**Supplementary Table 1.** Days until complete mortality or reported survivorship of diamondback moth, *Plutella xylostella*, eggs at temperatures below the estimated lower developmental threshold (7.0–7.8ºC).

|  |  |  |
| --- | --- | --- |
| **Days until complete mortality or reported survivorship** | **Environmental conditions** | **Reference** |
| 55 days | 6 °C | Liu *et al.* 2002 |
| 33 days with no mortality until seven days | 5 °C | Saito 1994b |
| > 21 days with 53.3% survivorship | 5 °C | Kim *et al.* 2014 |
| 39 days | 4 °C | Smith and Sears 1982 |
| 55 days | 4 °C | Liu *et al.* 2002 |
| 42 days | 2 °C | Butts 1979 |
| 14 days | 0 °C | Hardy 1938 |
| 33 days with no mortality until seven days | 0 °C | Saito 1994b |
| > 28 days | 0 °C (outdoor) | Kim *et al.* 2014 |
| 50 days | 0 °C (under snow for 45 days then at -1 °C ± 2 °C) | Kimura and Fujimura 1988 |
| 50 days | 0 °C (preconditioning at 10 °C for two days and 5 °C for two days) | Honda 1992 |
| 23 days with no mortality until seven days | -5 °C | Saito 1994b |
| > 19 days with 19.7% survivorship | -5 °C | Kim *et al.* 2014 |

**Supplementary Table 2.** Days until complete mortality or reported survivorship of diamondback moth, *Plutella xylostella*, larvae at temperatures below the estimated lower developmental threshold (7.0–7.8ºC).

|  |  |  |
| --- | --- | --- |
| **Days until complete mortality or reported survivorship** | **Environmental conditions** | **Reference** |
| 29.3 days ± 0.37 (development first to second instar)  31.8 days ± 0.36 (development second to third instar)  24.8 days ± 0.27 (development third to fourth instar)  30.0 days ± 1.27 (development fourth instar to pre-pupae) | 6 °C | Liu *et al.* 2002 |
| 21 days (first instar)  27 days (second instar)  32 days (third instar)  37 days (fourth instar) | 5 °C | Saito 1994b |
| 40 days | 5 °C | Gu 2009 |
| > 21 days with 89.9% survivorship (second instar)  > 21 days with 85.5% survivorship (fourth instar) | 5 °C | Kim *et al.* 2014 |
| 47.9 days ± 0.70 (development first to second instar)  44.7 days ± 0.56 (development second to third instar)  41.8 days ± 1.52 (development third to fourth instar)  51.7 days ± 3.37 (development fourth instar to pre-pupae) | 4 °C | Liu *et al.* 2002 |
| > 60 days with approximately 70% survivorship (32% ± 17.9 pupated, 38% ± 21.7 remained larvae, 30% ± 10 died) | 0 °C to 5 °C alternating | Gu 2009 |
| 30 days (second and third instar)  40 days (fourth instar) | 0 °C (preconditioning at 10 °C for two days and 5 °C for two days) | Honda 1992 |
| 80 days (second instar) (70% at 40 days, 24% at 50 days, 12% at 60 days, 2% at 70 days) | 0 °C (preconditioning at 5 °C for five days) | Kimura *et al.* 1987c |
| > 28 days (fed and unfed treatments) | 0 °C (outdoor) | Kim *et al.* 2014 |
| 50 days (first instar)  50 days (second instar)  60 days (third instar)  80 days (fourth instar) | 0 °C (under snow for 43 days (first and second instar), 34 days (third and fourth instar) then at -1 °C ± 2 °C) | Kimura and Fujimura 1988 |
| 17 days (fourth instar)  17 days (second instar)  32 days (third instar)  24 days (fourth instar) | 0 °C | Saito 1994b |
| 2 days (second instar)  4 days (third instar)  6 days (fourth instar) | -5 °C | Gu 2009 |
| 11 days (first instar)  5 days (second instar)  16 days (third instar)  18 days (fourth instar) | -5 °C | Saito 1994b |
| > 19 days with 70% survivorship (second instar)  > 19 days with 66.7% survivorship (fourth instar) | -5 °C | Kim *et al.* 2014 |

**Supplementary Table 3.** Days until complete mortality or reported survivorship of diamondback moth, *Plutella xylostella*, pupae at temperatures below the estimated lower developmental threshold (7.0–7.8 ºC).

|  |  |  |
| --- | --- | --- |
| **Days until complete mortality or reported survivorship** | **Environmental conditions** | **Reference** |
| 9.8 ± 0.43 days (development pre-pupae to pupae) | 6 °C | Liu *et al.* 2002 |
| 56 days | 5 °C | Smith and Sears 1982 |
| 46 days | 5 °C | Saito 1994b |
| > 21 days with 66.7% survivorship | 5 °C | Kim *et al.* 2014 |
| 12 ± 0.48 days (development pre-pupae to pupae) | 4 °C | Liu *et al.* 2002 |
| 60–90 days | 0 °C to 7 °C | Hardy 1938 |
| > 60 days with 56.7% ± 11.5 survivorship | 0 °C to 5 °C alternating | Gu 2009 |
| 32 days | 0 °C | Saito 1994b |
| > 28 days | 0 °C (Outdoor) | Kim *et al.* 2014 |
| > 80 days with 10% survivorship  30 days with adult eclosion and survival  40 days with adult eclosion but poor adult survival | 0 °C (under snow for 30 days then at -1 °C ± 2 °C) | Kimura and Fujimura 1988 |
| 60 days | 0 °C (preconditioning at 10 °C for two days and 5 °C for two days) | Honda 1992 |
| 13 days | -5 °C | Gu 2009 |
| 12 days | -5 °C | Saito 1994b |
| > 19 days with 60.7% survivorship | -5 °C | Kim *et al.* 2014 |

**Supplementary Table 4.** Days until complete mortality or reported survivorship of diamondback moth, *Plutella xylostella*, adults at temperatures below the estimated lower developmental threshold (7.0–7.8 ºC).

|  |  |  |
| --- | --- | --- |
| **Days until complete mortality or reported survivorship** | **Environmental conditions** | **Reference** |
| 66 days | 5 °C | Saito 1994b |
| 51 days | 5 °C | Ohtomo and Chiba 2001 |
| 77 days | 4 °C | Smith and Sears 1982 |
| > 60 days with 15–20% survivorship with eggs | 0 °C to 5 °C alternating | Gu 2009 |
| > 70 days with 50% survivorship with eggs | 0 °C (under snow for 56 days then at -1 °C ± 2 °C) | Kimura and Fujimura 1988 |
| 50 days with eggs  > 60 days with 7.5% male, 10% female survivorship without eggs | 0 °C (preconditioning at 10 °C for two days and 5 °C for two days) | Honda 1992 |
| 60 days | 0 °C | Ohtomo and Chiba 2001 |
| 58 days | 0 °C | Saito 1994b |
| 28 days | 0 °C (outdoor) | Kim *et al.* 2014 |
| > 20 days with 33% survivorship with eggs | -5 °C | Gu 2009 |
| 11 days | -5 °C | Saito 1994b |

**Supplementary Table 5.** Average supercooling points for diamondback moth, *Plutella xylostella*, at different life stages and treatments.

|  |  |
| --- | --- |
| **Average supercooling point** | **Reference** |
| **Egg** |  |
| -15.8 °C  -17.8 °C (with rapid cold hardening) | Park and Kim 2014 |
| **Larva** |  |
| -16.70 °C (fourth instar laboratory reared control)  -15.04 °C (fourth instar wildtype control)  -15.71 °C (fourth instar wildtype with preconditioning at 5 °C for five days)  -18.0 °C (fourth instar laboratory reared with preconditioning at 5 °C for five days) | Kaneko 1995 |
| -16.1 °C (second instar)  -14.9 °C (third instar)  -13.1 °C (fourth instar) | Hayakawa *et al.* 1988 |
| -11.7 °C (first instar)  -13.1 °C (first instar with rapid cold hardening)  -12.4 °C (second instar)  -13.3 °C (second instar with rapid cold hardening)  -12.8 °C (third instar)  -14.5 °C (third instar with rapid cold hardening)  -13.0 °C (fourth instar)  -14.9 °C (fourth instar with rapid cold hardening) | Park and Kim 2014 |
| **Pupa** |  |
| -16.90 °C (laboratory reared control)  -19.45 °C (wildtype with preconditioning at 5 °C for five days)  -13.50 °C (laboratory reared with preconditioning at 5 °C for five days)  -23.2 °C (laboratory reared (sterile) with preconditioning at 5 °C for five days) | Kaneko 1995 |
| -19.21 °C | Hayakawa *et al.* 1988 |
| -10.8 °C  -12.6 °C (with rapid cold hardening) | Park and Kim 2014 |
| **Adult** |  |
| -19.1 °C (laboratory reared control)  -19.0 °C (laboratory reared with preconditioning at 5 °C for five days)  -22.4 °C (laboratory reared (sterile) with preconditioning at 5 °C for five days) | Kaneko 1995 |
| -10.1 °C  -10.1 °C (with rapid cold hardening) | Park and Kim 2014 |

**Supplementary Table 6.** Weather data for diamondback moth, *Plutella xylostella*, overwintering studies accessed through Environment Canada.

|  |  |  |  |
| --- | --- | --- | --- |
| Weather data from Environment Canada | Station identification  (Meteorological Service of Canada) | Station name | Station decimal degrees (latitude, longitude) |
| Harcourt (1954)  1953–1954  Merivale Research Station, Ottawa, Ontario  45°23'19.9"N 75°43'18.5"W  45.388846, -75.721818 | 6105976 | OTTAWA CDA | 45.38, -75.72 |
| Butts (1979)  1977–1978  Cambridge Research Station, Cambridge, Ontario  43°26'22.6"N 80°20'57.9"W  43.439598, -80.349427 | 6149387 | WATERLOO WELLINGTON A | 43.45, -80.38 |
| Smith and Sears (1982)  1980–1981  Cambridge Research Station, Cambridge, Ontario  43°26'22.6"N 80°20'57.9"W  43.439598, -80.349427 | 6149387 | WATERLOO WELLINGTON A | 43.45, -80.38 |
| Dosdall (1994)  1990–1992  Alberta Environmental Center, Vegreville, Alberta  53°30'14.1"N 112°05'59.5"W  53.503920, -112.099875 | 3016GF0 | VEGREVILLE | 53.51, -112.1 |
| Dosdall *et al*. (2001)  1993–1998  Alberta Environmental Center, Vegreville, Alberta  53°30'14.1"N 112°05'59.5"W  53.503920, -112.099875 | 3016GF0 | VEGREVILLE | 53.51, -112.1 |
| Dosdall *et al*. (2001)  1993–1995 (supplement)  Alberta Environmental Center, Vegreville, Alberta  53°30'14.1"N 112°05'59.5"W  53.503920, -112.099875 | 3016840 | VIKING | 53.10, -111.78 |
| Dosdall *et al*. (2001)  1996–1997  Saskatoon Research and Development Center, Saskatoon, Saskatchewan  52°09'11.0"N 106°34'47.5"W  52.153056, -106.579861 | 4057154 | SASKATOON KERNEN FARM | 52.15, -106.55 |

**Supplementary Table 7.** Weather data for diamondback moth, *Plutella xylostella*, overwintering studies accessed through National Centres for Environmental Information.

|  |  |  |  |
| --- | --- | --- | --- |
| Weather data from National Centers for Environmental Information (NOAA) | Station identification | Station name | Station decimal degrees (latitude, longitude) |
| Harcourt (1954)  1953–1954  Liddell Field Station, Ithaca, New York  42°27'38.2"N, 76°26'39.6"W  42.460617, -76.444335 | GHCND:USC00304174 | ITHACA CORNELL UNIVERSITY NY US | -42.45, 76.4667 |
| Talekar and Shelton (1993)  1990–1991  Ithaca, New York | GHCND:USC00304174 | ITHACA CORNELL UNIVERSITY NY US | 42.45, -76.4667 |
| Talekar and Shelton (1993)  1990–1991  Long Island, New York | GHCND:USC00302091 | DIX HILLS NY US | 40.8, -73.3 |
| Idris and Grafius (1996)  1992–1993  Michigan State University Collins Road Entomology Research farm, Lansing, Michigan  42°41'45.5"N, 84°29'51.8"W  42.695987, -84.497730 | GHCND:USC00202395 | EAST LANSING 4 S MI US | 42.6667, -84.4833 |
| Kim *et al*. (2014, 2015)  2013–2014  South Korea | 471110 | Seoul AB | 127.144, 37.446 |
| 471140 | Wonju | 127.96, 37.438 |

**Supplementary Table 8.** Weather data for diamondback moth, *Plutella xylostella*, and overwintering study accessed through Agricultural Applied Climate Information System (AgACIS).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Weather data from Agricultural Applied Climate Information System (AgACIS)  http://agacis.rcc-acis.org/ | FIPS | Station identification | Station name | Station decimal degrees (latitude, longitude) |
| Marsh (1917)  1908–1916  Colorado State University, Rocky Ford, Colorado  38°02'22.6"N 103°41'33.6"W  38.039606, -103.692674 | 08089 | 57167 | ROCKY FORD 2 ESE | 38.03, -103.69 |