

Pieris brassicae

Scientific Name

Pieris brassicae (L.)

Synonyms:

Mancipium brassicae Linnaeus
Papilio Danaus brassicae
Papilio brassicae Linnaeus
Pieris anthrax Graham-Smith & Graham-Smith
Pieris brassicae brassicae (Linnaeus)
Pieris brassicae wollastoni (Butler)
Pieris carnea Graham-Smith & Graham-Smith
Pieris chariclea (Stephens)
Pieris emigrisea Rocci
Pieris griseopicta Rocci
Pieris infratrinotata Carhel
Pieris nigrescens Cockerell
Pontia brassicae Linnaeus
Pontia chariclea Stephens



Figure 1. *P. brassicae* adult (Image courtesy of Hania Berdys, Bugwood.org)

Common Names

Large white butterfly, cabbage caterpillar

Type of Pest

Butterfly

Taxonomic Position

Class: Insecta, **Order:** Lepidoptera, **Family:** Pieridae

Reason for Inclusion

CAPS Target: AHP Prioritized Pest List for FY 2012

Pest Description

Egg: “When first laid the eggs are a very pale straw color; within twenty four hours this has darkened to yellow and in at least one subspecies (*P. h. cheiranthi* Hueb) they are bright orange... a few hours before hatching the eggs turn black and the form of the larva can be seen through the shell” (Gardiner, 1974).

Larva: “Length [of the larva is] 40 mm. Body fawn with black patches, yellow longitudinal stripes, covered with short white hairs. First instar head black; final instar head black and gray, frons yellow (Brooks and Knight 1982, Emmett 1980)” (USDA, 1984).

Pupa: “Length 20-24 mm, width 5-6 mm, yellow brown marked with black dots (Avidov and Harpaz 1969)” (USDA, 1984).

Adult: “Body length 20 mm (Avidov and Harpaz 1969). Antennae black, tips white. Wingspan 63 mm. Wings dorsally white. Forewing tips black; hindwing front margin with black spot. Female forewing with 2 black spots, black dash on each. Spring generation markings grayish. Forewing ventrally white with yellow apex, 2 black spots; hindwing yellow. Variation uncommon, may be more black markings or cream ground color (Brooks and Knight 1982)” (USDA, 1984).

Biology and Ecology:

Adults feed on plant nectar of a variety of species (Ferrerres et al., 2007) and are active on hot days (USDA, 1984). In India, adults breed on rapeseed-mustard during September and are active until April (Ali and Rizvi, 2007). In the United Kingdom, the first generation appears in spring and the second in summer (USDA, 1984). Central Europe may have up to 4 generations when conditions are favorable (USDA, 1984). Areas in its southern range may have up to 7 generations (Feltwell, 1982).

Eggs are laid in batches containing a few to over 100 eggs (Gardiner, 1974). “A female is capable of producing 750 eggs during a full lifespan (David & Gardiner, 1962) but it is doubtful if the full number is ever produced under feral conditions” (Gardiner, 1974). Eggs are laid on the underside of the leaves (Ovsyannikova and Grichanov, n.d.). Egg hatch can range from 4 to 6 days to over 2 weeks, depending on weather conditions (Gardiner, 1974).

Larvae eat their eggshells and will often eat the top of eggshells of larvae that have yet to hatch (Gardiner, 1974). As a group, larvae spin a silken pad and rest on the pad when they are not feeding (Gardiner, 1974). Larvae are gregarious unlike other similar species (i.e., *P. rapae*) and go through five instars (Gardiner, 1974). Larvae feed on the outside of the leaves (Gardiner, 1974).

Larvae can travel great distances (100+ m (328 feet)) when looking for pupation sites (Feltwell, 1982). Pupation length depends on the time of year. In warm weather, it can last 10 days or up to 60 days in cold weather (Gardiner, 1974). Diapause occurs in the pupal stage and can last from 6 to 8 months (Gardiner, 1974). “As long as the daylength is sixteen hours or longer, dawn to dusk, and the temperature averages above 10°C, there will be a continuous succession of broods, at least one every six weeks in very warm tropical weather. As soon as the daylength falls the pupae will enter diapause. All summer brood stages can withstand frost for short periods and diapausing pupae can withstand severe and prolonged winter conditions” (Gardiner, 1974).

In Turkey, *P. brassicae* has 4-6 generations per year (Atak and Atak, 1984). Studies in Turkey showed that females laid approximately 125 eggs with the egg

stage lasting 11-14 days, the larval stage lasting 11-54 days and the pupal stage lasting 6-9 days (Atak and Atak, 1984).

Symptoms/Signs

Young larvae are gregarious and scrape the underside of the leaves, while older larvae (3rd instar and up) live separately and eat holes in the leaves, leaving thick veins behind (Ovsyannikova and Grichanov, n.d.). Frass can contaminate the leaves (Ovsyannikova and Grichanov, n.d.).

The most susceptible crops to *P. brassicae* damage in Europe and Russia include Brussels sprouts, cabbage, cauliflower, Kohlrabi, rape, swede, and turnip (Feltwell, 1982). Attacks to crops are usually localized and may lead to 100% crop loss (Feltwell, 1982). Due to their strong migratory habit, adults may infest new areas previously free from attack.

Since many of the host crops of *P. brassicae* are sold for fresh consumption, damage by *P. brassicae* can cause significant reduction in crop value (Cartea et al., 2009). *P. brassicae* larvae occasionally cause damage to cabbage and cauliflower by boring into the heads of the vegetables (Ali and Rizvi, 2007). In addition, high populations of larvae can skeletonize host plants (USDA, 1984).



Figure 2. Damage to Brussels sprouts caused by the similar species *Pieris rapae*. Damage by *P. brassicae* would be similar (Image courtesy of Whitney Cranshaw, Colorado State University, Bugwood.org).

Pest Importance

P. brassicae is less of a pest in Great Britain today due to the effects of natural and chemical control although it is still considered a pest in other areas including north and central Europe, China, India, Nepal and Russia (Feltwell, 1982).

In India, *P. brassicae* is estimated to cause over 40% yield loss annually on different vegetable crops on its own (Ali and Rizvi, 2007). In parts of Turkey, damage to cabbages averaged 40% while damage to cauliflowers averaged 27% in the years 1985 and 1986 (Atalay and Hncal, 1992).

“*Pieris brassicae* represents the same threat to agricultural production that is already represented by *P. rapae* (Bulluck and Smith, 2003).

Known Hosts

P. brassicae readily feeds on five main plant families, including: Brassicaceae (=Cruciferae), Tropaeolaceae, Capparaceae, Resedaceae, and Papilionaceae (Feltwell, 1982).

Unless otherwise noted, the following host records were reviewed in Feltwell (1982):

Brassicaceae (=Cruciferae)

One of the most important hosts of *P. brassicae* is cabbage (*Brassica oleracea* var. *capitata*). Many cultivars of cabbage can be used as host plants. Other hosts in this family include:

Alliaria petiolata (garlic mustard), *Alyssum saxatile* (golden alison), *Arabis alpina* (alpine rocket cress), *A Armoracia rusticana* (horse radish), *Aubretia deltoidea*, *Barbarea stricta* (small flowered yellow rocket), *B. vulgaris* (winter cress), *Biscutella auriculata*, *B. laevigata*, *Brassica* spp., *B. oleracea* var. *botrytis* (cabbage), *B. oleracea* var. *caulorapa* (Kohl-rabi), *B. oleracea* var. *gemmifera* (rape), *B. oleracea* var. *gongylodes*** , *B. napus* (turnip), *B. nigra* (black mustard), *Bunias orientalis* (warty cabbage), *Cakile maritima* (sea rocket), *Cardamine hirsuta* (hairy bitter cress), *Cardaria (Lepidium) draba* (hoary cress), *Cheiranthus cheiri* (wallflower), *Crambe cordifolia*, *C. maritima* (sea kale), *Diplotaxis eruroides* (white wall rocket), *D. muralis* (wall rocket), *D. tenuifolia* (perennial wall rocket), *Draba incana* (hoary whitlow grass), *Eruca sativa*, *Erucastrum nasturtiifolium*, *Erysimum hieraciifolium*, *E. perofskianum*, *Hesperis matronalis* (dame's violet), *Hirschfeldia (Sinapis) incana* (hoary mustard), *Hornungia petraea* (rock hutchinsia), *Iberis amara* (wild candytuft), *I. gibraltaria*, *I. umbellata* (candytuft), *Isatis tinctoria*, *Kernera saxatilis*, *Lepidium* spp., *L. latifolium* (dittander), *L. sativum* (garden cress), *Lobularia (Clypeola) maritima* (sweet alison), *Lunaria annua* (honesty), *Matthiola* spp. (stock), *M. annua* (double stock), *M. incana* (stock), *Peltaria turkmeria*, *Raphanus raphanistrum* (wild radish), *R. sativus* (radish), *Rorippa nasturtium-aquaticum* (water cress), *R. sylvestris* (creeping yellow cress), *Sinapis alba* (white mustard), *S. arvensis* (charlock), *Sisymbrium officinale* (hedge mustard), *S. sophia* (flixweed), *S. strictissimum*, *Thlapsi arvense* (field penny cress), and *T. rotundifolium*.

Capparaceae

Capparis spp., *Capparis spinosa*, *Cleome spinosa*, *Polonisia trachysperma*

Papilionaceae

Genista alba, *G. tinctoria* (dyer's greenweed), *Glycine soja* (soy bean), *Lathyrus latifolius* (sweet pea), *L. sylvestris* (narrow leaved everlasting pea), *L. tuberosus* (earth-nut pea), *Medicago sativa* (alfalfa/ lucerne), *Pisum* sp. (pea), *Vicia* sp. (bean), and *V. cracca* (tufted vetch).

Resedaceae

Caylusea abyssinica, *Reseda* spp. (mignonette), *R. alba* (upright mignonette), *R. lutea* (wild mignonette), *R. luteola* (dyer's rocket), and *R. virgata*.

Tropaeolaceae

Tropaeolum brasiliense (nasturtium), *T. majus* (nasturtium), and *T. peregrinum* (canary creeper).

Hosts from other families include: *Beta* sp. (beet), *Euphorbia polychroma* (spurge), *Geranium* sp., *Allium sativum* (garlic), *Petiveria alliacea*, and *Rumex* sp.

**experimental hosts

Pathogens Vectored

This pest is not currently known to vector any pathogens or other associated organisms.

Known Distribution

The known distribution of *P. brassicae* covers most of Europe and Asia. Areas of distribution include: Aegean Islands, Afghanistan, Albania, Algeria, Andorra, Armenia, Austria, Azerbaijan, Azores, Balearic Islands, Bangladesh, Belarus, Belgium, Bhutan, Bosnia and Herzegovina, Bulgaria, Burma, Canary Islands, Channel Islands, Chile, China, Corsica, Crete, Croatia, Cyclades Islands, Cyprus, Czech Republic, Denmark, Dodecanese Islands, Egypt*, Estonia, Finland, France, Georgia, Germany, Gibraltar, Great Britain, Greece, Hong Kong, Hungary, Iceland, India, Iran, Iraq, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Kyrgyzstan, Latvia, Lebanon, Libya, Liechtenstein, Lithuania, Luxembourg, Macedonia, Madeira, Malta, Monaco, Morocco, Myanmar, Nepal, Netherlands, New Zealand, Northern Ireland, Norway, Pakistan, Poland, Portugal, Romania, Russia, Sardinia, Serbia, Sicily, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Syria, Tajikistan, Tibet, Tunisia, Turkmenistan, Turkey, Ukraine, Uzbekistan, and former Yugoslavia (Gardiner, 1974; Feltwell, 1982; Geertsema, 1996; Sato and Ohsaki, 2004; EPPO, 2007; Moore, 2010; Vliegthart et al., 2010).

*considered a migrant species (Larsen, 1990).

Potential Distribution within the United States

The range of *P. brassicae* is restricted by both temperature and humidity (Feltwell, 1982). Distribution of this pest is limited by low winter temperatures (-20°C, -4°F) (Ovsyannikova and Grichanov, n.d.).

Main host plants for this species are grown at low levels throughout many parts of the United States (USDA-CPHST, 2009).

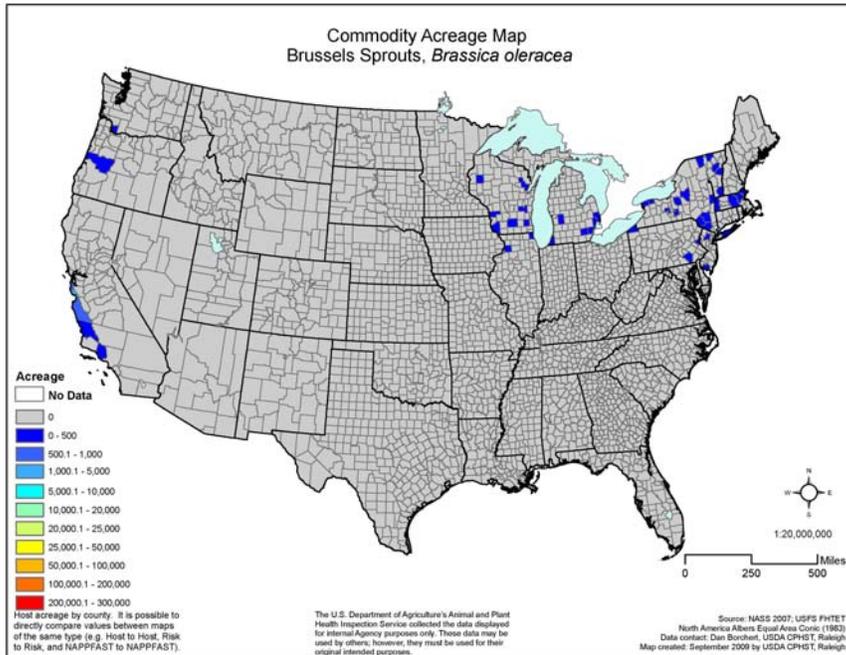


Figure 3. Commodity acreage map of Brussels sprouts (*Brassica oleracea*) within the continental United States. Values from low to high indicate increased commodity density. Map courtesy of USDA-APHIS-PPQ-CPHST. Check www.nappfast.org for the most recent map updates.

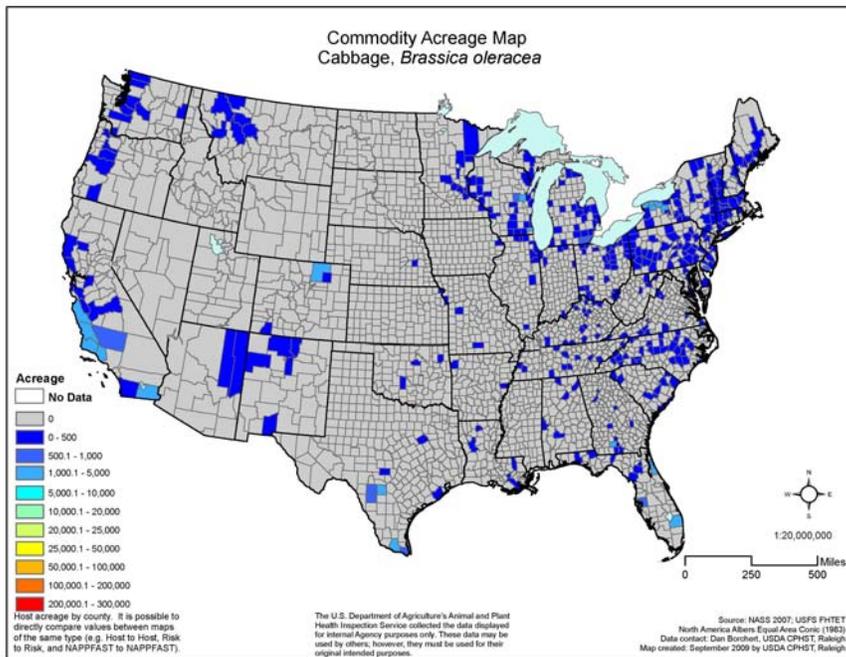


Figure 4. Commodity acreage map of cabbage (*Brassica oleracea*) within the continental United States. Values from low to high indicate increased commodity density. Map courtesy of USDA-APHIS-PPQ-CPHST. Check www.nappfast.org for the most recent map updates.

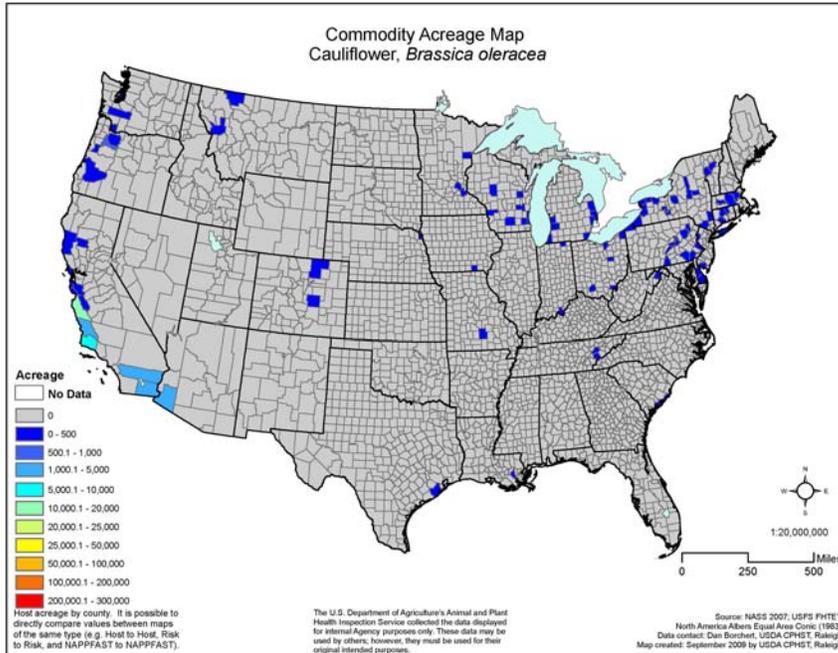


Figure 5. Commodity acreage map of cauliflower (*Brassica oleracea*) within the continental United States. Values from low to high indicate increased commodity density. Map courtesy of USDA-APHIS-PPQ-CPHST. Check www.nappfast.org for the most recent map updates.

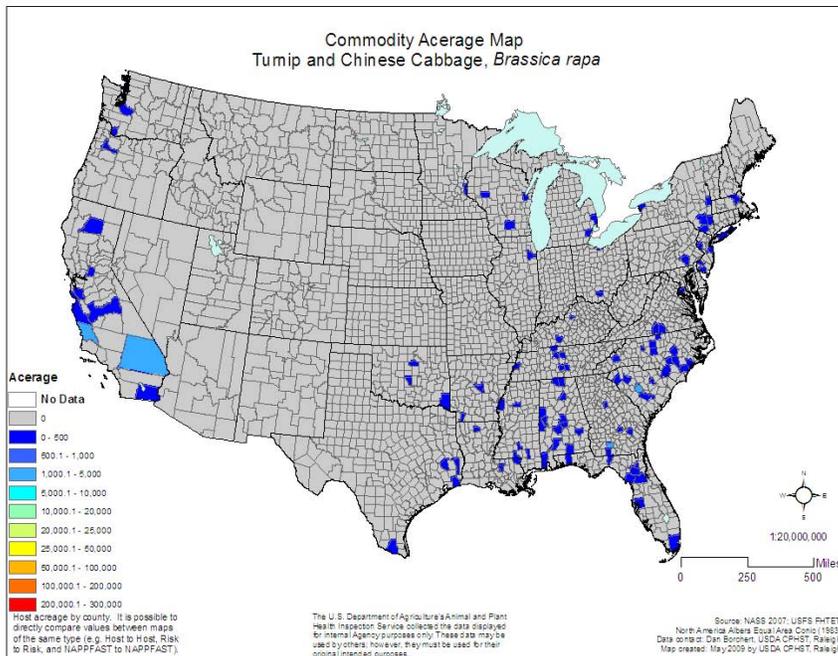


Figure 6. Commodity acreage map of turnip and Chinese cabbage (*Brassica rapa*) within the continental United States. Values from low to high indicate increased commodity density. Map courtesy of USDA-APHIS-PPQ-CPHST. Check www.nappfast.org for the most recent map updates.

Pathway

This species can move through natural spread. Within a day or two of emergence, the adults are capable of migrating up to 250 miles in a few days (Gardiner, 1974).

P. brassicae can also potentially travel through international trade. Viable pupae have previously been found on the exterior parts of shipping containers coming from Spain (NAPPO, 2002). Last instar larvae can move long distances to find pupation sites (NAPPO, 2002). This species has been intercepted over 25 times in the last 10 years, mainly on cargo containers in the pupal stage (AQAS, 2011).

Survey

CAPS-Approved Method*:

Visual inspection. All life stages can be looked for manually. Larvae can be found on the upper surface of the leaves during later instars (Feltwell, 1982). Adults are active on warm, sunny days and can be captured using sweep nets (Yildizhan et al., 2009, Gencer et al., 2008). No pheromones have currently been developed for this pest although some studies have looked at aphrodisiac pheromones in males (Yildizhan et al., 2009).

Literature-Based Methods:

Cartea et al. (2009) monitored *P. brassicae* larvae in crops in northwestern Spain by visually counting them on the plants; adults were not surveyed as no pheromone lures are available. Sweep netting is a common trapping method for many diurnal butterflies, including *P. brassicae*.

Survey site selection:

This species is attracted to host crops and to gardens, both for their nectar and cultivated cabbage species, (USDA, 1984). *P. brassicae* can survive on wild hosts when crops are not available.

Time of year to survey:

In Russia, adults fly from May to August and “in southern regions from the end of March to mid-October” (Ovsyannikova and Grichanov, n.d.).

Identification

CAPS-Approved Method*:

Morphological. Adult color can vary in the amount of black present (Gardiner, 1963). A few of the color variations are described in Gardiner (1963). Feltwell (1982) has a detailed chapter on the descriptions of all life stages. Other descriptions of the life stages can be found in Emmet and Heath (1989) and USDA (1984).

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at <http://caps.ceris.purdue.edu/>.

Easily Confused Pests

This species may be confused with *P. rapae*, the imported cabbageworm, because of similar color and markings (USDA, 1984). *P. rapae* is present in North America (NAPPO, 2002). *P. brassicae* is larger with a wingspan of 63 mm versus 48 mm for *P. rapae*; also, *P. rapae* males have a black spot on the forewing (USDA, 1984). Eggs of both species are also similar; *P. brassicae* lays eggs in batches of 20-50 while *P. rapae* lays eggs singly or in pairs (USDA, 1984). Caterpillars of *P. brassicae* and *P. rapae* can be easily distinguished as their colorings are distinctively different (Biosecurity New Zealand, 2010).

Commonly Encountered Non-targets

“Both *P. brassicae* and *P. rapae* have the same host range, similar oviposition preferences and life cycles” (Bulluck and Smith, 2003). As such, these two species would most likely be found together if *P. brassicae* were to be introduced into the United States. However, experienced taxonomists should have no problem telling the two species apart.

References

- Ali, A. and P. Q. Rizvi. 2007.** Developmental response of cabbage butterfly, *Pieris brassicae* L. (Lepidoptera: Pieridae) on different cole crops under laboratory and field condition. Asian Journal of Plant Sciences 6(8): 1241-1245.
- AQAS. 2011.** Interception data on *Pieris brassicae* from 1-1-2001 to 12-31-2010. Queried March 9, 2011.
- Atak, U. and E. D. Atak. 1984.** Investigations on the biology, ecology and control of microbial remedies of the large cabbage white butterfly (*Pieris brassicae* L.) [abstract]. Bitki Koruma Bülteni 24(4): 173-199.
- Atalya, R. and P. Hncal. 1992.** Investigations on the species of Pieridae (Lepidoptera) which are harmful to plants belonging to the family Cruciferae with their importance in Izmir and its vicinity and the biology of the large white butterfly (*Pieris brassicae* (L.)) along with the factors affecting its population fluctuations [abstract]. Doga Türk Tarım ve Ormancılık Dergisi 16(1): 271-286.
- Biosecurity New Zealand. 2010.** Great White Cabbage Butterfly. Biosecurity New Zealand, New Zealand Government.
- Bulluck, R. and J. Smith. 2003.** NPAG Report, *Inachis io*, *Nymphalis urticae*, and *Pieris brassicae*: European Butterflies. USDA-APHIS-PPQ-CPHST-PERAL-New Pest Advisory Group.
- Cartea, M. E., G. Padilla, M. Vilar, and P. Velasco. 2009.** Incidence of the major *Brassica* pests in Northwestern Spain. Journal of Economic Entomology 102(2): 767-773.
- David, W. A. L. and B. O. C. Gardiner. 1966.** Mustard oil glucosides as feeding stimulants for *Pieris brassicae* larvae in a semi-synthetic diet. Entomologic Experimentalis et Applicata. 9: 247-255.
- Emmet, A. M. and J. Heath (eds). 1989.** The Moths and Butterflies of Great Britain and Ireland. Volume 7, Part I. Harley Books. Essex, England. 370 pp.

EPPO. 2007. PQR database (version 4.6). Paris, France: European and Mediterranean Plant Protection Organization. www.eppo.org.

Feltwell, J. 1982. Large white butterfly, the biology, biochemistry and physiology of *Pieris brassicae* (Linnaeus). The Hague, the Netherlands. Dr. W. Junk Publishers. 535 pp.

Ferreres, F., C. Sousa, P. Valentão, J. A. Pereira, R. M. Seabra, P. B. Andrade. 2007. Tronchuda cabbage flavonoids uptake by *Pieris brassicae*. *Phytochemistry* 68: 361-367.

Gardiner, B. O. C. 1963. Genetic and environmental variation in *Pieris brassicae*. *Journal of Research on the Lepidoptera* 2(2): 127-136.

Gardiner, B. O. C. 1974. *Pieris brassicae* L. established in Chile; another Palearctic pest crosses the Atlantic (Pieridae). *Journal of the Lepidopterists' Society* 28(3): 269-277.

Geertsema, H. 1996. The large cabbage white, *Pieris brassicae*, an exotic butterfly of potential threat to cabbage growers in the Western Cape, South Africa [Abstract]. *Journal of the Southern African Society for Horticultural Sciences* . 6(1): 31-34.

Larsen, T. B. 1990. The Butterflies of Egypt. Apollo Books. Svendborg, Denmark. 117 pp.

Moore, B. 2010. Great white butterfly found in Nelson. *The Nelson Mail*. June 17, 2010. Accessed January 7, 2011 from: <http://www.naturalsciences.org/programs-events/?select=1589>.

NAPPO. 2002. Pathway identified for introduced *Pieris brassicae* (Lepidoptera: Pieridae) from Europe. North American Plant Protection Organization's Phytosanitary Alert System.

Ovsyannikova, E.I. and I.Y. Grichanov. No date. Pests: *Pieris Brassicae* L.- Large Cabbage White. *AgroAtlas: Interactive Agricultural Ecological Atlas of Russia and Neighboring Countries, Economic Plants and their Diseases, Pests and Weeds*. Accessed 18 November 2010 from: http://www.agroatlas.ru/en/content/pests/Pieris_brassicae/.

Sato, Y. and N. Ohsaki. 2004. Response of the wasp (*Cotesia glomerata*) to larvae of the large white butterfly (*Pieris brassicae*) [abstract]. *Ecological Research* 19(4): 445-449.

USDA-CPHST, 2009. Commodity Acreage Maps. USDA-APHIS-PPQ-CPHST. NCSU APHIS Plant Pest Forecasting System.

USDA. 1984. Pests not known to occur in the United States or of limited distribution, no. 47: large white butterfly. United States Department of Agriculture. Animal and Plant Health Inspection Service, Plant Protection and Quarantine.

Vliegthart, A., R. Verovnik, and M. Wiemers. 2010. Fauna Europaea: *Pieris brassicae*. In Karsholt, O. & Nieuwerkerken, E.J. van (eds.). *Fauna Europaea* version 2.3. Accessed January 5, 2011 from: <http://www.faunaeur.org>.

Yildizhan, S., J. van Loon, A. Sramkova, M. Ayasse, C. Arsene, C. ten Broeke, and S. Schulz. 2009. Aphrodisiac pheromones from the wings of the small cabbage white and large cabbage white butterflies, *Pieris rapae* and *Pieris brassicae*. *ChemBioChem* 10:1666-1677.

This datasheet was developed by USDA-APHIS-PPQ-CPHST staff. Cite this document as:

Molet, T. 2011. CPHST Pest Datasheet for *Pieris brassicae*. USDA-APHIS-PPQ-CPHST.