvittana* (Walker) prepared by CAB International (CABI, 1999) or the USDA (USDA, 1984) list any species of *Capsicum* as primary or even secondary hosts. A single record exists for the interception of *E. postvittana* on a cargo of peppers in Honolulu, but because these insects are primarily leaf-rollers and do not normally feed on *Capsicum*, they were not selected for further analysis.

Johnston, 1981 described *Phoma plurivora* as a “saprophyte or weak wound parasite” of *Capsicum*. Symptoms described indicate that *P. plurivora* affects leaf tissue. Because of its saprobic habit and its effect on leaves rather than fruit, *P. plurivora* was not analyzed further.

Only quarantine pests selected for further analysis are subjected to steps 7-9 below.

Table 5: Quarantine Pest Selected for Further Analysis: **Pepper Fruit *(Capsicum* spp.*)* from New Zealand**	
Arthropods	*Helicoverpa armigera* Hubner *Sceliodes cordalis* Doubleday *Spodoptera litura* Fabricius *Thrips obscuratus* (Crawford)

7. Consequences of Introduction: Economic/Environmental Importance

We rate each pest with respect to potential economic importance based on five biological features referred to here as Risk Elements (RE). Details of the five RE's and rating criteria are provided in USDA (1995). Our ratings for these five RE's are shown in Table 6. The cumulative (Total) score for Risk Elements 1-5 (i.e., the "Consequences of Introduction Risk Ratings") is considered to be a biological indicator of the potential destructiveness of the pest.

Table 6: Risk Rating: Consequences of Introduction

Pest	Climate / Host	Host Range	Dispersal	Economic	Environmental	Risk Rating[1]
Helicoverpa armigera	high (3)	high (3)	high (3)	medium (2)	medium (2)	**high** (13)
Sceliodes cordalis	medium (2)	medium (2)	high (3)	medium (2)	medium (2)	**medium** (11)
Spodoptera litura	high (3)	high (3)	high (3)	high (3)	medium (2)	**high** (14)
Thrips obscuratus	high (3)	high (3)	high (3)	low (1)	high (3)	**high** (13)

1= High (13-15)
Medium (9-12)
Low (5-8)

Climate / Host

Ratings determined as follows:

- **High**: Pest able to establish breeding colony in four or more plant hardiness zones (USDA, 1990).
- **Medium**: Pest able to establish breeding colony in two or three plant hardiness zones.
- **Low**: Pest able to establish breeding colony in at most a single plant hardiness zone.

Helicoverpa armigera

This pest has been reported to occur from a large number of countries ranging from Australasia, through equatorial Africa to Scandinavia (CIE, 1993a). Consequently, it would be expected to be able to establish in well over four plant hardiness zones and receives a rating of **high**.

Sceliodes cordalis

According to Zhang, 1994, *S. cordalis* has only been reported from parts of Australia and New Zealand. Given this limited distribution, we would estimate that this pest would be able to establish breeding colonies in two or three plant hardiness zones, therefore *S. cordalis* received a rating of **medium**.

Spodoptera litura

This pest has been reported to occur from a large number of countries ranging from Australasia, throughout the Indian subcontinent and north to northeastern China (CIE, 1993b). Consequently, it would be expected to be able to establish in well over four plant hardiness zones and receives a rating of **high**.

Thrips obscuratus

This pest has been reported from across New Zealand ranging from lowland to alpine regions (Mound and Walker, 1982). This distribution across differing climates in New Zealand as well as the broad distribution of related thrips species, suggests that the pest would be able to establish in at least three to four hardiness zones and was rated **high**.

Host Range

Ratings are determined as follows:

- **High**: Pest attacks multiple species within multiple plant families.
- **Medium**: Pest attacks multiple species within a single plant family.
- **Low**: Pest attacks a single species or multiple species within a single genus.

Helicoverpa armigera

Zhang, 1994 lists a wide variety of recorded hosts for *H. armigera*. Included are species in the Asteraceae, Cruciferae, Fabaceae, Chenopodiaceae, Convulvaceae and Poaceae, just to name a few. Because of its broad host range, this pest was rated as **high**.

Sceliodes cordalis

Zhang, 1994 lists only hosts in the Solanaceae for *S. cordalis*. Consequently, this pest received a rating of **medium**.

Spodoptera litura

Among the hosts for *S. litura* listed in Zhang, 1994 were members of the Cruciferae, Rutaceae, Fabaceae, Poaceae, Convulvaceae and the Solanaceae to name a few. Because of its broad host range, this pest was rated as **high** for the host range element.

Thrips obscuratus

Among the hosts of *T. obscuratus* listed in Mound and Walker, 1982 are members of the Rosaceae, Poaceae, Cruciferae, Passifloraceae and Actinidiaceae. Because of its broad host range *T. obscuratus* was rated as **high** for host range.

Dispersal

Ratings are determined as follows:

- **High**: Pest has high reproductive potential (*e.g.*, many generations per year, many offspring per reproduction, high innate capacity for population increase (*i.e.*, "r-selected" species), ***AND*** evidence exists that the pest is capable of rapid dispersal (*e.g.*, over 10 km per year) either under its own power, human-assisted, or by natural forces such as wind, water or vectors.
- **Medium**: Pest has either high reproductive potential ***OR*** the species is capable of rapid dispersal.
- **Low**: Neither high reproductive potential nor capable of rapid dispersal.

Helicoverpa armigera

Adult female moths are capable of laying 500 to 1000 eggs and there are probably several generations per year (Chapman, 1976). Adults can migrate over long distances, borne by wind and movement in international trade is mainly on ornamentals but also in infested fruit (Smith, *et al.*, 1997). Because of its high reproductive capacity and the ability to move long distances, *H. armigera* was rated as **high** for dispersal.

Sceliodes cordalis

In warm weather, the life cycle of *S. cordalis* may be as short as 3 weeks and females may lay as many as 100 eggs in a single night (Davis, 1964). Therefore, rapid population buildup can occur. Even a small population of moths can spread rapidly through a crop, and although there are no data indicating how far these moths can travel in a single year, they are capable fliers and we believe that it is not unreasonable to expect that they may spread as much as 10 km per year. Because of its high reproductive capacity and the ability to move long distances, *S. cordalis* was rated as **high** for dispersal.

Spodoptera litura

S. litura eggs are laid in clusters of several hundred and fecundity varies from 2000-2600 eggs

(CABI, 1999). In India, this pest completes 12 generations per year (CABI, 1999). The moths can fly 1.5 km in a single night and can consequently cover long distances. Eggs and larvae have been transported long distances in international trade (CABI, 1999). Because of its high reproductive capacity and the ability to move long distances, this pest was rated as **high** for the dispersal element.

Thrips obscuratus

T. obscuratus reproduces continuously in warmer climates resulting in several generations per year and may reach populations as high as 3000 individuals on a single plant (Mound and Walker, 1982). Numerous interceptions of *T. obscuratus* on other commodities from New Zealand suggest the pest can be spread long distances in international trade. Because of its high reproductive capacity and the ability to be moved long distances on commodities, this pest was rated as **high** for the dispersal element.

Economic Impact

Ratings for economic impact were determined as follows:

- **High:** Pest causes lower yield of the host crop (*e.g.*, by causing plant mortality, or by acting as a disease vector); pest causes lower value of the commodity (*e*.g., by increasing costs of production, lowering market price, or a combination thereof); or, pest causes the loss of foreign or domestic markets due to presence of new quarantine pest.
- **Medium:** Pest causes any two of the above impacts.
- **Low:** Pest causes any one or none of the above impacts.

Helicoverpa armigera

H. armigera has been reported causing serious losses throughout its range, in particular to cotton, tomatoes and maize, as well as *Capsicum*. Monetary losses result from the direct reduction of yields and from the cost of monitoring and control, particularly the cost of insecticides. Larger larvae may bore into older fruits; subsequent secondary infections by other organisms lead to rotting and unmarketable fruit (CABI, 1999). Because *H. armigera* causes two types of economic impacts, it received a rating of **medium** for the economic impact element.

Sceliodes cordalis

S. cordalis attacks *Capsicum* as well as eggplant and is considered a troublesome pest in Australia because it reduces yield or causes rejections of unsound fruit (Davis, 1964). Because *S. cordalis* causes two types of economic impacts, it received a rating of **medium** for the economic impact element.

Spodoptera litura

S. litura is known to cause severe damage to many crops, including tobacco, cotton, chillies, cabbage, cauliflower and a range of legume crops. Densities of 2.3 and 1.5 larvae reduced yield of aubergines and Capsicum in glasshouses by 10% (CABI, 1999). In tomatoes, larvae bore into fruit which is then rendered unsuitable for consumption (Smith, *et al.*, 1997). S. litura is listed as of quarantine significance by EPPO (European and Mediterranean Plant Protection Organization), CPPC (Caribbean Plant Protection Commission), NAPPO (North American Plant Protection Organization) and OIRSA (Organismo Internacional Regional de Sanidad Agropecuaria in Central America.). Because *S. litura* causes all three types of economic impacts, it received a rating of **high** for the economic impact element.

Thrips obscuratus

T. obscuratus is a flower thrip and mainly attacks flowers. In stone fruit, feeding damage can lead to the discoloring, bleaching and speckling of fruit. Damage can range from an inoffensive cosmetic blemish to a significant downgrading of fruit (Teulon and Penman, 1996). Assuming that *T. obscuratus* can cause similar damage to *Capsicum*, we rated it as **low** for this element.

Environmental Impact

Ratings for environmental impact were determined as follows:

- **High:** Two or more of the following would occur: Introduction of the pest is expected to cause significant, direct environmental impacts, *e.g.*, ecological disruptions, reduced biodiversity. When used within the context of the National Environmental Policy Act (NEPA) (Title 7 Code of Federal Regulations §372), significance is qualitative and encompasses both the likelihood and severity of an environmental impact; Pest is expected to have direct impacts on species listed by Federal Agencies as endangered or threatened (Title 50 Code of Federal Regulations §17.11 and §17.12), by infesting/infecting a listed plant. If the pest attacks other species within the genus or other genera within the family, and preference/no preference tests have not been conducted with the listed plant and the pest, then the plant is assumed to be a host; pest is expected to have indirect impacts on species listed by Federal Agencies as endangered or threatened by disrupting sensitive, critical habitat; or, introduction of the pest would stimulate chemical or biological control programs.
- **Medium:** One of the above would occur.
- **Low:** None of the above would occur; it is assumed that introduction of a nonindigenous pest will have some environmental impact (by definition, introduction of a nonindigenous species affects biodiversity).

Helicoverpa armigera

We estimate that the only impact of the introduction of *H. armigera* would be that introduction of the pest would stimulate chemical or biological control programs. We therefore rated this pest as

medium for environmental impact.

Sceliodes cordalis

We estimate that the only impact of the introduction of *S. cordalis* would be that introduction of the pest would stimulate chemical or biological control programs. We therefore rated this pest as **medium** for environmental impact.

Spodoptera litura

We estimate that the only impact of the introduction of *S. litura* would be that introduction of the pest would stimulate chemical or biological control programs. We therefore rated this pest as **medium** for environmental impact.

Thrips obscuratus

We estimate that the introduction of *T. obscuratus* would stimulate chemical or biological control programs. *T. obscuratus* attacks members of the genus *Prunus* (Mound and Walker, 1982; Teulon and Penman, 1996) and there is a member of the genus *Prunus* listed as endangered. We therefore rated this pest as **high** for environmental impact.

8. Likelihood of Introduction

We rate each pest with respect to introduction (i.e., entry and establishment) potential. We consider two separate components. First, we estimate the amount of commodity likely to be imported. More imports lead to greater risk; the result is a risk rating that applies to the commodity and country in question and is the same for all quarantine pests considered. Second, we consider five biological features (i.e., risk elements) concerning the pest and its interactions with the commodity. The resulting risk ratings are specific to each pest. Details of elements and rating criteria are provided in USDA (1995). The cumulative risk rating for introduction is considered to be an indicator of the likelihood that a particular pest would be introduced.

Table 7: Risk Rating: Likelihood of Introduction

Pest	Quantity imported annually	Survives post - harvest treatment	Survives shipment	Not detected at port of entry	Moved to suitable habitat	Finds suitable host	Risk Rating[1] (Total)
Helicoverpa armigera	low (1)	high (3)	high (3)	medium (2)	high (3)	high (3)	**high** (15)

Sceliodes cordalis	low (1)	high (3)	high (3)	high (3)	high (3)	low (1)	**medium** (14)
Spodoptera litura	low (1)	high (3)	high (3)	medium (2)	high (3)	high (3)	**high** (15)
Thrips obscuratus	low (1)	high (3)	high (3)	high (3)	high (3)	high (3)	**high** (16)
1 = Low (6 - 9) Medium (10 - 14) High (15 - 18)							

Volume of Imports

Ratings for volume of imports were determined as follows:

- **Low**: < 10 40 foot shipping containers/year
- **Medium**: 10 - 100 40 foot shipping containers/year
- **High**: > 100 40 foot shipping containers/year

Helicoverpa armigera
Sceliodes cordalis
Spodoptera litura
Thrips obscuratus

The Government of New Zealand has indicated that they expect fewer than 10 40 foot shipping containers per year of *Capsicum* will be offered for import into the United States. Therefore, all four pests received a rating of **low** for volume of imports.

Survives postharvest treatment

Ratings for this sub-element were determined as follows:

- **High:** > 10% (greater than one in ten) chance that the pest will survive postharvest treatment (any manipulation, handling or specific phytosanitary treatment to which the commodity is subjected). Examples of postharvest treatments include culling, washing, chemical treatment, cold storage, etc. If there is no postharvest treatment, estimate the likelihood of this sub-element as High.
- **Medium:** Between 0.1% - 10% (between one in one thousand to one in ten) chance.
- **Low:** < 0.1% (less than one in one thousand) chance.

Helicoverpa armigera
Sceliodes cordalis

Spodoptera litura
Thrips obscuratus

Because no mandatory postharvest treatment was indicated, all four pests were rated **high**.

Survives shipment

Ratings for this sub-element were determined as follows:

- **High:** > 10% (greater than one in ten) chance that the pest will survive shipment from New Zealand to the United States, assuming standard shipping practices.
- **Medium:** Between 0.1% - 10% (between one in one thousand to one in ten) chance.
- **Low:** < 0.1% (less than one in one thousand) chance.

Helicoverpa armigera
Sceliodes cordalis
Spodoptera litura
Thrips obscuratus

Numerous interceptions of *Helicoverpa*, *Spodoptera* and Lepidoptera related to *S. cordalis* (Table 2) on shipments of *Capsicum* from countries other than New Zealand indicate that these pests can and do survive in commercial shipments. *T. obscuratus* has been intercepted over 100 times from commodities other than *Capsicum* shipped from New Zealand to the United States. Because of their demonstrated survival in commercial shipments, all four pests were rated **high** for this sub-element.

Not detected at port of entry

Ratings for this sub-element were determined as follows:

- **High:** > 10% (greater than one in ten) chance that the pest will not be detected during port of entry inspection, assuming standard inspection protocols for like commodities are employed.
- **Medium:** Between 0.1% - 10% (between one in one thousand to one in ten) chance.
- **Low:** < 0.1% (less than one in one thousand) chance.

Helicoverpa armigera
Spodoptera litura

Larvae, the most likely stage of the pest to be imported are relatively large when full grown: about 30-40 mm long for *H. armigera* and 40-45 mm for *S. litura* (CABI, 1999). The feeding larvae can be seen on the surface of plants but they are often hidden within plant organs (flowers, fruits etc.). Bore holes and heaps of frass (excreta) may be visible, but otherwise it is necessary to cut open the plant organs to detect the pest (CABI, 1999). For these reasons, *H. armigera* and *S. litura* were rated as **medium** for this sub-element.

Sceliodes cordalis

In eggplant, where small caterpillars are present, there may be practically no external signs of damage. Older grubs usually make small holes at the surface, but against the dark skin of the fruit these are often hard to see. Infested fruit may not be detected until secondary rots break down the fruit (Davis, 1964). We assumed that the pest will behave similarly on *Capsicum* fruit and accordingly rated it as **high** for this sub-element.

Thrips obscuratus

We have little information on the feeding behavior of *T. obscuratus* but given its small size (1 mm; Mclaren and Walker, 1998) and its propensity to hide in the calyx of fruits (Teulon and Penman, 1996), we assumed this pest would be difficult to detect and accordingly rated it as **high** for this sub-element.

Moved to suitable habitat

Ratings for this sub-element were determined as follows:

- **High:** > 10% (greater than one in ten) chance that, considering the geographic location of likely markets, the commodity will be imported or moved subsequently to an area with an environment suitable for pest survival.
- **Medium:** Between 0.1% - 10% (between one in one thousand to one in ten) chance.
- **Low:** < 0.1% (less than one in one thousand) chance.

Helicoverpa armigera
Sceliodes cordalis
Spodoptera litura
Thrips obscuratus

Though some of these pests (*e.g., S. litura*) are more commonly reported from tropical and neotropical areas, all are widespread in more temperate countries and regions. Shipment is to any U.S. port, therefore we rated all four pests as **high** for this sub-element.

Finds suitable host

Ratings for this sub-element were determined as follows:

- **High:** > 10% (greater than one in ten) chance that, considering the complete host range of the pest species and in order for the pest to survive, imported pests will come into contact with host material suitable for reproduction.

- **Medium:** Between 0.1% - 10% (between one in one thousand to one in ten) chance.
- **Low:** < 0.1% (less than one in one thousand) chance.

Helicoverpa armigera
Spodoptera litura
Thrips obscuratus

H. armigera attacks a broad range of hosts. The most important crop hosts of which *H. armigera* is a major pest are cotton,, tomato, sorghum and cowpea; other hosts include peas, beans, soybeans, tobacco, potatoes, maize, a number of fruits (*Prunus, Citrus*), forest trees and a range of vegetable crops (CABI, 1999). A wide range of wild plant species support larval development. The host range of *S. litura* covers at least 120 species. Among the main crop species attacked by *S. litura* are cotton, maize, rice, soybeans, tobacco, vegetables (*Brassica*, *Capsicum*, cucurbit vegetables, potatoes, sweet potatoes). Other hosts include ornamentals, wild plants, weeds and shade trees (CABI, 1999). *T. obscuratus* is a key pest of stone fruit in New Zealand (Teulon and Penman, 1996). Among other crop species *T. obscuratus* attacks grapes, maize and turnips (Mound and Walker, 1982). *T. obscuratus* is however, polyphagous and adults are found throughout the year in New Zealand on flowers and on leaves of introduced and native plants (Mound and Walker, 1982). Because of their polyphagous nature, broad host ranges, and because imported *Capsicum* are proposed entry through all ports and suitable host material would be available near at least some of these ports throughout the year, these three pests were rated as **high** for this sub-element.

Sceliodes cordalis

According to Zhang (1994) *S. cordalis* is restricted to hosts in the Solanaceae. Davis (1964) lists only eggplant, *Capsicum*, tomato and two solanaceous New Zealand weed species as hosts for *S. cordalis*. Because of its more restricted host range we estimated that it would be less likely to find suitable host material than the three pests listed above. Consequently, we rated *S. cordalis* as **low** for this sub-element.

9. Conclusion: Pest Risk Potential and Phytosanitary Measures

The measure of pest risk potential combines the risk ratings for consequences and likelihood of introduction (USDA, 1995). Our rating of the overall pest risk potential (PRP) for each quarantine pest selected for further analysis is shown in Table 7.

Table 8: Pest Risk Potential, Quarantine Pests, *Capsicum* spp. from New Zealand

Pest	Pest Risk Potential[1]

Helicoverpa armigera Hubner	**high** (28)
Sceliodes cordalis Doubleday	**medium** (25)
Spodoptera litura Fabricius	**high** (29)
Thrips obscuratus (Crawford)	**high** (29)
1 = Low (11 - 18) Medium (19 - 26) High (27 - 33)	

Plant pests with a medium or high Pest Risk Potential may require specific phytosanitary measures. The choice of appropriate sanitary and phytosanitary measures to mitigate risks is undertaken as part of Risk Management and is not addressed, *per se*, in this document.

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