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The parasite-host relationship between *Encarsia formosa* (Hymenoptera: Aphelinidae) and *Trialeurodes vaporariorum* (Homoptera: Aleyrodidae) XXXIV. Life-history parameters of the greenhouse whitefly, *Trialeurodes vaporariorum* as a function of host plant and temperature.

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Contents

Abstract

Life-history parameters of the greenhouse whitefly are reviewed. The relationship immature development rate, immature mortality, sex ratio, longevity, pre-oviposition period, fecundity, oviposition frequency, period of increase of daily oviposition and temperature have been assessed by non-linear regression for each host plant. Five mathematical equations were fitted, the best being selected on the basis of comparison of coefficients of determination (r^2) and by visual comparison of the curves. Coefficients to describe mean life-history parameters as a function of temperature are summarized. Coefficients of variation (cv) among individuals of each life-history parameter are also given. These will be used as inputs into a simulation model of the population dynamics of the greenhouse whitefly.

1. Introduction

The greenhouse whitefly, *Trialeurodes vaporariorum* (Westwood), is a well known, highly polyphagous pest insect. Recently, van Lenteren & Noldus (1990) reviewed whitefly-plant relationships. Adults and immatures feed on phloem sap and produce large amounts of honeydew, on which occasionally black moulds develop. As a result, crop yield is reduced (Lindquist et al., 1972). More important is the economic damage on fruits and ornamentals due to the residue of sticky honeydew. Hussey et al. (1958) measured significant yield reduction on tomato at an average pest density (between start of pest and final picking of fruits) of 22 scales/cm^2 leaf or more, and an economic yield reduction at 6 scales/cm^2 or more. According to Helgesen & Tauber (1974), a much lower density of 0.3-0.7 scales/cm^2 leaf is commercially acceptable on poinsettia.

Despite available insecticides, whiteflies are still a major economic problem in greenhouse crop production. Other control methods have been studied, such as resistance breeding (de Ponti et al., 1990) and biological control (Noldus & van Lenteren, 1990). Introduction of the parasitoid *Encarsia formosa* has proven to be commercially successful. In the Netherlands, about 90 percent of the tomato acreage is under biological control and the parasitoid has been introduced in many other countries (van Lenteren & Woets, 1988). As yet there is no explanation as to why the parasitoid cannot be applied successfully on some other crops.

A simulation model based on developmental and behavioural aspects of individuals in relationship to host plant and environment is being developed to find out more about the tritrophic system host plant- greenhouse whitefly- *Encarsia formosa* in order to understand failure or success of biological control.

The simulation model consists of several submodels each simulating a certain subprocess, for example the population dynamics of the greenhouse whitefly, which depends on the host plant species and the environment. Inputs in this submodel are life-history parameters, such as immature development, immature mortality, adult longevity, sex ratio and fecundity or oviposition frequency. These life-history parameters have been reviewed to some extent by Vet et al. (1980), van Lenteren & Hulspas-Jordaan (1983) and Hulspas-Jordaan & van Lenteren (1989). In this article a more comprehensive review has been given and the relationship between life-history parameters and temperature has been estimated for each host plant by non-linear regression.

2. Material & Methods

Between 1915 and 1990, about 100 studies were done on life-history parameters of the greenhouse whitefly. Data were selected on development rate of each immature stage, percentage mortality of each immature stage, sex ratio, longevity, pre-oviposition period, fecundity, oviposition frequency and period of increase of daily oviposition on several host plants, such as bean (*Phaseolus vulgaris* L.), cucumber (*Cucumis sativus* L.), eggplant (*Solanum melongena* L.), gerbera (*Gerbera jamesonii* Hook.), tobacco (*Nicotiana tabacum* L.), tomato (*Lycopersicon esculentum* Miller) and sweet pepper (*Capsicum annuum* L.). Data sets are incomplete for garden chrysanthemums (*Dendranthema* cvs), gherkin (*Cucumis sativus* L.), hibiscus (*Hibiscus rosa-sinensis* L.), melon (*Cucumis melo* L.), potato (*Solanum tuberosum* L.), one of the wild potatoes (*Solanum berthaultii* Hawkes) and tree tobacco (*Nicotiana glauca* Grah.). Sometimes a distinction was made between East European (Hungarian, Bulgarian, Russian) and West European whitefly. As van Lenteren et al. (1989) clearly showed, there is a difference in whitefly strains. Most experiments have focused on the effect of temperature on these parameters with little attention to other environmental factors such as humidity and light. All collected data are given in Appendices A-H, in which the number of decimals have been copied from the original studies. Small experiments (with a low number of whiteflies) of one study were sometimes combined and the (weighted) average is given in the appendices.

Host plant and temperature are the most important factors influencing life-history parameters for many insect species. The relationship between life-history parameters and temperature was determined for each host plant by non-linear regression based on a least squares method of Marquard (Statgraphics User's Manual, version 4.0, 1989). For each life-history parameter, several mathematical equations were used to describe the relationship to temperature. The best fitted curve was selected on the basis of the coefficient of determination (r^2, based on the corrected total sum of squares) and on visual comparison of the curves which was necessary to check whether a curve was biologically realistic, particularly the tails.

Five mathematical equations were used, in which Y is the life-history parameter and X is the temperature (°C):

1) Linear: $Y = a + b*X$

2) Exponential: $Y = \exp(a + b*X)$

3) Third degree polynomial: $Y = a + b*X + c*X^2 + d*X^3$

4) Logan (et al., 1976): $Y = a * \{\exp(b*(X\text{-}d)) - \exp(b*(e\text{-}d) - (e\text{-}X)/c)\}$

5) Weibull (1951; Campbell & Madden, 1990):

$$Y = c/b * ((X\text{-}a)/b)^{c-1} * \exp(-((X\text{-}a)/b)^{c}) * d$$

The first three models are well known, the last two need some explanation. According to the Logan model (Fig. 1-9), Y increases exponentially from the value *a* at the lower threshold temperature *d* to an optimum temperature with a relative increase of *b*, whereafter Y declines sharply until the upper lethal temperature *e* has been reached. If the lower threshold and upper lethal temperature are known, only three coefficients have to be estimated. The Weibull model (Fig. 10, 12 and 13) describes an exponential increase from the lower lethal temperature *a* to an optimum temperature, whereafter Y decreases exponentially. The scale parameter *b* is inversely related to the rate of increase, the shape parameter *c* controls the skewness of the curve and the coefficient *d* is the area under the curve. Other shapes are also possible, depending on the values of the coefficients. When the lower lethal temperature is known, three coefficients have to be estimated.

As four of these models descibe non-linear relations, only life-history parameters measured at a constant temperature can be used in the regression procedure. Experiments done at fluctuating temperature can only be used to validate the models when hourly temperature data are available.

3. Results

3.1 Life-history parameters

Whiteflies feed on phloem sap and produce large amounts of honeydew. The adults can migrate to other leaves or plants. The females lay their white eggs on the underside of the plant leaves. After a few days the eggs turn purple or black. The first instar larva (L1) is initially mobile and after a few hours it settles down and inserts its mouth parts into the leaf. Subsequently, the larva moults into the second (L2) and third (L3) instar, which differ in size (for sizes, see Hulspas-Jordaan and van Lenteren, 1989). The next moult results in the last instar, which is initially flat and translucent, like the previous instars. As the last instar larva develops, it thickens and becomes white-coloured with waxy

Table 1. Terms used to describe the last immature instar of the greenhouse whitefly.

Author	First phase	Second phase	Third phase
This article	L4	prepupa	pupa
Hargreaves, 1915	L4	L4	L4
Weber, 1931	L4	L4	L4
Burnett, 1949	L4	pupa	pupa
Hussey & Gurney, 1957	pupa	pupa	pupa
Eijsackers, 1969	L4	L4	pupa
Kraayenbrink, 1972	L4	L4	L4
Veerkamp, 1975	L4	L4	pupa
van Bruggen, 1975	L4	L4	pupa
van Lenteren et al., 1976	L4	prepupa	pupa
Di Pietro, 1977	L4	pupa	pupa
Nechols & Tauber, 1977a and b	early 4th	Transitional	Pharate adult
Hulspas, 1978	L4	L4	pupa
van de Merendonk, 1978	L4	pupa	pupa
Zebitz, 1978	L4	L4	L4
Madueke, 1979	L4	L4	pupa
Li et al, 1980	pseudopupa	pseudopupa	pseudopupa
Christochowitz & van der Fluit, 1981	L4	prepupa	pupa
Agekyan, 1981	pupa	pupa	pupa
Arakawa, 1982	L4	prepupa	pupa
Kajita, 1982	L4	pupa	pupa
van Evert & Schutte, 1983	L4	prepupa	pupa
Burggraaf & van der Laan, 1983	L4	prepupa	pupa
Fransen & van Montfort, 1987	L4	prepupa	pupa
Yano, 1988	early L4	late L4	late L4
Kajita, 1989	L4	pupa	pupa
Dorsman & van der Vrie (unpubl.)	pupa	pupa	pupa

spines. During the last phase of its development the red pigmented eyes of the adult can be seen. Many studies do not distinguish the three phases of the last instar or they use different terms to describe these phases (Table 1). Because the parasitoid *Encarsia formosa* makes a significant difference in accepting the phases of the last instar (Nell et al., 1976), these phases have been distinguished as follows: fourth instar larva (L4), prepupa (PP) and pupa (PU). Development rate and mortality have been calculated for each of the three last phases separately (L4, PP, PU) and for the total last instar (L4 + PP + PU).

3.1.1 Immature development rate

The development rate of each immature stage was calculated as the reciprocal of its duration. Weber (1931) found a lower threshold temperature for development of eggs and the first three larval instars of 8 °C on tobacco and for L4 larvae a few degrees lower. Van Evert & Schutte (1983) did experiments on tomato at 7 °C and found hardly any development of all immature stages. Therefore a lower threshold temperature of 8 °C was taken in the regression procedure. Osborne (1982) estimated a lower threshold temperature of 8.3 °C by linear regression using data of Stenseth (1971), whereas Madueke & Coaker (1984), using their own data estimated the threshold temperature at 7.0-11.5 °C.

Weber (1931) found an upper lethal temperature of 35 °C for egg development and a somewhat higher temperature for the other immature stages. Van Evert & Schutte (1983) still found larval development at 35 °C. Thus 35 °C was taken as the upper lethal temperature for egg development and 38 °C for other immature stages in the regression procedure. It was assumed that the lower threshold and upper lethal temperature for development were the same on all host plants. The Logan model yielded the highest coefficients of determination (r^2). This model was also used by Gerling et al. (1986) for immature development of the cotton whitefly, *Bemisia tabaci*. The relationships between development rate of the immature whitefly stages and temperature on eight host plants are shown in Tables 2-10 and presented in Figures 1-9 for tomato. Data on tobacco and tree tobacco were combined because no difference was observed.

Exceptional data points were excluded (n_e) from the regression, such as Eijsackers (1969; L1, L2, L3, pupa, L4 + prepupa + pupa and total development on tomato at 30 °C); van de Merendonk (1978; L4 on tomato at 24 °C); Huang (1988; pupa on tomato at 25 °C); Collman & All (1980; L2 on bean at 26 °C); Hooy (1984; L1 on cucumber at 25 °C); van Sas (1978; total development on cucumber and eggplant at 25 °C); Di Pietro (1977; L1 at 22 °C and L4 + prepupa + pupa at 27 °C on tobacco); Mulock Houwer (1977; L2 at 21 °C, L3 at 25 °C and total development at 25 °C on gerbera). Huang (1988) used old plants, and Mulock Houwer (1977) used leaves that had been removed from the plant. The reasons for the exceptional development rates could not be ascertained from the other studies. All data points are presented in the relevant figures and appendices.

Table 2. Relationship between the development rate of eggs and temperature based on the Logan model where *a*, *b* and *c* are coefficients, *d* and *e* are the lower threshold and upper lethal temperature (8 and 35°C respectively), r^2 is the coefficient of determination, and n_i and n_e are the number of data points included and excluded respectively.

Host plant	*a*	*b*	*c*	r^2	n_i	n_e
Tomato	0.0464	0.0767	2.56	0.733	19	0
Bean	0.0265	0.108	3.09	0.913	18	0
Cucumber	0.0303	0.115	4.09	0.865	7	0
Eggplant	–	–	–	–	2	0
(Tree)Tobacco	0.0409	0.0796	1.83	0.920	9	0
Gerbera	0.0320	0.103	3.67	0.947	9	0
Sweet pepper	–	–	–	–	4	0
Chrysanthemum	0.0444	0.0647	4.15	0.911	4	0

Table 3. Relationship between the development rate of L1 and temperature based on the Logan model where *a*, *b* and *c* are coefficients, *d* and *e* are the lower threshold and upper lethal temperature (8 and 38°C respectively), r^2 is the coefficient of determination, and n_i and n_e are the number of data points included and excluded respectively.

Host plant	*a*	*b*	*c*	r^2	n_i	n_e
Tomato	0.0612	0.101	3.21	0.726	14	1
Bean	0.0614	0.146	5.39	0.874	17	0
Cucumber	0.120	0.0581	1.19	0.617	6	1
Eggplant	–	–	–	–	2	0
(Tree)Tobacco	0.118	0.130	6.70	0.830	6	1
Gerbera	0.0749	0.0813	4.19	0.869	9	0
Sweet pepper	–	–	–	–	4	0
Chrysanthemum	0.0467	0.0515	2.08	0.975	4	0

Table 4. Relationship between the development rate of L2 and temperature based on the Logan model where *a*, *b* and *c* are coefficients, *d* and *e* are the lower threshold and upper lethal temperature (8 and 38°C respectively), r^2 is the coefficient of determination, and n_i and n_e are the number of data points included and excluded respectively.

Host plant	*a*	*b*	*c*	r^2	n_i	n_e
Tomato	0.100	0.0848	1.71	0.801	14	1
Bean	0.0704	0.0914	0.539	0.537	10	1
Cucumber	0.142	0.0712	0.886	0.762	7	0
Eggplant	–	–	–	–	2	0
(Tree)Tobacco	0.323	0.115	7.58	0.933	6	0
Gerbera	0.284	0.0957	8.16	0.581	8	1
Sweet pepper	–	–	–	–	4	0
Chrysanthemum	0.318	0.0441	15.0	0.593	4	0

Table 5. Relationship between the development rate of L3 and temperature based on the Logan model where *a*, *b* and *c* are coefficients, *d* and *e* are the lower threshold and upper lethal temperature (8 and 38°C respectively), r^2 is the coefficient of determination, and n_i and n_e are the number of data points included and excluded respectively.

Host plant	*a*	*b*	*c*	r^2	n_i	n_e
Tomato	0.123	0.0644	2.09	0.868	13	2
Bean	0.0835	0.0837	0.895	0.770	11	0
Cucumber	0.0874	0.120	4.60	0.876	7	0
Eggplant	–	–	–	–	2	0
(Tree)Tobacco	0.141	0.119	6.76	0.923	6	0
Gerbera	0.237	0.0918	8.44	0.822	8	1
Sweet pepper	–	–	–	–	4	0
Chrysanthemum	–	–	–	–	4	0

Table 6. Relationship between the development rate of L4 and temperature based on the Logan model where *a*, *b* and *c* are coefficients, *d* and *e* are the lower threshold and upper lethal temperature (8 and 38°C respectively), r^2 is the coefficient of determination, and n_i and n_e are the number of data points included and excluded respectively.

Host plant	*a*	*b*	*c*	r^2	n_i	n_e
Tomato	0.124	0.0774	0.236	0.989	5	1
Bean	–	–	–	–	2	0
Cucumber	0.148	0.112	6.09	0.804	3	0
Eggplant	–	–	–	–	1	0
(Tree)Tobacco	0.053	0.208	4.52	0.874	3	0
Gerbera	0.180	0.0768	8.23	0.528	5	0
Sweet pepper	–	–	–	–	3	0
Chrysanthemum	–	–	–	–	0	0

Table 7. Relationship between the development rate of the prepupa and temperature based on the Logan model where *a*, *b* and *c* are coefficients, *d* and *e* are the lower threshold and upper lethal temperature (8 and 38°C respectively), r^2 is the coefficient of determination, and n_i and n_e are the number of data points included and excluded respectively.

Host plant	*a*	*b*	*c*	r^2	n_i	n_e
Tomato	0.331	0.0882	9.40	0.929	3	0
Bean	–	–	–	–	1	0
Cucumber	–	–	–	–	2	0
Eggplant	–	–	–	–	0	0
(Tree)Tobacco	–	–	–	–	1	0
Gerbera	0.338	0.106	7.60	0.918	5	0
Sweet pepper	–	–	–	–	0	0
Chrysanthemum	–	–	–	–	0	0

Table 8. Relationship between the development rate of the pupa and temperature based on the Logan model where *a*, *b* and *c* are coefficients, *d* nd *e* are the lower threshold and upper lethal temperature (8 and 38 °C respectively), r^2 is the coefficient of determination, and n_i and n_e are the number of data points included and excluded respectively.

Host plant	*a*	*b*	*c*	r^2	n_i	n_e
Tomato	0.125	0.115	6.43	0.780	6	2
Bean	0.0743	0.0933	4.06	0.967	4	0
Cucumber	0.0585	0.108	1.20	0.416	3	0
Eggplant	–	–	–	–	1	0
(Tree)Tobacco	–	–	–	–	1	0
Gerbera	0.121	0.0955	6.82	0.685	5	0
Sweet pepper	–	–	–	–	1	0
Chrysanthemum	–	–	–	–	0	0

Table 9. Relationship between the development rate of L4 + prepupa + pupa and temperature based on the Logan model where *a*, *b* and *c* are coefficients, *d* and *e* are the lower threshold and upper lethal temperature (8 and 38 °C respectively), r^2 is the coefficient of determination, and n_i and n_e are the number of data points included and excluded respectively.

Host plant	*a*	*b*	*c*	r^2	n_i	n_e
Tomato	0.0377	0.104	5.12	0.764	15	1
Bean	0.0635	0.116	7.16	0.846	17	0
Cucumber	0.0415	0.127	6.05	0.851	7	0
Eggplant	–	–	–	–	2	0
(Tree)Tobacco	0.0628	0.139	6.35	0.895	10	1
Gerbera	0.0911	0.0962	8.45	0.639	9	0
Sweet pepper	–	–	–	–	4	0
Chrysanthemum	0.0563	0.0165	4.30	0.114	4	0

Table 10. Relationship between the total immature development rate and temperature based on the Logan model where *a*, *b* and *c* are coefficients, *d* and *e* are the lower threshold and upper lethal temperature (8 and 35 °C respectively), r^2 is the coefficient of determination, and n_i and n_e are the number of data points included and excluded respectively.

Host plant	*a*	*b*	*c*	r^2	n_i	n_e
Tomato	0.0109	0.0838	2.13	0.739	29	1
Bean	0.00915	0.109	4.21	0.929	28	0
Cucumber	0.0153	0.148	5.65	0.960	12	1
Eggplant	0.00906	0.167	4.89	0.891	14	1
(Tree)Tobacco	0.0220	0.123	6.74	0.771	11	0
Gerbera	0.0316	0.146	6.33	0.953	21	1
Sweet pepper	0.0151	0.0928	6.37	0.344	14	0
– East European whitefly	–	–	–	–	5	0
– West European whitefly	0.00777	0.138	5.05	0.730	9	0
Chrysanthemum	0.0143	0.0294	2.62	0.983	4	0

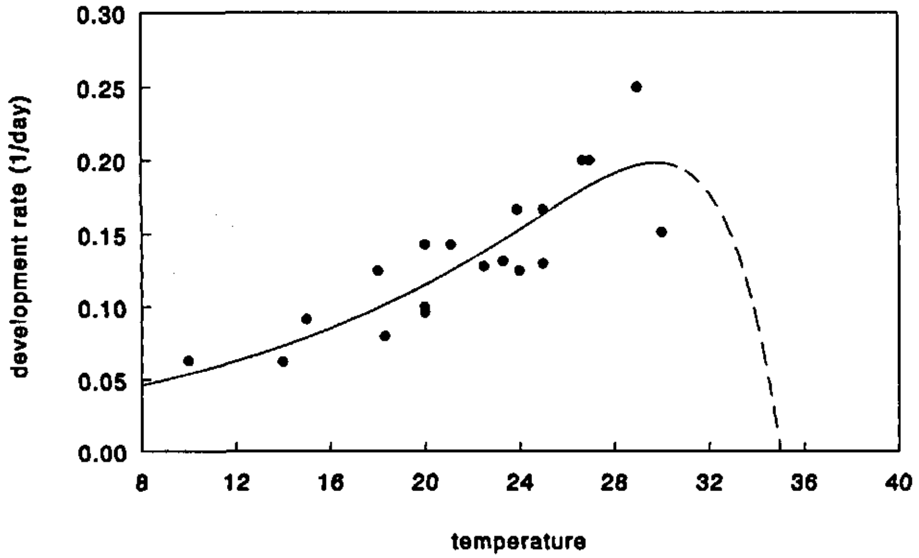

Fig. 1. Relationship between the development rate (1/day) of the egg stage and temperature on tomato.

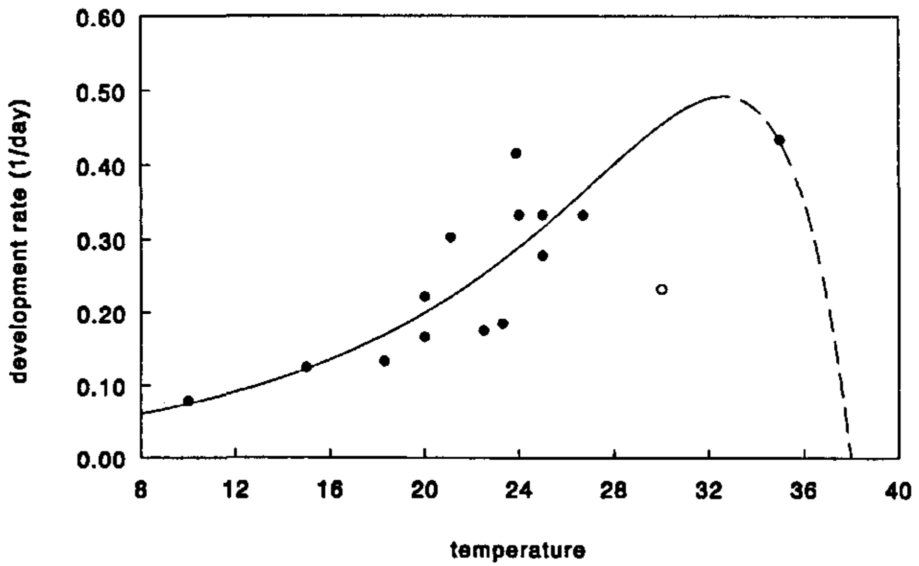

Fig. 2. Relationship between the development rate (1/day) of L1 and temperature on tomato. Open dots represent data points excluded from the regression.

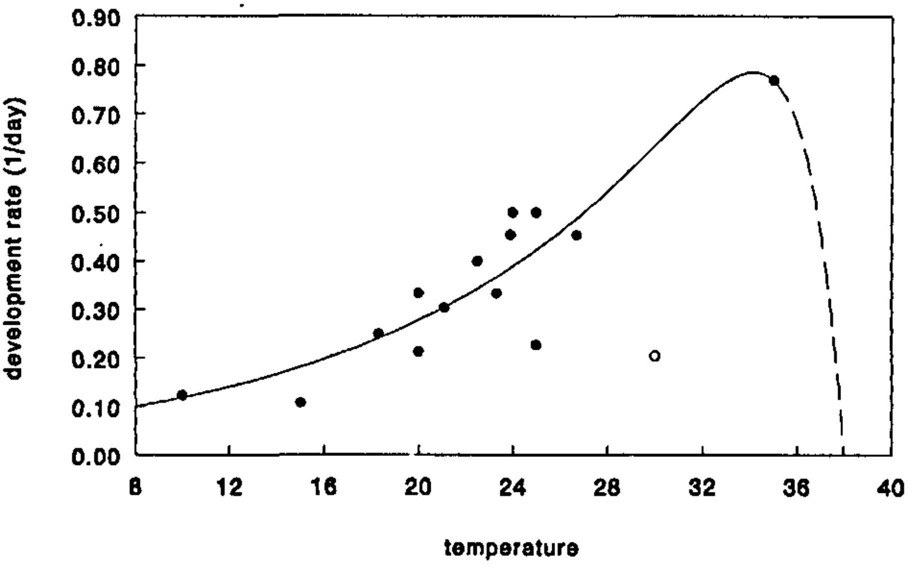

Fig. 3. Relationship between the development rate (1/day) of L2 and temperature on tomato. Open dots represent data points excluded from the regression.

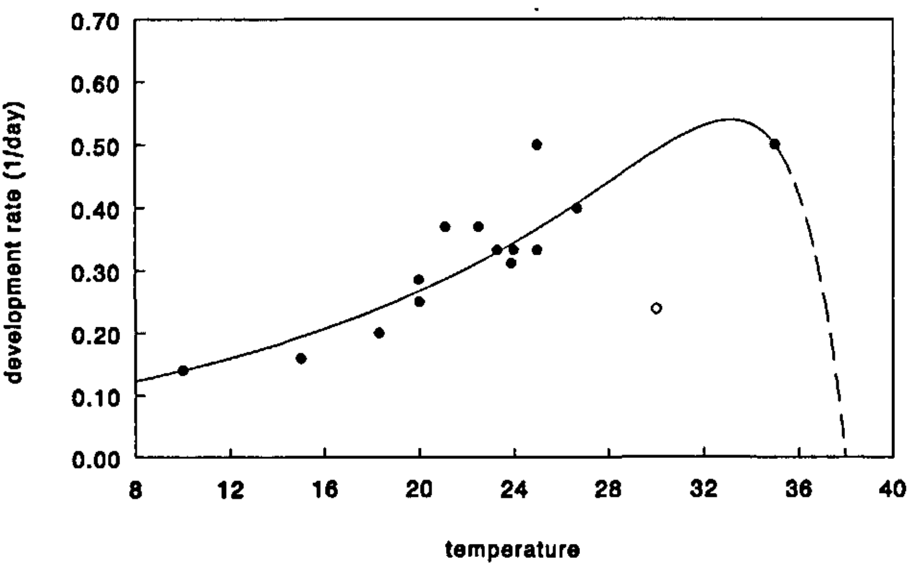

Fig. 4. Relationship between the development rate (1/day) of L3 and temperature on tomato. Open dots represent data points excluded from the regression.

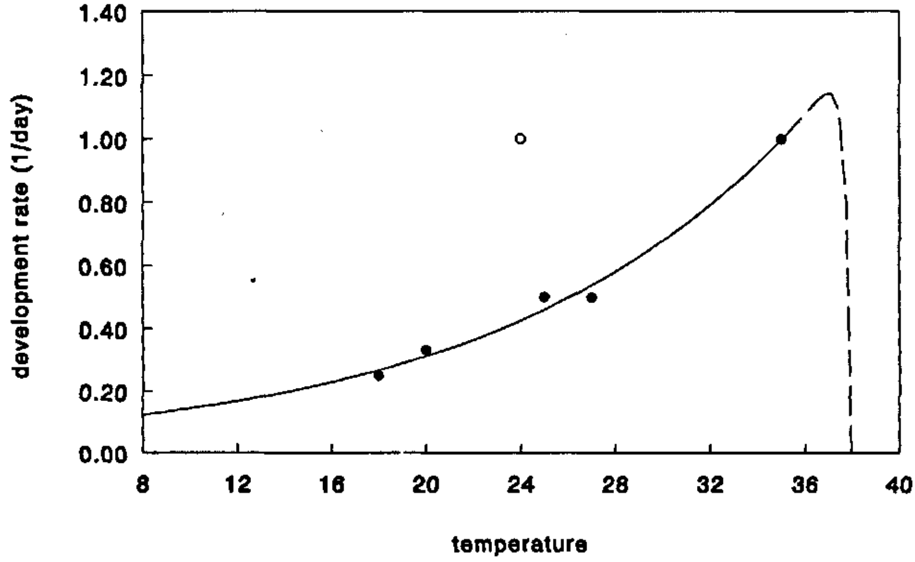

Fig. 5. Relationship between the development rate (1/day) of L4 and temperature on tomato. Open dots represent data points excluded from the regression.

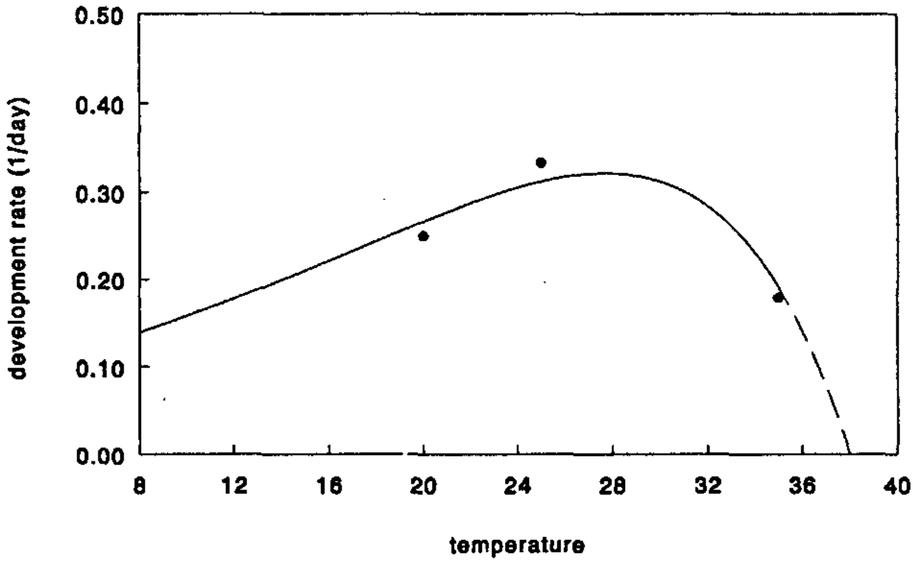

Fig. 6. Relationship between the development rate (1/day) of the prepupa and temperature on tomato.

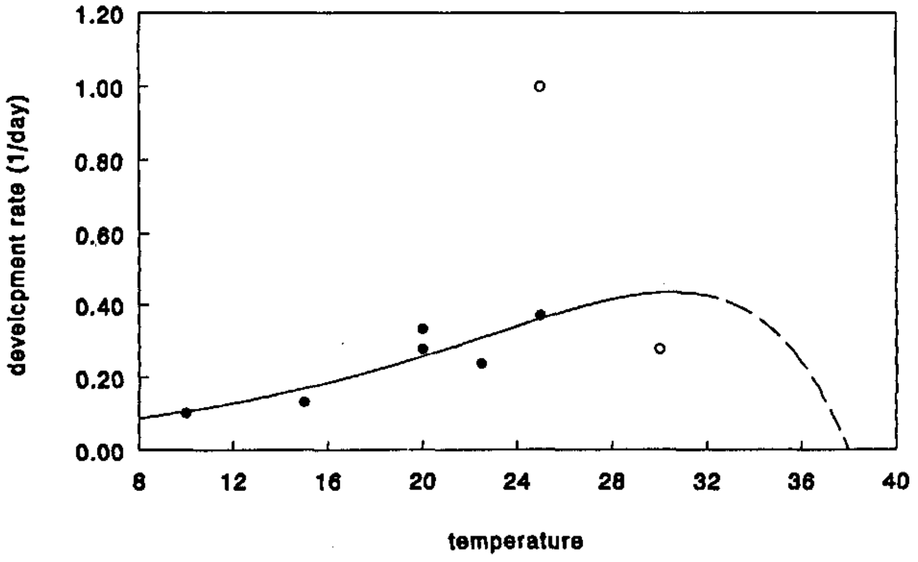

Fig. 7. Relationship between the development rate (1/day) of the pupa and temperature on tomato. Open dots represent data points excluded from the regression.

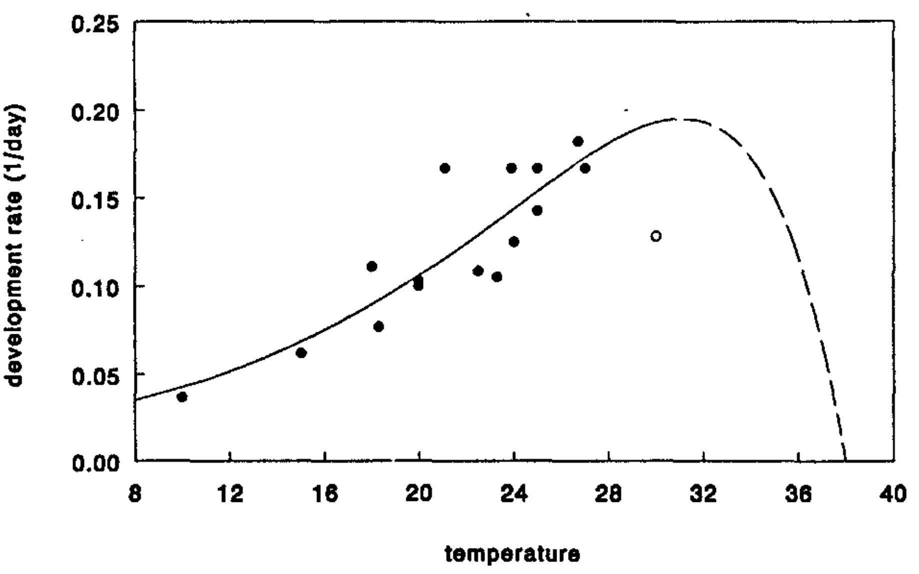

Fig. 8. Relationship between the development rate (1/day) of L4 + prepupa + pupa and temperature on tomato. Open dots represent data points excluded from the regression.

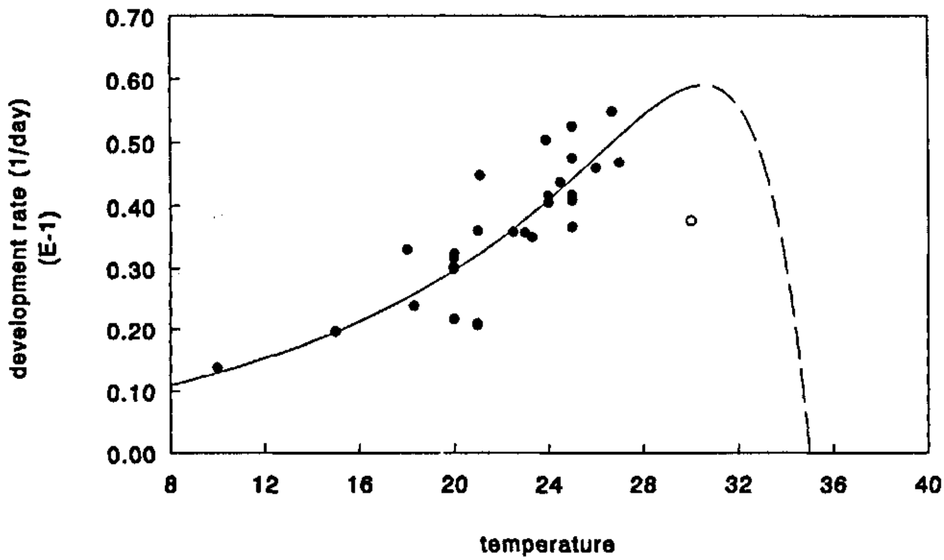

Fig. 9. Relationship between the total immature development rate (1/day) and temperature on tomato. Open dots represent data points excluded from the regression.

3.1.2 Relative development duration

The development duration of a development stage can also be expressed as a proportion of the total immature development duration. As shown in Table 10, the curves for total immature development rate are often based on more data points and show a higher r^2 than the curves for development rate of individual stages. Curves for the L4, prepupa and pupa stages especially are sometimes based on a few data points only. If the proportion is independant of temperature, that is development duration of all stages change in the same way with temperature, data points measured at fluctuating temperature can also be included to produce a more reliable estimate.

For all host plants, the relationship between the duration of each stage expressed as a proportion of the total length of all immature stages and temperature was examined for data points obtained at a constant temperature. After visual inspection of the data, it was concluded that only the linear model should be tested. In this way, 46 linear regressions could be made. In 42 cases, the regression was not significant ($\alpha = 0.05$; data not shown), while in three cases the slope was significantly negative, and in one case significantly positive. Therefore, it was concluded that there is no relationship between the proportion of total immature duration and temperature. This means that data points obtained at fluctuating temperature can also be included to calculate the mean proportion.

Results are shown in Tables 11-21. As a measure of variation among data, the coefficient of variation (*cv*) was calculated, which is the standard deviation divided by the overall mean (sd_{n-1}/mean). No data points were excluded ($n_e = 0$).

Where estimation of the Logan model was not possible in Tables 2-9, the development rate can be estimated by calculating total immature development rate (Table 10) and then dividing this figure by the proportion in Tables 11-18.

The sum of the proportions of all immature stages of Tables 11-18 for one host plant is not exactly 1.000, because the studies or number of data points were not the same for all stages. Proportions can be rounded off for this purpose.

Data were analysed for host plant effects by a Kruskall-Wallis test, although differences among host plants can also be caused by differences in experimental conditions and in whitefly strains. The proportion of the duration of the short stages L1, L2 and L3 compared to total immature duration does not vary significantly among host plants (Kruskall-Wallis, $\alpha = 0.05$). It is possible that this is caused by inaccuracies during observation. Usually in development experiments, immature stages are checked once a day, which is not frequent enough for measurement of the short stages. This effect is also shown by the higher *cv* values for short stages.

Table 11. Development duration of the eggs expressed as proportion of the total immature development duration, *cv* is the coefficient of variation and n_i is the number of data points.

Host plant	Mean	*cv*	n_i
Tomato	0.295	0.155	27
Bean	0.302	0.154	22
Cucumber	0.312	0.0535	10
Eggplant	0.324	0.00648	2
Tobacco	0.266	0.0286	6
Tree tobacco	0.289	0.172	3
Gerbera	0.289	0.115	12
Sweet pepper	0.291	0.128	4
Chrysanthemum	0.224	0.130	4
Hibiscus	0.270	–	1
All host plants	0.291	0.156	93

Kruskall-Wallis, $p = 0.0439$, $n = 93$

Table 12. Development duration of L1 expressed as proportion of the total immature development duration, *cv* is the coefficient of variation and n_i is the number of data points.

Host plant	Mean	*cv*	n_i
Tomato	0.161	0.172	23
Bean	0.158	0.167	17
Cucumber	0.136	0.136	10
Eggplant	0.146	0.0663	2
Tobacco	0.186	–	1
Tree tobacco	0.142	0.296	3
Gerbera	0.153	0.187	12
Sweet pepper	0.186	0.277	4
Chrysanthemum	0.215	0.213	4
Hibiscus	0.154	–	1
All host plants	0.158	0.208	79

Kruskall-Wallis, $p = 0.0698$, $n = 79$

Table 13. Development duration of L2 expressed as proportion of the total immature development duration, *cv* is the coefficient of variation and n_i is the number of data points.

Host plant	Mean	*cv*	n_i
Tomato	0.114	0.285	24
Bean	0.123	0.322	11
Cucumber	0.0988	0.0931	10
Eggplant	0.0808	0.214	2
Tobacco	0.0873	–	1
Tree tobacco	0.0933	0.046	3
Gerbera	0.105	0.179	12
Sweet pepper	0.113	0.264	11
Chrysanthemum	0.130	0.243	4
Hibiscus	0.100	–	1
All host plants	0.111	0.268	81

Kruskall-Wallis, p = 0.370, *n* = 81

Table 14. Development duration of L3 expressed as proportion of the total immature development duration, *cv* is the coefficient of variation and n_i is the number of data points.

Host plant	Mean	*cv*	n_i
Tomato	0.127	0.236	24
Bean	0.122	0.177	11
Cucumber	0.106	0.0840	10
Eggplant	0.103	0.137	2
Tobacco	0.117	–	1
Tree tobacco	0.122	0.0181	3
Gerbera	0.125	0.252	12
Sweet pepper	0.121	0.213	11
Chrysanthemum	0.112	0.264	4
Hibiscus	0.120	–	1
All host plants	0.122	0.217	81

Kruskall-Wallis, p = 0.401, *n* = 81

Table 15. Development duration of L4 expressed as proportion of the total immature development duration, *cv* is the coefficient of variation and n_i is the number of data points.

Host plant	Mean	*cv*	n_i
Tomato	0.0816	0.360	8
Bean	0.140	0.225	2
Cucumber	0.0977	0.0972	4
Eggplant	0.0930	–	1
Tobacco	0.135	–	1
Tree tobacco	0.208	0.0866	2
Gerbera	0.136	0.181	8
Sweet pepper	0.115	0.196	10
Chrysanthemum	–	–	0
Hibiscus	0.136	–	1
All host plants	0.118	0.314	38

Kruskall-Wallis, p = 0.00850, *n* = 38

Table 16. Development duration of the prepupa expressed as proportion of the total immature development duration, *cv* is the coefficient of variation and n_i is the number of data points.

Host plant	Mean	*cv*	n_i
Tomato	0.128	0.184	5
Bean	0.0880	–	1
Cucumber	0.117	0.0849	3
Eggplant	–	–	0
Tobacco	–	–	0
Tree tobacco	0.0751	–	1
Gerbera	0.0696	0.0862	5
Sweet pepper	0.0925	0.186	5
Chrysanthemum	–	–	0
Hibiscus	0.108	–	1
All host plants	0.0960	0.301	22

Kruskall-Wallis, $p = 0.0141$, $n = 22$

Table 17. Development duration of the pupa expressed as proportion of the total immature development duration, *cv* is the coefficient of variation and n_i is the number of data points.

Host plant	Mean	*cv*	n_i
Tomato	0.120	0.238	11
Bean	0.129	0.0241	4
Cucumber	0.150	0.281	4
Eggplant	0.202	–	1
Tobacco	0.117	–	1
Tree tobacco	–	–	0
Gerbera	0.137	0.0884	5
Sweet pepper	0.0949	0.314	6
Chrysanthemum	–	–	0
Hibiscus	0.112	–	1
All host plants	0.126	0.258	34

Kruskall-Wallis, $p = 0.0392$, $n = 34$

Table 18. Development duration of L4+prepupa+pupa expressed as proportion of the total immature development duration, *cv* is the coefficient of variation and n_i is the number of data points.

Host plant	Mean	*cv*	n_i
Tomato	0.307	0.0812	26
Bean	0.332	0.145	19
Cucumber	0.347	0.0706	10
Eggplant	0.352	0.0119	2
Tobacco	0.332	0.0169	6
Tree tobacco	0.369	0.100	3
Gerbera	0.331	0.109	12
Sweet pepper	0.314	0.133	11

Table 18. (continued)

Host plant	Mean	cv	n_i
Chrysanthemum	0.319	0.187	4
Hibiscus	0.359	–	1
All host plants	0.327	0.117	96

Kruskall-Wallis, $p = 0.0117$, $n = 96$

Table 19. Development duration of L4 expressed as proportion of the development duration of L4 + prepupa + pupa, cv is the coefficient of variation and n_i is the number of data points.

Host plant	Mean	cv	n_i
Tomato	0.269	0.383	8
Bean	0.400	0.163	2
Cucumber	0.290	0.0765	4
Eggplant	0.267	–	1
Tobacco	0.413	–	1
Tree tobacco	0.598	0.128	2
Gerbera	0.420	0.170	8
Sweet pepper	0.357	0.123	10
Chrysanthemum	–	–	0
Hibiscus	0.379	–	1
All host plants	0.361	0.284	38

Kruskall-Wallis, $p = 0.00663$, $n = 38$

Table 20. Development duration of the prepupa expressed as proportion of the development duration of L4 + prepupa + pupa, cv is the coefficient of variation and n_i is the number of data points.

Host plant	Mean	cv	n_i
Tomato	0.412	0.133	5
Bean	0.266	–	1
Cucumber	0.335	0.0686	3
Eggplant	–	–	0
Tobacco	0.230	–	1
Tree tobacco	–	–	0
Gerbera	0.206	0.132	5
Sweet pepper	0.303	0.299	5
Chrysanthemum	–	–	0
Hibiscus	0.302	–	1
All host plants	0.296	0.330	22

Kruskall-Wallis, $p = 0.0127$, $n = 22$

Table 21. Development duration of the pupa expressed as proportion of the development duration of L4 + prepupa + pupa, *cv* is the coefficient of variation and n_i is the number of data points.

Host plant	Mean	*cv*	n_i
Tomato	0.383	0.228	11
Bean	0.393	0.0326	4
Cucumber	0.429	0.274	4
Eggplant	0.568	–	1
Tobacco	0.357	–	1
Tree tobacco	–	–	0
Gerbera	0.403	0.0796	5
Sweet pepper	0.310	0.254	6
Chrysanthemum	–	–	0
Hibiscus	0.312	–	1
All host plants	0.384	0.222	34

Kruskall-Wallis, $p = 0.122$, $n = 34$

3.1.3 Immature mortality

Immature mortality of each stage was expressed as a percentage of the number of individuals entering that stage. The relationship between percentage mortality and temperature on each host plant was examined by using data points obtained at a constant temperature. From visual inspection of the data, it was concluded that only the linear model should be tested. In this way, 46 linear regressions were done, from which only eight were significant ($\alpha = 0.05$; data not shown). Of these eight significant regressions, the slope was negative in two cases, 0 in three cases and positive in three cases. Therefore, it was concluded that there is no relationship between percentage mortality and temperature. Thus, experiments done at fluctuating temperature could also be used to calculate the mean percentage mortality for each immature stage on each host plant.

Yano (1981) found higher mortality at low temperatures (around 15 °C) on tobacco, but these results were not confirmed by other studies (Dorsman & van der Vrie, unpubl. on gerbera; Weber, 1931 on tobacco). At high temperatures (30 °C or more) mortality of egg, prepupa and pupa was usually higher (van Evert & Schutte, 1983; Weber, 1931). This resulted in a higher total immature mortality (van Evert & Schutte, 1983; Weber, 1931; Yano, 1981). However, high mortality was only observed when temperature was constantly high. At fluctuating temperatures with peaks of 30 °C or more, which is usually the case in greenhouses, higher mortality was not observed (van Evert & Schutte, 1983; Kajita, 1982; Yano, 1988; van Vianen et al., 1987, also in van Lenteren et al., 1989; Meyer, 1990, also in Meyer et al., 1990). Even if eggs, prepupae and pupae remained for as long as five hours at temperatures between 30 and 35 °C, mortality was not higher than at lower temperatures (van Evert & Schutte, 1983). This means that at high temperatures the duration of exposition is important. Because in greenhouses temperatures do not often exceed 30 °C for more than 5 hours, this effect was not included in the tables below.

The percentage mortality was calculated using data obtained at an average temperature not exceeding 30 °C. Exceptionally high mortalities were excluded, such as observed by Oostenbrug (1988; also in van Lenteren et al., 1989; egg, L1, L2, L3, L4, prepupa, pupa, L4+prepupa+pupa and total mortality on tomato at 22.9 °C); Kusters (1990; egg, L1, L2, L3, L4, prepupa, pupa, L4+prepupa+ pupa and total mortality on gerbera at 22 °C); Schönherr (1988; egg, L1, L2, L3, L4, L4+prepupa+pupa and total mortality on gerbera at 23.5 °C (three times)); Nechols & Tauber (1977a; L1, L2, L3, and L4 mortality on tobacco at 25 °C); Yano (1981; L1, L3 and total mortality on tobacco at 15 °C); Yano (1988; L2 and total mortality on tomato at 20 °C); van de Merendonk (1978; L1 mortality on sweet pepper at 24 °C); Kraayenbrink (1972; L1 mortality on sweet pepper at 23.3 °C); Zebitz (1978; L2, L3, L4+prepupa+pupa and total (twice) mortality on tobacco at 25 °C, and total mortality at 20.5 °C); Li & Li (1983; L4+prepupa+pupa and total mortality on cucumber at 17.8 °C); Huang (1988; total mortality on tomato at 20 °C); Laska (1986; total mortality on bean at 20 °C); Malausa et al. (1984; total mortality on eggplant at 22 °C (twice)); van Sas (1978; total mortality on gerbera at 25 °C); Mulock Houwer (1977; total mortality on gerbera at 21 °C).

The reasons for the high mortalities could not always be ascertained. Kusters (1990) and Schönherr (1988) used whitefly not originating from gerbera. Nechols & Tauber (1977a) and Zebitz (1978) used host varieties not used in any other experiments. Mulock Houwer (1977) used leaves that had been removed from the plant.

Results are shown in Tables 22-30. Host plant effects were not tested statistically, because differences in mortality among host plants were obvious. The high variation in percentage mortality among different experiments is expressed by the high *cv* values.

Table 22. Mean egg mortality expressed as the percentage of the number entering the stage, *cv* is the coefficient of variation, and n_i and n_e are the number of data points included and excluded.

Host plant	Mean	*cv*	n_i	n_e
Tomato	3.7	0.885	15	1
Bean	1.6	0.713	7	0
Cucumber	5.6	0.959	9	0
Eggplant	4.1	–	1	0
Tobacco	2.8	0.991	5	0
Tree tobacco	3.4	0.518	3	0
Gerbera	1.5	0.551	3	4
Sweet pepper	12.5	0.802	10	0
– West European whitefly	10.6	0.797	4	0
– East European whitefly	13.7	0.839	6	0

Table 23. Mean L1 mortality expressed as the percentage of the number entering the stage, *cv* is the coefficient of variation, and n_i and n_e are the number of data points included and excluded.

Host plant	Mean	*cv*	n_i	n_e
Tomato	4.2	0.632	11	1
Bean	5.7	0.071	3	0
Cucumber	2.2	1.307	8	0
Eggplant	1.2	1.175	2	0
Tobacco	12.2	1.121	4	2
Tree tobacco	18.8	0.515	3	0
Gerbera	4.3	0.893	3	4
Sweet pepper	31.8	0.660	11	0
– West European whitefly	30.3	0.188	5	2
– East European whitefly	14.6	0.431	4	0

Table 24. Mean L2 mortality expressed as the percentage of the number entering the stage, *cv* is the coefficient of variation, and n_i and n_e are the number of data points included and excluded.

Host plant	Mean	*cv*	n_i	n_e
Tomato	2.6	0.814	10	2
Bean	1.8	1.051	3	0
Cucumber	2.7	1.121	8	0
Eggplant	0.1	1.400	2	0
Tobacco	0.9	1.029	5	2
Tree tobacco	3.4	0.642	3	0
Gerbera	2.0	0.435	3	4
Sweet pepper	24.0	0.523	11	0
– West European whitefly	31.4	0.348	4	0
– East European whitefly	19.7	0.610	7	0

Table 25. Mean L3 mortality expressed as the percentage of the number entering the stage, *cv* is the coefficient of variation, and n_i and n_e are the number of data points included and excluded.

Host plant	Mean	*cv*	n_i	n_e
Tomato	3.7	0.812	11	1
Bean	0.0	0.000	3	0
Cucumber	3.2	1.514	8	0
Eggplant	0.1	1.400	2	0
Tobacco	7.2	1.359	4	3
Tree tobacco	2.9	1.050	3	0
Gerbera	1.3	0.953	3	4
Sweet pepper	27.2	0.769	11	0
– West European whitefly	25.5	0.255	4	0
– East European whitefly	28.1	0.943	7	0

Table 26. Mean L4 mortality expressed as the percentage of the number entering the stage, *cv* is the coefficient of variation, and n_i and n_e are the number of data points included and excluded.

Host plant	Mean	*cv*	n_i	n_e
Tomato	3.4	1.273	3	1
Bean	0.0	0.000	3	0
Cucumber	0.3	0.967	4	0
Eggplant	0.0	–	1	0
Tobacco	–	–	0	1
Tree tobacco	1.0	0.671	2	0
Gerbera	0.0	0.000	3	4
Sweet pepper	22.9	0.899	10	0
– West European whitefly	13.4	0.767	3	0
– East European whitefly	27.0	0.858	7	0

Table 27. Mean prepupa mortality expressed as the percentage of the number entering the stage, *cv* is the coefficient of variation, and n_i and n_e are the number of data points included and excluded.

Host plant	Mean	*cv*	n_i	n_e
Tomato	3.8	–	1	1
Bean	0.0	0.000	3	0
Cucumber	–	–	0	0
Eggplant	–	–	0	0
Tobacco	1.3	–	1	0
Tree tobacco	–	–	0	0
Gerbera	0.0	0.000	3	1
Sweet pepper	1.6	0.722	5	0
– West European whitefly	1.5	0.093	2	0
– East European whitefly	1.6	0.982	3	0

Table 28. Mean pupa mortality expressed as the percentage of the number entering the stage, *cv* is the coefficient of variation, and n_i and n_e are the number of data points included and excluded.

Host plant	Mean	*cv*	n_i	n_e
Tomato	2.6	0.327	2	1
Bean	1.3	0.864	3	0
Cucumber	0.4	–	1	0
Eggplant	1.1	–	1	0
Tobacco	–	–	0	0
Tree tobacco	–	–	0	0
Gerbera	0.7	1.716	3	1
Sweet pepper	8.0	0.759	6	0
– West European whitefly	11.3	0.673	3	0
– East European whitefly	4.7	0.253	3	0

Table 29. Mean mortality of L4 + prepupa + pupa expressed as the percentage of the number entering the stage, *cv* is the coefficient of variation, and n_i and n_e are the number of data points included and excluded.

Host plant	Mean	*cv*	n_i	n_e
Tomato	7.3	0.655	9	1
Bean	1.3	0.864	3	0
Cucumber	3.8	1.579	6	1
Eggplant	2.8	-	1	0
Tobacco	18.4	0.682	11	1
Tree tobacco	1.8	0.733	3	0
Gerbera	0.6	1.746	3	4
Sweet pepper	32.8	0.664	7	0
– West European whitefly	22.0	0.119	3	0
– East European whitefly	40.8	0.666	4	0

Table 30. Mean total immature mortality expressed as the percentage of the number entering the egg stage, *cv* is the coefficient of variation, and n_i and n_e are the number of data points included and excluded.

Host plant	Mean	*cv*	n_i	n_e
Tomato	16.7	0.713	21	4
Bean	7.9	0.284	7	1
Cucumber	15.9	0.663	12	1
Eggplant	12.9	0.574	11	2
Tobacco	30.0	0.464	4	4
Tree tobacco	30.3	0.405	3	0
Gerbera	10.2	0.406	15	6
Sweet pepper	69.7	0.299	24	0
– West European whitefly	80.7	0.075	6	0
– East European whitefly	66.0	0.345	18	0

3.1.4 Sex ratio

The relationship between sex ratio (expressed as the proportion of females of total offspring) and temperature was studied for each host plant using data obtained at a constant temperature. From visual inspection of the data, it was concluded that only the linear model should be tested. The linear regression was not significant for tomato, bean and cucumber. Only for sweet pepper it was, but the data were for temperatures between 22 and 27 °C, so the regression is not reliable. For all host plants together, the regression was not significant ($p = 0.253$, $n = 43$). Therefore it was concluded that sex ratio was not related to temperature. A Kruskall-Wallis test ($\alpha = 0.05$) showed no effect of host plant on sex ratio (see Table 31). Four data points of van Rongen (1979) on cucumber were excluded because of difficulties in interpreting the sampling method. Data points of Lloyd (1922) on various host plants were combined because of the

Table 31. Sex ratio expressed as the proportion of females of total offspring, *cv* is the coefficient of variation and n_i and n_e are the number of data points included and excluded.

Host plant	Mean	*cv*	n_i	n_e
Tomato	0.483	0.063	5	0
Bean	0.553	0.166	12	0
Cucumber	0.543	0.146	5	4
Eggplant	0.440	–	1	0
Tobacco	–	–	0	0
Tree tobacco	0.514	0.018	2	0
Gerbera	0.525	0.176	3	0
Sweet pepper	0.525	0.090	9	0
Wild potato	0.732	–	1	0
Potato	0.700	–	1	0
Various	0.558	–	1	0
All host plants	0.538	0.149	40	4

Kruskall-Wallis, $p = 0.219$, $n = 39$

small number of whiteflies used and were not included in the Kruskall-Wallis test.

3.1.5 Longevity

As rough data indicated longevity was lower in males than in females, this life-history parameter was studied separately for the sexes. Data points obtained at constant temperatures were used to examine the relationship between female longevity and temperature. Weber (1931) did experiments at extreme temperatures and found longevities of 6.5 days at 0°C and 0.25 days at 36°C on tobacco. These data have been taken as the arbitrary lower and upper values for all host plants. The highest coefficients of determination (r^2) were obtained when the third degree polynomial and the Weibull model were used. On the basis of visual inspection of the curves, the Weibull model was chosen. The third degree polynomials yielded biologically unrealistic tails. Table 32 shows the results. The lower lethal temperature (coefficient *a*) is fixed at –10°C according to Weber (1931). Figure 10 presents the relationship between female longevity and temperature on tomato.

The coefficients of determination on tomato and eggplant were low because of differences in host plant variety, as shown for tomato by an increase in r^2 when host plant varieties were analysed separately. High variation in longevity among eggplant varieties was shown by Malausa et al. (1984, 1988). The shape coefficient *c* for eggplant was fixed at 3.50 (average of host plants with high r^2) because data at low temperatures were missing. The great variation in longevity on sweet pepper, also shown by Zabudskaya (1989), was not caused by a difference in whitefly strains, because r^2 remained low when the West European and East European strain were analyzed separately. Data below 22°C were not available, which resulted in a shape coefficient of 10.9.

Exceptional data points were excluded from the regression, such as van Boxtel (1980; twice on tomato cv. moneymaker and twice on cucumber) and Mulock Houwer (1977; four times on gerbera). Van Boxtel did these experiments in winter on poor quality host plants and as already mentioned, Mulock Houwer did experiments on leaves removed from the plant.

Table 32. Relationship between female longevity and temperature based on the Weibull model where *b*, *c* and *d* are coefficients, *a* is the lower lethal temperature of −10°C, r^2 is the coefficient of determination and n_i and n_e are the number of data points included and excluded.

Host plant	*b*	*c*	*d*	r^2	n_i	n_e
Tomato	29.6	4.68	723	0.609	22	2
– 'Bonnie Best'	27.8	5.56	622	0.905	11	0
– 'Moneymaker' + 'Moneydor'	29.0	3.45	725	0.864	6	2
Bean	26.2	3.79	754	0.852	7	0
Cucumber	31.4	3.59	752	0.793	12	2
Eggplant	33.2	3.50*	1570	0.486	20	0
Tobacco	30.1	3.06	833	0.716	11	0
Gerbera	29.1	3.43	1230	0.849	8	4
Sweet pepper	38.6	10.9	131	0.482	17	0
– West European whitefly	23.5	2.64	260	0.402	8	0
– East European whitefly	27.5	4.02	964	0.442	11	0

*: fixed at 3.50

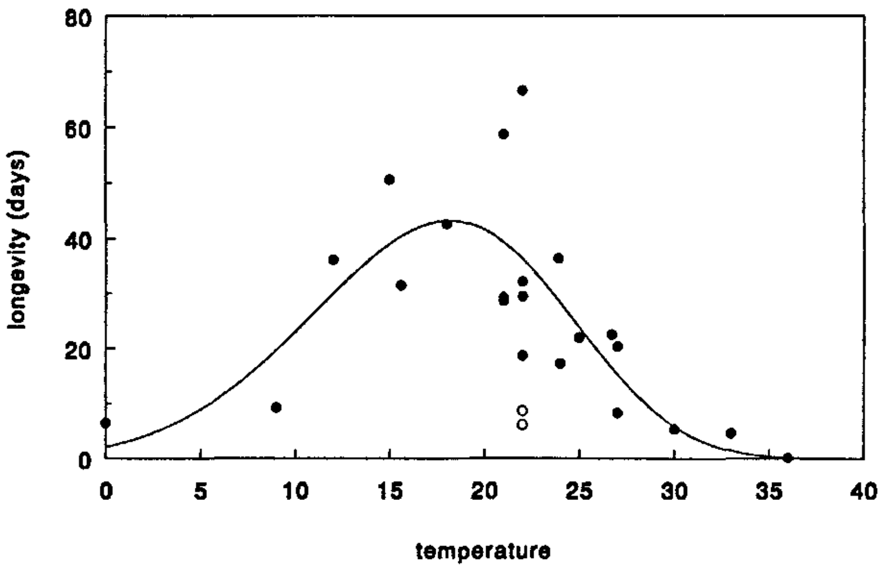

Fig. 10. Relationship between the female longevity (day) and temperature on tomato. Open dots represent data points excluded from the regression.

Not enough data were available to estimation the relationship between male longevity and temperature in the same way as for female longevity. However, it was possible to express male longevity as a proportion of female longevity because in many studies longevity was examined for both sexes under the same environmental conditions. According to the available data, there is no significant linear relationship between this proportion and temperature ($p=0.167$, $n=28$), so data were averaged (Table 33). Differences in the proportion among host plants were not significant (Kruskall-Wallis, $\alpha=0.05$).

Data points of Genchev (1986, on bean) and Lloyd (1922, twice on various host plants) were excluded, because the first study differed greatly from other studies and the second used a small number of whiteflies. Male longevity can easily be estimated by calculating female longevity from Table 32 and then multiplying this figure by the proportion given in Table 33.

The survival pattern of adult whiteflies in relation to age has been studied by van Rongen (1979), van Sas (1978; also in van Sas et al., 1978), van Boxtel (1980; also in van Boxtel et al., 1978), Yano (1981, 1988, 1989), Burggraaf-van Nierop & van der Laan (1983; also in van der Laan et al., 1982), Dorsman & van der Vrie (1987) and Oostenbrug (1988; also in van Lenteren et al., 1989). The results are shown in graphs without fitting the data to a statistical distribution and without giving the original data. S-shaped or linear decline are mostly shown. An exponential decline was found for Dutch whiteflies on sweet pepper (Burggraaf-van Nierop & van der Laan, 1983; Oostenbrug, 1988). The survivalship curves of van Boxtel (1980) on eggplant and van Sas (1978) on tomato showed a tail to the right, indicating that some individuals reached a high age (more than twice the average). However, on 7 other host plants this was not clear and van Rongen (1979), Yano (1981, 1988, 1989) and Dorsman & van der Vrie (1987) did not find this at all. Because adults of high age are not important for the population growth rate, as shown by Birch (1948), it is possible to describe the whitefly survivalship curve by a decreasing cumulative normal distribution, of which the S-shape depends on the variation in longevity. Maximum longevity can be calculated as the mean longevity plus three times the standard deviation to include 96 % of the adults.

Table 33. Male longevity expressed as the proportion of female longevity, *cv* is the coefficient of variation and n_i and n_e are the number of data points included and excluded.

Host plant	Mean	*cv*	n_i	n_e
Tomato	0.46	0.281	2	0
Bean	0.71	–	1	1
Cucumber	0.64	0.137	7	0
Eggplant	0.47	0.248	8	0
Sweet pepper	0.53	0.316	10	0
Various	–	–	0	2
All host plants	0.54	0.264	28	3

Kruskall-Wallis, $p=0.0787$, $n=28$

3.1.6 Pre-oviposition period

The period between adult emergence and oviposition was measured only between temperatures of 17 °C and 27 °C. The exponential model described the best relationship between the pre-oviposition period and temperature, although r^2's were low. Differences among host plants were not clear. Extrapolation to temperatures below 17 °C is very unreliable, because of a rapid increase of the pre-oviposition period according to the exponential model. For low temperatures, a pre-oviposition period the same as that at 17 °C is a better estimate. Table 34 gives the results of the regression and Figure 11 shows the graph when all host plants were combined.

Table 34. Relationship between the pre-oviposition period and temperature based on the exponential model where *a* and *b* are coefficients, r^2 is the coefficient of determination and n_i and n_e are the number of data points included and excluded.

Host plant	*a*	*b*	r^2	n_i	n_e
Tomato	0.558	–0.0213	0.014	4	0
Bean	1.94	–0.0765	0.380	6	0
Eggplant	3.97	–0.176	0.968	3	0
All host plants	2.17	–0.0901	0.328	13	0

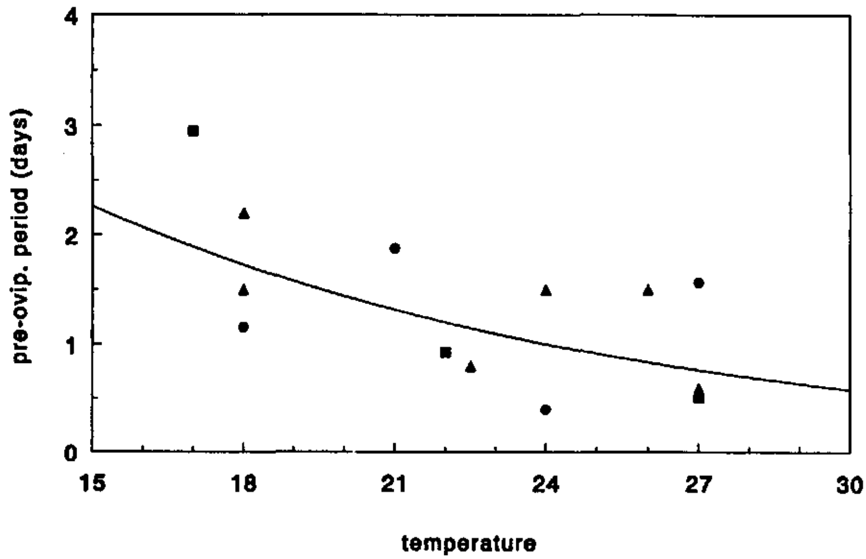

Fig. 11. Relationship between the pre-oviposition period (day) and temperature. Circle: tomato; triangle: bean and square: eggplant.

3.1.7 Fecundity

Fecundity is the total number of eggs laid in a female's lifetime. Some of the variation in fecundity among females is caused by variation in longevity. Weber (1931) found a lower and upper threshold temperature for oviposition of 10 and 37 °C on tobacco and a lower threshold temperature for egg maturation of 4 °C. Pravisani (1981) studied fecundity at 2.5 °C intervals on bean and found 7.5 and 37.5 °C respectively. It is assumed that these lower and upper temperatures are the same on other host plants. When the relationship between fecundity and temperature was studied, the best fits were obtained with the Weibull model and resulted in the highest r^2 values and realistic tails of the curves. Table 35 presents the results for different host plants and Figure 12 for tomato. As for longevity, r^2 values were low for tomato, eggplant and sweet pepper, because of the differences in varieties of the tomato and eggplant. For cucumber a biological realistic fit was only possible when the shape coefficient c was fixed at the average value of 2.70 for the other host plants. Data for sweet pepper below 22 °C were not available, which resulted in a shape coefficient of 7.55.

Exceptional data points were excluded from the regression, such as van Boxtel (1980; twice on tomato, twice on cucumber, once on sweet pepper at 22 °C); Huang (1988; twice on tomato); Christochowitz & van der Fluit (1983; on tomato); Burnett (1949; on tomato at 18 °C); Collman & All (1980; on bean at 26 °C); Zabudskaya (1989; seven times on cucumber); Di Pietro (1977; on eggplant at 27 °C) and Mulock Houwer (1977; four times on gerbera). Van Boxtel (1980) did these experiments in winter on poor quality host plants. Huang (1988) used old host plants, Christochowitz & van der Fluit (1983) studied fecundity over a period of 17 days only, Mulock Houwer (1977) used leaves removed from the plant. Low fecundities obtained by Zabudskaya (1989) may be due to the East European whitefly strain or to the cucumber variety. No clear explanation could be found for low data points of Collman & All (1980) and Di Pietro (1977) and for the very high data point of Burnett (1949).

Table 35. Relationship between fecundity and temperature based on the Weibull model where b, c and d are coefficients, a is the lower threshold temperature of 7.5 °C, r^2 is the coefficient of determination and n_i and n_e are the number of data points included and excluded.

Host plant	b	c	d	r^2	n_i	n_e
Tomato	14.9	2.58	2350	0.481	25	6
– 'Bonnie Best'	12.8	3.91	2430	0.921	10	0
– 'Moneymaker' + 'Moneydor'	12.8	2.23	2580	0.848	7	3
Bean	14.6	2.27	1840	0.998	5	1
Cucumber	17.9	2.70*	3300	0.961	4	9
Eggplant	17.1	2.55	8940	0.618	18	1
Tobacco	17.2	3.64	3700	0.947	8	0
Gerbera	17.6	2.37	4190	0.787	17	4
Sweet pepper	22.8	7.55	736	0.277	15	1
– West European whitefly	14.0	7.55*	60	0.173	6	1
– East European whitefly	22.9	7.55*	757	0.187	11	0

*: fixed at given value

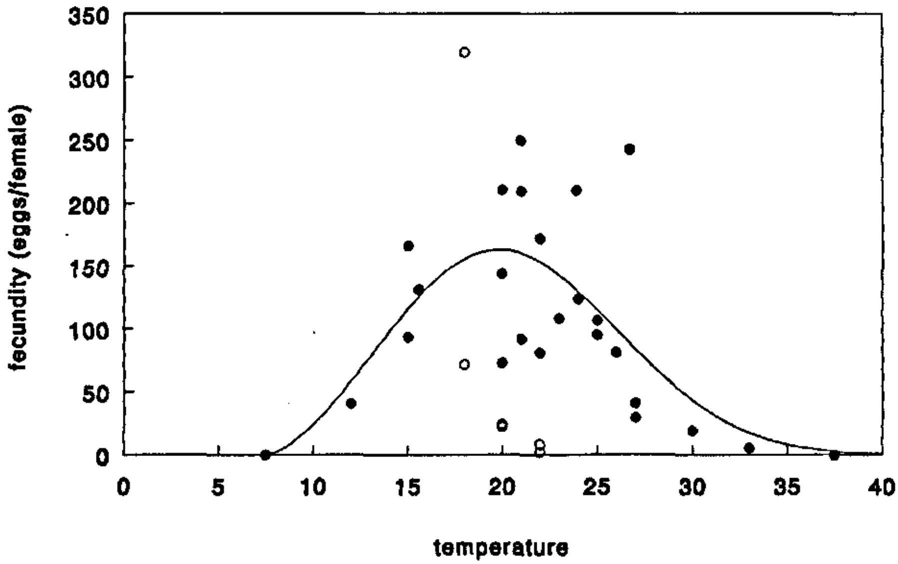

Fig. 12. Relationship between the fecundity (egg/female) and temperature on tomato. Open dots represent data points excluded from the regression.

3.1.8 Oviposition frequency

Mean oviposition frequency can be calculated by dividing the fecundity of a female whitefly by her longevity. Oviposition frequency may be less variable than fecundity, because differences in longevity are accounted for.

Only 'whole lifetime' experiments done at a constant temperature were used to examine the relationship between oviposition frequency and temperature. Lower and upper threshold temperatures of 7.5 and 37.5 °C observed by Pravisani (1981) were taken for all host plants. The Weibull model yielded the best fit, although the r^2 values of the third degree polynomials were very close. The tails of the third degree polynomials were not always realistic. The mean oviposition frequency is given in Table 36 and for tomato also in Figure 13. Data for sweet pepper below 20 °C were not available, which resulted in a shape coefficient of 9.25.

Exceptional data points were excluded from the regression, such as van Boxtel (1980; twice on tomato, once on sweet pepper at 22 °C); Hussey & Gurney (1957; on tomato at 26.7 °C); Zabudskaya (1989; on tomato at 27 °C); Castresana Estrada et al. (1982; on tomato at 22 °C) and Mulock Houwer (1977; four times on gerbera). Data from van Boxtel (1980), Zabudskaya (1989), and Mulock Houwer (1977) were excluded for the same reasons that they were excluded from study on fecundity. The high oviposition frequency given by Hussey & Gurney

(1957) and the low value of Castresana Estrada et al. (1982) could not be explained.

Table 36. Relationship between mean oviposition frequency during a lifetime and temperature based on the Weibull model where *b*, *c* and *d* are coefficients, *a* is the lower threshold temperature of 7.5°C, r^2 is the coefficient of determination and n_i and n_e are the number of data points included and excluded.

Host plant	*b*	*c*	*d*	r^2	n_i	n_e
Tomato	16.8	2.64	107	0.759	17	5
– 'Bonnie Best'	16.7	3.01	119	0.922	10	0
– 'Moneymaker'+'Moneydor'	16.4	2.57	76.7	0.985	5	2
Bean	15.8	3.33	56.2	0.971	6	0
Cucumber	16.8	4.12	87.8	0.988	7	0
Eggplant	17.6	2.76	170	0.937	12	0
Tobacco	19.4	3.14	156	0.958	8	0
Gerbera	20.6	3.36	105	0.897	8	4
Sweet pepper	18.7	9.25	27.6	0.404	19	1
– West European whitefly	21.0	6.45	40.8	0.550	8	1
– East European whitefly	18.4	4.57	53.1	0.376	13	0

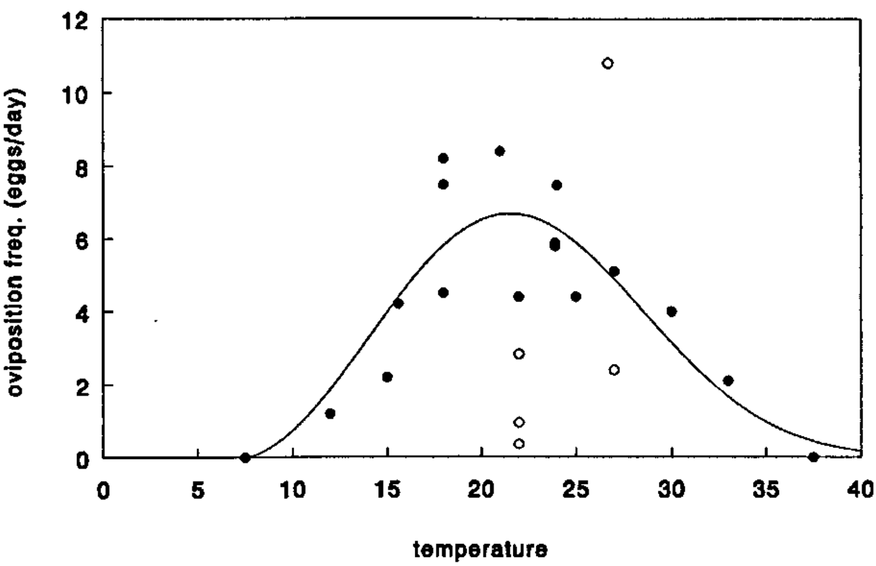

Fig. 13. Relationship between the mean oviposition frequency during a lifetime (egg/female/day) and temperature on tomato. Open dots represent data points excluded from the regression.

3.1.9 Change in oviposition frequency during ageing

Oviposition frequency is not constant throughout the lifetime of a female. Van Sas (1978; also in van Sas et al., 1978), van Boxtel (1980; also in van Boxtel et al., 1978), Yano (1981, 1988, 1989), Burggraaf-van Nierop & van der Laan (1983; also in van der Laan et al. (1982), Steenhuis (unpubl.), Dorsman & van der Vrie (1987 and unpubl.) and Oostenbrug (1988; also in van Lenteren et al., 1989) have shown that oviposition frequency usually varied greatly from day to day. In all cases it increased in the first few days from zero to a maximum level. This maturation period, in which the pre-oviposition period is included, was estimated from these studies. The relationship between maturation period and temperature could be described well by the exponential model (see Table 37). Hulspas-Jordaan & van Lenteren (1989) published slightly different data.

In some studies the oviposition frequency was found to be constant after the maturation period until the whiteflies died (van Boxtel (1980) on eggplant and tomato; Yano (1981, 1988, 1989); Oostenbrug (1988) for Hungarian whiteflies), but more often it remained constant for a period and then decreased almost linearly with age (van Boxtel (1980) on cucumber; van Sas (1978) on five host plants; Burggraaf-van Nierop & van der Laan (1983); Dorsman & van der Vrie (1987 and unpubl.); van Lenteren et al., 1989 for Dutch whiteflies).

In general, oviposition frequency during ageing increases linearly with maturation to a maximum. This level remains constant until mean longevity is attained and then decreases linearly to zero at maximum longevity. Maximum longevity can be estimated from the mean longevity plus three times the standard deviation. The maximum level of the oviposition frequency can be calulated by using the fecundity, the pre-oviposition period, the maturation period and the mean longevity.

Table 37. Relationship between the maturation period (pre-oviposition period included) and temperature based on the exponential model where a and b are coefficients, r^2 is the coefficient of determination and n_i and n_e are the number of data points included and excluded.

Host plant	a	b	r^2	n_i	n_e
All host plants	2.82	-0.0568	0.953	5	0

3.2 Variation among individuals

So far only mean values of the life-history parameters were used to relate the parameter to host plant and temperature. Variation among individuals within one experiment was also obtained in many studies. As a measure of this variation, the coefficient of variation (cv, also called relative dispersion) was calculated, that is the sample standard deviation divided by the overall mean (sd_{n-1}/mean). For data from different populations, the mean and standard deviation often tend to change together so that the *cv* is relatively stable. The *cv* values should be used as input parameters in simulation models when stochasticity is desired and normality can be assumed, as arises often during developmental dispersion (Goudriaan & van Roermund, 1989; Schaub & Baumgärtner, 1989).

Mean *cv* values were calculated for immature development duration, longevity, fecundity, oviposition frequency and pre-oviposition period. Two catagories of *cv* values were excluded: values of which the number of replicates (n) was lower than the total number of whiteflies (because then variation among n experiments was calculated instead of variation among individuals) and values of mean life-history parameters which were excluded from the regression in Section 3.1 (referred to Tables 38-40 as the number of observations excluded, n_e). If variation was given without the number of replicates or whiteflies, it was assumed to be among individuals and was included.

3.2.1 Immature development duration

Variation among individuals in development duration (which is almost equal to the variation in development rate) can be measured by following individual larvae separately through leaf mapping or calculated after linearization of the s-curve when populations were followed. The latter method was chosen by van Zoest (1987).

Only data obtained at a constant temperature were used when the relationship between *cv* and temperature was studied. From visual inspection it was concluded that only the linear model should be tested. No significant relationship could be found from 11 cases tested ($\alpha = 0.05$, results not shown), so *cv* values obtained at constant and fluctuating temperatures were combined. Table 38 shows the mean *cv* of development duration of each whitefly immature stage on each host plant. No observations were excluded (n_e = 0). Data on tobacco and tree tobacco were combined, because no difference was observed. According to Kruskall-Wallis tests, differences in *cv* among host plants were only significant for the egg stage ($\alpha = 0.05$). This is probably due to a high *cv* on sweet pepper. The *cv* of the development duration of the shorter stages (L2, L3, L4) is higher than that of the longer stages (egg- and total immature stage) and can be caused by inaccuracies during experimentation. In many studies individuals were checked once a day, which is not frequent enough for reliable estimation of the duration of stages of only a few days duration.

Sequential dependance of development of individuals during successive stages, that is individuals developing slowly during one stage and compensating for this by developing faster in the next stage, can be studied accurately if the development duration of each individual during each stage is known. This was done by Hulspas-Jordaan & van Lenteren (1989) using data of Christochowitz & van der Fluit (1981), showing no correlation between successive stages. If it occurs, the variance (sd^2) of the total immature development duration will be lower than when calculated from the variances of the separate stages. From data of Eijsackers (1969), Nechols & Tauber (1977b), Laska et al. (1980), Kusters

Table 38. Mean coefficient of variation among individuals (*cv*) of immature development duration of each whitefly stage and number of observations included (n_i).

Host plant	Egg		L1		L2		L3		L4		Prepupa		Pupa		Total	
	cv	n_i	*cv*	n_i	*cv*	n_i	*cv*	n_i	*cv*	n_i	*cv*	n_i	*cv*	n_i	*cv*	n_i
Tomato	0.11	8	0.26	7	0.35	10	0.36	10	0.50	4	0.31	4	0.30	8	0.077	16
Bean	0.081	4	0.22	4	0.24	4	0.24	4	–	0	–	0	0.19	3	0.10	1
Cucumber	0.057	3	–	0	–	0	–	0	–	0	–	0	–	0	0.058	4
Eggplant	–	0	–	0	–	0	–	0	–	0	–	0	–	0	0.087	1
(Tree)Tobacco	0.029	4	0.35	1	0.29	1	0.22	1	0.39	1	0.42	1	0.16	1	0.076	11
Gerbera	0.065	5	0.24	5	0.28	5	0.28	5	0.24	5	0.52	1	0.25	1	0.072	17
Sweet pepper	0.16	2	–	0	0.46	9	0.44	10	0.53	9	0.38	5	0.46	5	0.14	6
Hibiscus	0.11	1	0.39	1	0.60	1	0.60	1	0.62	1	0.41	1	0.20	1	0.16	1
All host plants	0.083	27	0.25	19	0.36	31	0.36	31	0.45	20	0.37	12	0.31	19	0.084	59
Kruskall-Wallis	$p=0.0424$, $n=27$		$p=0.365$, $n=19$		$p=0.0875$, $n=31$		$p=0.0704$, $n=31$		$p=0.271$, $n=20$		$p=0.163$, $n=12$		$p=0.510$, $n=19$		$p=0.126$, $n=59$	

(1990) and Dorsman & van der Vrie (unpubl.), the measured variance of the total immature development duration was compared to the calculated variance and no significant difference was found (Wilcoxon signed rank test, $p=0.610$, $n=12$ pairs). Thus sequential dependance appears to be absent.

3.2.2 Longevity and pre-oviposition period

The relationship between *cv* and temperature was studied for each host plant separately. From visual inspection it was concluded that only the linear model should be tested. No significant regression was found in the six tested for longevity. For the pre-oviposition period, however, one significant relationship was found on bean in two tested ($\alpha=0.05$), but the number of observations was very low ($n=3$, data not shown). Therefore, no relationship with temperature was assumed. Table 39 shows mean *cv* values on each of the seven host plants. Data on other host plants were also used but are not given separately in the table. No significant host plant effect on the *cv* was found (Kruskall-Wallis, $\alpha=0.05$), although on poor host plants such as sweet pepper *cv* tends to be higher.
In some studies the longevity of males was compared to that of females under the same experimental conditions. From these 15 experiments the *cv* of male longevity tended to be higher than that of females (mean *cv* was 1.0 and 0.68 respectively), but no significant difference could be found (Wilcoxon signed rank test, $p=0.0938$, $n=15$ pairs).

Table 39. Mean coefficient of variation among individuals (*cv*) of female longevity and pre-oviposition period and number of observations included (n_i) and excluded (n_e).

	Female longevity			Pre-oviposition period		
Host plant	*cv*	n_i	n_e	*cv*	n_i	n_e
Tomato	0.54	21	2	–	0	0
Bean	0.41	4	0	0.92	3	0
Cucumber	0.48	4	2	–	0	0
Eggplant	0.45	7	0	0.83	3	0
Tobacco	0.39	6	0	–	0	0
Gerbera	0.55	9	4	–	0	0
Sweet pepper	0.76	14	0	–	0	0
All host plants	0.56	69	8	0.88	6	0
Kruskall-Wallis	$p=0.0640$, $n=69$			$p = 0.827$, $n=6$		

3.2.3 Fecundity and oviposition frequency

The relationship between *cv* and temperature was studied for each host plant separately. From visual inspection of the data it was concluded that only the linear model should be tested. No significant regression was found for the *cv* of fecundity on four host plants ($\alpha = 0.05$). Of the four tested for mean oviposition frequency during a lifetime only on tomato *cv* increased linearly with temperature ($\alpha = 0.05$), but r^2 was very low (0.348, data not shown). Therefore it was concluded that a relationship with temperature was absent. Table 40 shows the results. Data on other host plants were also used but are not given separately in the table.

A significant host plant effect was found, due to the high *cv* on sweet pepper. The *cv* of fecundity is in general higher than that of oviposition frequency, because fecundity is a combination of oviposition frequency and longevity which both vary among individuals.

Table 40. Mean coefficient of variation among individuals (*cv*) of fecundity and mean oviposition frequency during a lifetime and number of observations included (n_i) and excluded (n_e).

	Fecundity			Oviposition frequency		
Host plant	*cv*	n_i	n_e	*cv*	n_i	n_e
Tomato	0.64	22	3	0.39	17	3
Bean	0.44	3	3	0.81	1	2
Cucumber	0.61	3	2	0.51	5	0
Eggplant	0.47	6	1	0.29	6	0
Tobacco	0.49	6	0	0.61	6	0
Gerbera	0.54	4	4	0.24	4	4
Sweet pepper	1.41	8	1	0.97	10	1
All host plants	0.71	55	15	0.52	52	9
Kruskall-Wallis	$p = 0.00166, n = 55$			$p = 0.000231, n = 52$		

4. Discussion

Most studies on life-history parameters of the greenhouse whitefly have focused on the relationship to temperature and host plants. Almost all experiments have been conducted at sub-optimal temperatures. Lower threshold and upper lethal temperatures were often obtained on one host plant species only. The same values were used for the other host plants in order to obtain realistic tails of the curves.

Few experiments have been done to study other factors, such as light intensity, air humidity or whitefly density. Weber (1931) studied the effect of humidity on immature mortality and found lowest mortality at 70-80 % R.H.. He also measured oviposition frequency in the dark, which was low compared to the oviposition frequency at daylight conditions. Hussey & Gurney (1959) did not find differences in oviposition at different light intensities or daylengths. Van Boxtel (1980; also in van Boxtel et al., 1978) noted a lower oviposition and longevity in winter than in spring, but also host plant quality played a role in his experiments. All these studies are qualitative and no attempt has been made to quantify the relationship between oviposition and light intensity.

The effect of whitefly density on immature mortality and oviposition frequency was studied by Xu Rumei (1983; also in Xu Rumei et al., 1984) and Yano (1988; also in Yano, 1989). High whitefly densities were shown to result in higher immature mortality and lower oviposition. Xu Rumei (1983) found an increase in mortality during the egg-L2 stage above densities of 8 eggs/cm^2, and during the L3-pupal stage between 0 and 3 (L3) larvae/cm^2 on bean. However, Yano (1988) did not find a significant increase of immature mortality up to a density of 30 eggs/cm^2 on tomato.

Xu Rumei (1983) found a decrease in oviposition frequency for densities above 3.6 adults/cm^2 on bean. However, Yano (1988) did not find a significant decrease below densities of 10 adults/cm^2 on tomato, despite a high variation in oviposition frequency at low densities. Such densities are only obtained well beyond the economic damage threshold, and will not be found in the greenhouse because control measures will have been taken.

Not all studies on life-history parameters describe how these parameters and *cv* values were calculated. In a number of cases the original protocols of the experiments were available so that they could be (re)calculated according to the proper method. Information needs to be given on variation (minimum and maximum value, coefficient of variation) and number of replicates, as well as host plant variety and whitefly origin. This information is often lacking, thus making interpretation difficult (see appendices).

From some studies it was not always clear whether mean longevity and development rate were calculated as arithmetic mean or 50 % point. Mean oviposition frequency during a lifetime was calculated by one of three methods: fecundity divided by longevity for each female and then averaged over all females; total number of eggs on a particular day divided by total number of still living females on that day and then averaged over all days (maximum longevity); and the sum of fecundity of all females divided by the sum of longevity. These three methods lead to the same result provided oviposition is constant during ageing. But if oviposition decreases during ageing, the first method overestimates and the second method underestimates mean oviposition frequency.

When multiplying the oviposition frequency of Table 36 with the longevity of Table 32, the result is usually higher than the fecundity of Table 35; the first method to calculate oviposition frequency was obviously more frequently used.

In studies on the change in oviposition during ageing, oviposition frequency was calculated per still living female or per introduced female. The disadvantage of the calculation per introduced female is that two life-history parameters, oviposition and longevity, are combined and can not be derived from these data anymore. The best method is to average the mean oviposition frequency over all still living females for each day. Variation among individuals has to be calculated for each day as well, because the number of replicates (whiteflies) decreases in time.

In studies on sex ratio, individuals have to be sexed just after emergence from pupa. In some studies, however, an adult population was sampled from host leaves, which is not satisfactory because more females will be sampled because longevity is higher in females than in males. In this way two life-history parameters, sex ratio and longevity, are mixed and can not be derived from such a sample separately. It is also possible that differences in behaviour between the sexes affect the sex ratio in the sample.

The coefficients which describe each life-history parameter in relation to temperature on a host plant will be used as inputs in a simulation model of the population dynamics of greenhouse whitefly. This model explains population dynamics and host plant performance by integration of individual life-history parameters. The effect of each life-history parameter will be evaluated and is of importance in plant resistance breeding. A preliminary version of the model was published by Hulspas-Jordaan & van Lenteren (1989) and Yano et al. (1989a and b).

The model will be used as a submodel in a simulation model of the tritrophic interaction between host plant, greenhouse whitefly and the parasitoid *Encarsia formosa* (van Roermund & van Lenteren, 1990). The model will help to gain better insight into the complex tritrophic system which is essential to understand whether biological control is feasible, particularly when new crops and other environmental factors are involved. The model will be used to evaluate timing and number of parasitoid release.

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Appendix A1. Development duration (days) of eggs of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration n	Duration n(wf)	Remarks	Reference
Tomato	'Bonnie Best'	Tomato	18.0		8	-	-	-		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	27.0		5	-	-	-		Burnett, 1949
Tomato	'Moneydor'	Cucumber	22.5		7.8	3.7	3	≈456	50%-point	van Bruggen, 1975
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Tomato	'Moneydor'	Tomato	10.0		15.8	10.7	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	15.0		10.9	14.8	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	20.0		10.4	12.7	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	25.0		7.7	20.3	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	30.0		6.6	7.0	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Bean	23.3		7.6	-	1	≈90	50%-point	Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3		12.5	-	1	≈107	50%-point	Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	7.0		>40	-	71	71		van Evert & Schutte, 1983
Tomato	'Moneydor'	Cucumber	24.0		8	-	161	161		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
Tomato	'Vesuvius'		20.0		10	-	3	500		Huang, 1988
Tomato	'Vesuvius'		25.0		6	-	3	500		Huang, 1988
Tomato	-	-	8.0		>20	-	-	-		Weber, 1931
Tomato	-	-	14.0		16	-	-	-		Weber, 1931
Tomato	-	-	20.0		7	-	-	-		Weber, 1931
Tomato	-		29.0		4	-	-	-		Weber, 1931
Tomato	-	-	26.7		5	-	-	-		Hussey & Gurney, 1957
Tomato	-	-	23.9		6	-	-	-		Hussey & Gurney, 1957
Tomato	-	-	21.1		7	-	-	-		Hussey & Gurney, 1957
Tomato	'Moneydor'	Bean	23.3	25/20	7.6	-	1	≈110		Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3	20/15	12.5	-	1	≈99		Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	11.4	18/7	22.7	6.8	276	276		Christochowitz & van der Fluit, 1981
										Christochowitz et al., 1981
Tomato	'Moneydor'	Tomato	27.5	35/20	7.0	6.8	202	202		van Evert & Schutte, 1983
Tomato	-	Tobacco	26.7	30/20	7.2	-	-	-	young plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	26.7	30/20	7.1	-	-	-	old plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	20.0	25/10	12.6	-	-	-	young plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	20.0	25/10	15.0	-	-	-	old plant	Yano, 1988
										Yano, 1989
Tomato	'Tropic'	-	24.0	34/14	7.8	8.1	482	482	temp.sum measured	Osborne, 1982
Tomato	-	-	16.6	30.6/8.9	22.5	-	-	-		Lloyd, 1922
Tomato	-	-	23.3	38.3/8.3	9.0	-	-	-		Lloyd, 1922
Bean	'Canadian wonder'	-	18.0		15.0	3.4	53	53		Madueke, 1979
										Madueke & Coaker, 1984
Bean	'Canadian wonder'	-	22.5		9.8	8.3	66	66		Madueke, 1979
										Madueke & Coaker, 1984
Bean	'Canadian wonder'	-	27.0		7.6	11.9	57	57		Madueke, 1979
										Madueke & Coaker, 1984
Bean	'Nanus'	Bean	9.0		53.0	-	-	-		Stenseth, 1971

Appendix A1 (continued). Development duration (days) of eggs of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration *n*	Duration *n*(wf)	Remarks	Reference
Bean	'Nanus'	Bean	12.0		27.3	-	-	-		Stenseth, 1971
Bean	'Nanus'	Bean	15.0		18.1	-	-	-		Stenseth, 1971
										Stenseth, 1977
Bean	'Nanus'	Bean	18.0		12.0	-	-	-		Stenseth, 1971
										Stenseth, 1977
Bean	'Nanus'	Bean	21.0		9.4	-	-	-		Stenseth, 1971
										Stenseth, 1977
Bean	'Nanus'	Bean	24.0		7.8	-	-	-		Stenseth, 1971
										Stenseth, 1977
Bean	'Nanus'	Bean	30.0		5.0	-	-	-		Stenseth, 1971
										Stenseth, 1977
Bean	'Sarka'	-	20.0		11.3	8.7	27	27	East European wf	Laska et al., 1980
Bean	'Contender'	-	26.0		6.2	-	-	-		Collman & All, 1980
Bean	-	-	13.3		18.5	-	14	14		Li Zu-Yin et al., 1980
Bean	-	-	16.2		17.5	-	140	140		Li Zu-Yin et al., 1980
Bean	-	-	19.7		8.6	-	29	29		Li Zu-Yin et al., 1980
Bean	-	-	23.1		7.5	-	29	29		Li Zu-Yin et al., 1980
Bean	-	-	24.5		6.5	-	27	27		Li Zu-Yin et al., 1980
Bean	-	-	25.8		5.5	-	33	33		Li Zu-Yin et al., 1980
Bean	'Nanus'	Bean	21.0	24/18	10	-	-	-		Stenseth, 1971
										Stenseth, 1977
Bean	'Nanus'	Bean	19.5	24/15	12	-	-	-		Stenseth, 1971
Bean	-	-	17.3	37.8/6.1	18.5	-	-	-		Lloyd, 1922
Bean	-	-	18.6	38.3/6.1	19.5	-	-	-		Lloyd, 1922
Bean	-	-	21.7	33.3/11.7	8.5	-	-	-		Lloyd, 1922
Cucumber	'IVT 71-240'	Cucumber	22.5		7.6	7.5	3	~584	50%-point	van Bruggen, 1975
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Cucumber	'IVT 71-240'	Cucumber	24.0		8	-	171	171		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
Cucumber	'Sporu'	Bean	23.3		7.0	-	1	~106	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	18.3		12.0	-	1	~105	50%-point	Kraayenbrink, 1972
Cucumber	'Gele Tros'	Cucumber	25.0		6	-	-	-		Hooy, 1984
Cucumber	'Profito'	Cucumber	20.0		9.0	5.6	1	1138	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		6.4	6.3	1	1010	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	7.7	5.2	1	1017	50%-point	van Zoest, 1987
Cucumber	'Sporu'	Bean	23.3	25/20	7.6	-	1	~129	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	18.3	20/15	11.0	-	1	~104	50%-point	Kraayenbrink, 1972
Eggplant	'Claresse'	Cucumber	22.5		8.0	0.0	3	~452	50%-point	van Bruggen, 1975
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Eggplant	'Mammouth'	Cucumber	24.0		7	-	192	192		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
Tree tobacco	-	-	17.0		12.2	0.8	1110	1110		Di Pietro, 1977
Tree tobacco	-	-	22.0		10	1.2	642	642		Di Pietro, 1977
Tree tobacco	-	-	27.0		5.77	0.5	2035	2035		Di Pietro, 1977
Tobacco	'Bright Yellow'	Tobacco	15.0		14.8	-	-	-		Yano, 1981

Appendix A1 (continued). Development duration (days) of eggs of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration *n*	Duration *n*(wf)	Remarks	Reference
Tobacco	'Bright Yellow'	Tobacco	18.0		10.2	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	21.0		7.8	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	24.0		6.3	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	27.0		5.3	-	-	-		Yano, 1981
Tobacco	'N.C.2326'	Tobacco	25.0		6.57	9.0	44	44		Nechols & Tauber, 1977b
Gerbera	'Terra Fame'	Gerbera	15.0		18.7	7.3	≈103	≈103		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		10.5	3.3	≈126	≈126		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		6.0	5.7	≈90	≈90		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		5.5	4.9	≈110	≈110		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		8.84	11.3	384	384		Kusters, 1990
Gerbera	'Mandarine'	Gerbera	15.0		12.5	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	21.0		9.0	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	25.0		6.9	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	30.0		5.9	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Symfonie'	Cucumber	23.5	30/18	8.1	-	1	174	50%-point	Schonherr, 1988
Gerbera	'Terra visa'	Cucumber	23.5	30/18	8.3	-	1	186	50%-point	Schonherr, 1988
Gerbera	'Terra kim'	Cucumber	23.5	30/18	8.5	-	1	226	50%-point	Schonherr, 1988
Sweet pepper	'Mospa'	Cucumber	24.0		7	-	146	146		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Sweet pepper	'Tisana'	Sweet pepper	24.4		10.5	18.6	-	-	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Sweet pepper	24.4		10.2	13.1	-	-	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Marike'	Cucumber	22.5		8.0	0.0	3	≈339	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Chrysanthemum	'Altis'	Gerbera	15.0		15.4	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	21.0		9.8	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	25.0		9.6	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	30.0		9.1	-	-	-	50%-point	Mulock Houwer, 1977
Hibiscus	'Nairobi'	Tomato	22.0		9.08	10.8	297	297		Kusters, 1990
-	-	-	23.1		7.5	-	-	-	East European wf	Agekyan, 1981
-	-	-	-		11.0	-	13	13		Hargreaves, 1914

Appendix A2. Development duration (days) of L1 of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n(wf)*, total number of whiteflies (*wf*).

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration n	Duration n(wf)	Remarks	Reference
Tomato	'Moneydor'	Cucumber	22.5		5.7	13.5	3	≈456	50%-point	van Bruggen, 1975
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Tomato	'Moneydor'	Tomato	10.0		12.7	34.7	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	15.0		8.0	26.4	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	20.0		4.5	24.5	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	25.0		3.6	28.9	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	30.0		4.3	24.4	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Bean	23.3		5.4	-	1	≈90	50%-point	Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3		7.5	-	1	≈107	50%-point	Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	7.0		>34	-	45	45		van Evert & Schutte, 1983
Tomato	'Moneydor'	Tomato	35.0		2.3	24.5	60	60		van Evert & Schutte, 1983
Tomato	'Moneydor'	Cucumber	24.0		3	-	149	149		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
Tomato	'Vesuvius'		20.0		6	-	3	500		Huang, 1988
Tomato	'Vesuvius'		25.0		3	-	3	500		Huang, 1988
Tomato	-	-	26.7		3.0	-	-	-		Hussey & Gurney, 1957
Tomato	-	-	23.9		2.4	-	-	-		Hussey & Gurney, 1957
Tomato	-	-	21.1		3.3	-	-	-		Hussey & Gurney, 1957
Tomato	'Moneydor'	Bean	23.3	25/20	5.4	-	1	≈110		Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3	20/15	9.5	-	1	≈99		Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	11.4	18/7	11.0	-	-	-		Christochowitz & van der Fluit, 1981
										Christochowitz et al., 1981
Tomato	'Moneydor'	Tomato	27.5	35/20	3.0	-	193	193		van Evert & Schutte, 1983
Tomato	-	Tobacco	26.7	30/20	2.8	-	-	-	young plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	26.7	30/20	4.7	-	-	-	old plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	20.0	25/10	5.7	-	-	-	young plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	20.0	25/10	6.9	-	-	-	old plant	Yano, 1988
										Yano, 1989
Tomato	'Tropic'	-	24.0	34/14	4.1	20.5	193	193	temp.sum measured	Osborne, 1982
Bean	'Canadian wonder'	-	18.0		6.5	10.9	50	50		Madueke, 1979
										Madueke & Coaker, 1984
Bean	'Canadian wonder'	-	22.5		4.2	22.5	62	62		Madueke, 1979
										Madueke & Coaker, 1984
Bean	'Canadian wonder'	-	27.0		2.9	25.3	54	54		Madueke, 1979
										Madueke & Coaker, 1984
Bean	'Nanus'	Bean	12.0		25.0	-	-	-		Stenseth, 1971
Bean	'Nanus'	Bean	15.0		12.0	-	-	-		Stenseth, 1971
										Stenseth, 1977
Bean	'Nanus'	Bean	18.0		7.0	-	-	-		Stenseth, 1971
										Stenseth, 1977
Bean	'Nanus'	Bean	21.0		4.5	-	-	-		Stenseth, 1971
										Stenseth, 1977
Bean	'Nanus'	Bean	24.0		2.6	-	-	-		Stenseth, 1971

Appendix A2 (continued). Development duration (days) of L1 of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration n	Duration n(wf)	Remarks	Reference
										Stenseth, 1977
Bean	'Nanus'	Bean	30.0		2.5	-	-	-		Stenseth, 1971
										Stenseth, 1977
Bean	'Sarka'	-	20.0		4.9	31.2	27	27	East European wf	Laska et al., 1980
Bean	'Contender'	-	26.0		3.2	-	-	-		Collman & All, 1980
Bean	-	-	13.3		13.0	-	14	14		Li Zu-Yin et al., 1980
Bean	-	-	16.2		8.5	-	137	137		Li Zu-Yin et al., 1980
Bean	-	-	19.7		6.1	-	28	28		Li Zu-Yin et al., 1980
Bean	-	-	23.1		5.5	-	29	29		Li Zu-Yin et al., 1980
Bean	-	-	24.5		4.5	-	27	27		Li Zu-Yin et al., 1980
Bean	-	-	25.8		3.0	-	33	33		Li Zu-Yin et al., 1980
Cucumber	'IVT 71-240'	Cucumber	22.5		4.3	13.3	3	≈584	50%-point	van Bruggen, 1975
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Cucumber	'IVT 71-240'	Cucumber	24.0		3.5	-	159	159		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
Cucumber	'Sporu'	Bean	23.3		3.3	-	1	≈106	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	18.3		4.5	-	1	≈105	50%-point	Kraayenbrink, 1972
Cucumber	'Gele Tros'	Cucumber	25.0		2	-	-	-		Hooy, 1984
Cucumber	'Profito'	Cucumber	20.0		3.7	-	1	938	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		2.9	-	1	731	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	2.9	-	1	794	50%-point	van Zoest, 1987
Cucumber	'Sporu'	Bean	23.3	25/20	3.4	-	1	≈129	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	18.3	20/15	5.5	-	1	≈104	50%-point	Kraayenbrink, 1972
Eggplant	'Claresse'	Cucumber	22.5		3.8	7.5	3	≈452	50%-point	van Bruggen, 1975
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Eggplant	'Mammouth'	Cucumber	24.0		3	-	184	184		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
Tree tobacco	-	-	17.0		8.16	-	880	880		Di Pietro, 1977
Tree tobacco	-	-	22.0		3.12	-	582	582		Di Pietro, 1977
Tree tobacco	-	-	27.0		3.14	-	1769	1769		Di Pietro, 1977
Tobacco	'N.C.2326'	Tobacco	25.0		4.41	35.4	34	34		Nechols & Tauber, 1977b
Tobacco	-	-	8.0		>>	-	-	-		Weber, 1931
Tobacco	-	-	19.0		7	-	-	-		Weber, 1931
Tobacco	-	-	23.0		5	-	-	-		Weber, 1931
Tobacco	-	-	29.0		4	-	-	-		Weber, 1931
Gerbera	'Terra Fame'	Gerbera	15.0		8.8	13.1	≈100	≈100		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		4.5	22.7	≈123	≈123		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		4.6	13.0	≈82	≈82		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		3.4	27.0	≈102	≈102		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		4.16	41.6	326	326		Kusters, 1990
Gerbera	'Mandarine'	Gerbera	15.0		8.8	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	21.0		4.8	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	25.0		4.0	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	30.0		2.8	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Symfonie'	Cucumber	23.5	30/18	3.9	-	1	66	50%-point	Schonherr, 1988

Appendix A2 (continued). Development duration (days) of L1 of *T. vaporariorum*.

Host plant	Cultivar	Pest	Temp. (°C)		Duration				Remarks	Reference
		reared on	Mean	Range	Mean	cv(%)	n	n(wf)		
Gerbera	'Terra visa'	Cucumber	23.5	30/18	3.5	-	1	137	50%-point	Schonherr, 1988
Gerbera	'Terra kim'	Cucumber	23.5	30/18	3.9	-	1	117	50%-point	Schonherr, 1988
Sweet pepper	'Mospa'	Cucumber	24.0		6.5	-	128	128		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Sweet pepper	'Tisana'	Sweet pepper	24.4		5.1	-	306	306	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Sweet pepper	24.4		4.2	-	491	491	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Marike'	Cucumber	22.5		6.5	7.7	3	≈339	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Chrysanthemum	'Altis'	Gerbera	15.0		15.7	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	21.0		10.2	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	25.0		9.3	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	30.0		7.1	-	-	-	50%-point	Mulock Houwer, 1977
Hibiscus	'Nairobi'	Tomato	22.0		5.17	39.3	253	253		Kusters, 1990
-	-	-	23.1		3	-	-	-	East European wf	Agekyan, 1981
-	-	-	-		11.0	7.4	13	13		Hargreaves, 1914

Appendix A3. Development duration (days) of L2 of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration *n*	Duration *n*(wf)	Remarks	Reference
Tomato	'Moneydor'	Cucumber	22.5		2.5	20.0	3	≈456	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Tomato	'Moneydor'	Tomato	10.0		8.1	17.6	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	15.0		9.3	24.7	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	20.0		4.7	75.6	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	25.0		4.4	45.8	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	30.0		4.9	28.2	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Bean	23.3		3.0	-	1	≈90	50%-point	Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3		4.0	-	1	≈107	50%-point	Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	7.0		>29	-	42	42		van Evert & Schutte, 1983
Tomato	'Moneydor'	Tomato	35.0		1.3	35.1	36	36		van Evert & Schutte, 1983
Tomato	'Moneydor'	Cucumber	24.0		2	-	136	136		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Tomato	'Vesuvius'		20.0		3	-	3	500		Huang, 1988
Tomato	'Vesuvius'		25.0		2	-	3	500		Huang, 1988
Tomato	-	-	26.7		2.2	-	-	-		Hussey & Gurney, 1957
Tomato	-	-	23.9		2.2	-	-	-		Hussey & Gurney, 1957
Tomato	-	-	21.1		3.3	-	-	-		Hussey & Gurney, 1957
Tomato	'Moneydor'	Bean	23.3	25/20	3.0	-	1	≈110		Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3	20/15	3.6	-	1	≈99		Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	11.4	18/7	4.7	26.1	36	36		Christochowitz & van der Fluit, 1981 Christochowitz et al., 1981
Tomato	'Moneydor'	Tomato	22.9	26/18	2.9	48.3	186	186	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	27.5	35/20	2.2	34.2	144	144		van Evert & Schutte, 1983
Tomato	-	Tobacco	26.7	30/20	2.7	-	-	-	young plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	26.7	30/20	2.1	-	-	-	old plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	4.3	-	-	-	young plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	5.7	-	-	-	old plant	Yano, 1988 Yano, 1989
Tomato	'Tropic'	-	24.0	34/14	2.5	12.5	188	188	temp.sum measured	Osborne, 1982
Bean	'Canadian wonder'	-	18.0		4.3	18.1	50	50		Madueke, 1979 Madueke & Coaker, 1984
Bean	'Canadian wonder'	-	22.5		3.2	24.4	61	61		Madueke, 1979 Madueke & Coaker, 1984
Bean	'Canadian wonder'	-	27.0		1.9	30.4	52	52		Madueke, 1979 Madueke & Coaker, 1984
Bean	'Sarka'	-	20.0		3.0	22.9	27	27	East European wf	Laska et al., 1980
Bean	'Contender'	-	26.0		1.2	-	-	-		Collman & All, 1980
Bean	-	-	13.3		13.5	-	13	13		Li Zu-Yin et al., 1980
Bean	-	-	16.2		5.5	-	136	136		Li Zu-Yin et al., 1980
Bean	-	-	19.7		5.0	-	27	27		Li Zu-Yin et al., 1980
Bean	-	-	23.1		5.0	-	27	27		Li Zu-Yin et al., 1980

Appendix A3 (continued). Development duration (days) of *L2* of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration *n*	Duration *n*(wf)	Remarks	Reference
Bean	-	-	24.5		4.5	-	20	20		Li Zu-Yin et al., 1980
Bean	-	-	25.8		3.5	-	30	30		Li Zu-Yin et al., 1980
Cucumber	'IVT 71-240'	Cucumber	22.5		2.3	24.7	3	≈584	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Cucumber	'IVT 71-240'	Cucumber	24.0		2.5	-	155	155		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Cucumber	'Sporu'	Bean	23.3		2.7	-	1	≈106	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	18.3		3.5	-	1	≈105	50%-point	Kraayenbrink, 1972
Cucumber	'Gele Tros'	Cucumber	25.0		2	-	-	-		Hooy, 1984
Cucumber	'Profito'	Cucumber	20.0		2.7	-	1	925	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		2.0	-	1	727	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	2.4	-	1	786	50%-point	van Zoest, 1987
Cucumber	'Sporu'	Bean	23.3	25/20	2.5	-	1	≈129	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	18.3	20/15	3.2	-	1	≈104	50%-point	Kraayenbrink, 1972
Eggplant	'Claresse'	Cucumber	22.5		1.7	17.3	3	≈452	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Eggplant	'Mammouth'	Cucumber	24.0		2	-	180	180		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Tree tobacco	-	-	17.0		4.25	-	688	688		Di Pietro, 1977
Tree tobacco	-	-	22.0		2.65	-	576	576		Di Pietro, 1977
Tree tobacco	-	-	27.0		2.17	-	1007	1007		Di Pietro, 1977
Tobacco	'N.C.2326'	Tobacco	25.0		2.07	29.0	128	128		Nechols & Tauber, 1977b
Tobacco	-	-	8.0		>>	-	-	-		Weber, 1931
Tobacco	-	-	19.0		3	-	-	-		Weber, 1931
Tobacco	-	-	29.0		2	-	-	-		Weber, 1931
Tobacco	-	-	27.5	30/25	1.5	-	-	-		Weber, 1931
Gerbera	'Terra Fame'	Gerbera	15.0		4.9	19.0	≈97	≈97		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		2.9	0.0	≈120	≈120		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		1.7	52.7	≈81	≈81		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		2.3	19.3	≈101	≈101		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		2.44	46.7	195	195		Kusters, 1990
Gerbera	'Mandarine'	Gerbera	15.0		5.9	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	21.0		4.4	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	25.0		2.1	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	30.0		3.1	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Symfonie'	Cucumber	23.5	30/18	3.3	-	1	61	50%-point	Schonherr, 1988
Gerbera	'Terra visa'	Cucumber	23.5	30/18	3.3	-	1	129	50%-point	Schonherr, 1988
Gerbera	'Terra kim'	Cucumber	23.5	30/18	3.0	-	1	109	50%-point	Schonherr, 1988
Sweet pepper	'Mospa'	Cucumber	24.0		4.5	-	37	37		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Sweet pepper	'Tisana'	Sweet pepper	24.4		3.1	61.3	206	206	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Sweet pepper	24.4		2.8	37.2	470	470	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Marike'	Cucumber	22.5		3.3	22.9	3	≈339	50%-point	van Bruggen, 1975

Appendix A3 (continued). Development duration (days) of L2 of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C)		Duration				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(wf)		
Sweet pepper	'Tisana'	Tomato	22.9	26/18	2.5	44.0	111	111	Dutch wf	Woets & van Lenteren, 1976; van Lenteren et al., 1977; Oostenbrug, 1988
Sweet pepper	'Tisana'	Sweet pepper	24.4	37/16	3.1	61.3	206	206	Hungarian wf	van Lenteren et al., 1989; van Vianen et al., 1987
Sweet pepper	'Angeli emleke'	Tomato	22.9	26/18	2.1	66.7	91	91	Dutch wf	van Lenteren et al., 1989; Oostenbrug, 1988
Sweet pepper	'Angeli emleke'	Sweet pepper	24.4	37/16	2.8	35.7	470	470	Hungarian wf	van Lenteren et al., 1989; van Vianen et al., 1987
Sweet pepper	'Angeli emleke'	Sweet pepper	24.1	31/19	3.2	31.3	184	184	Hungarian wf	van Lenteren et al., 1989; Meyer, 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	31/19	3.4	35.3	155	155	Hungarian wf	Meyer et al., 1990; Meyer, 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	31/19	3.4	41.2	131	131	Hungarian wf	Meyer et al., 1990; Meyer, 1990
Chrysanthemum	'Altis'	Gerbera	15.0		6.2	-	-	-	50%-point	Meyer et al., 1990; Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	21.0		4.8	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	25.0		6.3	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	30.0		7.5	-	-	-	50%-point	Mulock Houwer, 1977
Hibiscus	'Nairobi'	Tomato	22.0		3.36	59.5	163	163		Kusters, 1990
-	-	-	23.1		2.5	-	-	-	East European wf	Agekyan, 1981
-	-	-	-		17.8	21.0	10	10		Hargreaves, 1914

Appendix A4. Development duration (days) of L3 of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest	Temp. (°C)		Duration				Remarks	Reference
		reared on	*Mean*	*Range*	*Mean*	*cv(%)*	*n*	*n(wf)*		
Tomato	'Moneydor'	Cucumber	22.5		2.7	21.7	3	≈456	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Tomato	'Moneydor'	Tomato	10.0		7.1	32.3	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	15.0		6.3	54.2	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	20.0		3.5	46.0	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	25.0		3.0	89.5	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	30.0		4.2	28.5	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Bean	23.3		3.0	-	1	≈90	50%-point	Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3		5.0	-	1	≈107	50%-point	Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	7.0		>26	-	72	72		van Evert & Schutte, 1983
Tomato	'Moneydor'	Tomato	35.0		2.0	0.0	32	32		van Evert & Schutte, 1983
Tomato	'Moneydor'	Cucumber	24.0		3	-	131	131		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Tomato	'Vesuvius'		20.0		4	-	3	500		Huang, 1988
Tomato	'Vesuvius'		25.0		2	-	3	500		Huang, 1988
Tomato	-	-	26.7		2.5	-	-	-		Hussey & Gurney, 1957
Tomato	-	-	23.9		3.2	-	-	-		Hussey & Gurney, 1957
Tomato	-	-	21.1		2.7	-	-	-		Hussey & Gurney, 1957
Tomato	'Moneydor'	Bean	23.3	25/20	9.0	-	1	≈110		Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3	20/15	4.4	-	1	≈99		Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	11.4	18/7	5.5	19.4	42	42		Christochowitz & van der Fluit, 1981 Christochowitz et al., 1981
Tomato	'Moneydor'	Tomato	22.9	26/18	3.4	47.1	164	164	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	27.5	35/20	2.6	25.2	122	122		van Evert & Schutte, 1983
Tomato	-	Tobacco	26.7	30/20	4.6	-	-	-	young plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	26.7	30/20	5.6	-	-	-	old plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	5.8	-	-	-	young plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	8.4	-	-	-	old plant	Yano, 1988 Yano, 1989
Tomato	'Tropic'	-	24.0	34/14	2.6	16.2	140	140	temp.sum measured	Osborne, 1982
Bean	'Canadian wonder'	-	18.0		4.5	20.4	50	50		Madueke, 1979 Madueke & Coaker, 1984
Bean	'Canadian wonder'	-	22.5		3.3	23.7	61	61		Madueke, 1979 Madueke & Coaker, 1984
Bean	'Canadian wonder'	-	27.0		2.5	25.7	51	51		Madueke, 1979 Madueke & Coaker, 1984
Bean	'Sarka'	-	20.0		3.6	25.1	27	27	East European wf	Laska et al., 1980
Bean	'Contender'	-	26.0		2.3	-	-	-		Collman & All, 1980
Bean	-	-	13.3		13.0	-	13	13		Li Zu-Yin et al., 1980
Bean	-	-	16.2		5.5	-	134	134		Li Zu-Yin et al., 1980
Bean	-	-	19.7		4.1	-	25	25		Li Zu-Yin et al., 1980
Bean	-	-	23.1		4.0	-	24	24		Li Zu-Yin et al., 1980

Appendix A4 (continued). Development duration (days) of L3 of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration *n*	Duration *n*(wf)	Remarks	Reference
Bean	-	-	24.5		4.5	-	18	18		Li Zu-Yin et al., 1980
Bean	-	-	25.8		2.5	-	30	30		Li Zu-Yin et al., 1980
Cucumber	'IVT 71-240'	Cucumber	22.5		2.7	21.7	3	~584	50%-point	van Bruggen, 1975
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Cucumber	'IVT 71-240'	Cucumber	24.0		2	-	155	155		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
Cucumber	'Sporu'	Bean	23.3		2.5	-	1	≈106	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	18.3		4.0	-	1	≈105	50%-point	Kraayenbrink, 1972
Cucumber	'Gele Tros'	Cucumber	25.0		2	-	-	-		Hooy, 1984
Cucumber	'Profito'	Cucumber	20.0		3.2	-	1	924	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		2.3	-	1	727	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	2.4	-	1	785	50%-point	van Zoest, 1987
Cucumber	'Sporu'	Bean	23.3	25/20	3.0	-	1	≈129	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	18.3	20/15	4.0	-	1	≈104	50%-point	Kraayenbrink, 1972
Eggplant	'Claresse'	Cucumber	22.5		2.8	20.4	3	~452	50%-point	van Bruggen, 1975
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Eggplant	'Mammouth'	Cucumber	24.0		2	-	180	180		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
Tree tobacco	-	-	17.0		5.16	-	206	206		Di Pietro, 1977
Tree tobacco	-	-	22.0		3.61	-	572	572		Di Pietro, 1977
Tree tobacco	-	-	27.0		2.92	-	967	967		Di Pietro, 1977
Tobacco	'N.C.2326'	Tobacco	25.0		2.77	22.4	124	124		Nechols & Tauber, 1977b
Tobacco	-	-	8.0		>>	-	-	-		Weber, 1931
Tobacco	-	-	22.0		3.5	-	-	-		Weber, 1931
Tobacco	-	-	17.5		6	-	-	-		Weber, 1931
Gerbera	'Terra Fame'	Gerbera	15.0		6.0	18.3	~97	~97		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		3.9	17.0	≈120	≈120		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		2.9	32.7	~81	~81		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		3.0	14.1	~94	~94		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		2.87	57.5	169	169		Kusters, 1990
Gerbera	'Mandarine'	Gerbera	15.0		4.4	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	21.0		3.7	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	25.0		1.5	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	30.0		3.0	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Symfonie'	Cucumber	23.5	30/18	5.5	-	1	55	50%-point	Schonherr, 1988
Gerbera	'Terra visa'	Cucumber	23.5	30/18	4.5	-	1	113	50%-point	Schonherr, 1988
Gerbera	'Terra kim'	Cucumber	23.5	30/18	4.5	-	1	98	50%-point	Schonherr, 1988
Sweet pepper	'Mospa'	Cucumber	24.0		2	-	20	20		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
Sweet pepper	'Tisana'	Sweet pepper	24.4		4.1	58.5	71	71	Hungarian wf	van Vianen et al., 1987
										van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Sweet pepper	24.4		3.1	36.8	431	431	Hungarian wf	van Vianen et al., 1987
										van Lenteren et al., 1989
Sweet pepper	'Marike'	Cucumber	22.5		4.5	22.2	3	~339	50%-point	van Bruggen, 1975
										Woets & van Lenteren, 1976

Appendix A4 (continued). Development duration (days) of L3 of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration *n*	Duration *n*(wf)	Remarks	Reference
Sweet pepper	'Tisana'	Tomato	22.9	26/18	4.1	36.6	81	81	Dutch wf	van Lenteren et al., 1977; Oostenbrug, 1988
Sweet pepper	'Tisana'	Sweet pepper	24.4	37/16	4.3	58.1	71	71	Hungarian wf	van Lenteren et al., 1989; van Vianen et al., 1987
Sweet pepper	'Angeli emleke'	Tomato	22.9	26/18	4.3	37.2	66	66	Dutch wf	van Lenteren et al., 1989; Oostenbrug, 1988
Sweet pepper	'Angeli emleke'	Sweet pepper	24.4	37/16	3.1	35.5	431	431	Hungarian wf	van Lenteren et al., 1989; van Vianen et al., 1987
Sweet pepper	'Angeli emleke'	Sweet pepper	24.1	31/19	2.6	42.3	154	154	Hungarian wf	van Lenteren et al., 1989; Meyer, 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	31/19	2.6	42.3	136	136	Hungarian wf	Meyer et al., 1990; Meyer, 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	31/19	2.8	46.4	109	109	Hungarian wf	Meyer et al., 1990; Meyer, 1990; Meyer et al., 1990
Chrysanthemum	'Altis'	Gerbera	15.0		5.3	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	21.0		4.4	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	25.0		6.9	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	30.0		4.8	-	-	-	50%-point	Mulock Houwer, 1977
Hibiscus	'Nairobi'	Tomato	22.0		4.03	60.1	119	119		Kusters, 1990
-	-	-	23.1		3	-	-	-	East European wf	Agekyan, 1981
-	-	-	-		18.2	58.1	20	20		Hargreaves, 1914

Appendix A5. Development duration (days) of L4 of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Hostplant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration *cv*(%)	Duration *n*	Duration *n*(wf)	Remarks	Reference
Tomato	'Bonnie Best'	Tomato	18.0		4	-	-	-		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	27.0		2	-	-	-		Burnett, 1949
Tomato	'Moneydor'	Tomato	7.0		>25	-	74	74		van Evert & Schutte, 1983
Tomato	'Moneydor'	Tomato	35.0		1.0	20.0	24	24		van Evert & Schutte, 1983
Tomato	'Moneydor'	Cucumber	24.0		1	-	131	131		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Tomato	'Vesuvius'		20.0		3	-	3	500		Huang, 1988
Tomato	'Vesuvius'		25.0		2	-	3	500		Huang, 1988
Tomato	'Moneydor'	Tomato	11.4	18/7	4.0	34.6	44	44		Christochowitz & van der Fluit, 1981 Christochowitz et al., 1981
Tomato	'Moneydor'	Tomato	22.9	26/18	1.7	70.6	155	155	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	27.5	35/20	1.5	76.0	105	105		van Evert & Schutte, 1983
Bean	'Sarka'	-	20.0		4.0	-	27	27	East European wf	Laska et al., 1980
Bean	'Contender'	-	26.0		3.3	-	-	-		Collman & All, 1980
Cucumber	'IVT 71-240'	Cucumber	24.0		2	-	155	155		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Cucumber	'Profito'	Cucumber	20.0		3.0	-	1	≈922	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		2.2	-	1	≈727	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	2.2	-	1	≈783	50%-point	van Zoest, 1987
Eggplant	'Mammouth'	Cucumber	24.0		2	-	180	180		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Tree tobacco	-	-	17.0		8.44	-	203	203		Di Pietro, 1977
Tree tobacco	-	-	22.0		6.47	-	569	569		Di Pietro, 1977
Tobacco	'N.C.2326'	Tobacco	25.0		3.19	38.9	122	122		Nechols & Tauber, 1977b
Gerbera	'Terra Fame'	Gerbera	15.0		7.4	11.5	≈97	≈97		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		3.7	0.0	≈120	≈120		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		2.8	0.0	≈81	≈81		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		4.3	30.4	≈75	≈75		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		3.43	76.7	159	159		Kusters, 1990
Gerbera	'Symfonie'	Cucumber	23.5	30/18	4.7	-	1	43	50%-point	Schonherr, 1988
Gerbera	'Terra visa'	Cucumber	23.5	30/18	3.0	-	1	76	50%-point	Schonherr, 1988
Gerbera	'Terra kim'	Cucumber	23.5	30/18	4.0	-	1	63	50%-point	Schonherr, 1988
Sweet pepper	'Mospa'	Cucumber	24.0		2	-	15	15		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Sweet pepper	'Tisana'	Sweet pepper	24.4		4.7	83.0	27	27	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Sweet pepper	24.4		3.0	39.4	378	378	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Tisana'	Tomato	22.9	26/18	2.7	51.9	73	73	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Tisana'	Sweet pepper	24.4	37/16	4.7	83.0	27	27	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Tomato	22.9	26/18	2.6	50.0	63	63	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Sweet pepper	24.4	37/16	3.0	40.0	378	378	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989

Appendix A5 (continued). Development duration (days) of L4 of *T. vaporariorum*.

Hostplant	Cultivar	Pest reared on	Temp. (°C)		Duration				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(wf)		
Sweet pepper	'Angeli emleke'	Sweet pepper	24.1	31/19	3.0	33.3	129	129	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	31/19	3.2	50.0	116	116	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	31/19	3.3	48.5	95	95	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Hibiscus	'Nairobi'	Tomato	22.0		4.56	62.3	91	91		Kusters, 1990
-	-	-	23.1		4	-	-	-	East European wf	Agekyan, 1981

Appendix A6. Development duration (days) of the prepupa of *T.vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(wf), number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration *cv*(%)	Duration *n*	Duration *n*(wf)	Remarks	Reference
Tomato	'Moneydor'	Tomato	35.0		5.6	40.7	16	16		van Evert & Schutte, 1983
Tomato	'Vesuvius'		20.0		4	-	3	500		Huang, 1988
Tomato	'Vesuvius'		25.0		3	-	3	500		Huang, 1988
Tomato	'Moneydor'	Tomato	11.4	18/7	6.8	20.8	45	45		Christochowitz & van der Fluit, 1981; Christochowitz et al., 1981
Tomato	'Moneydor'	Tomato	22.9	26/18	2.9	31.0	144	144	Dutch wf	Oostenbrug, 1988; van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	27.5	35/20	3.5	29.8	101	101		van Evert & Schutte, 1983
Bean	'Sarka'	-	20.0		3.0	-	27	27	East European wf	Laska et al., 1980
Cucumber	'Profito'	Cucumber	20.0		3.7	-	1	≈922	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		2.3	-	1	≈727	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	2.6	-	1	≈783	50%-point	van Zoest, 1987
Tobacco	'N.C.2326'	Tobacco	25.0		1.78	41.6	23	23		Nechols & Tauber, 1977b
Gerbera	'Terra Fame'	Gerbera	15.0		3.8	-	≈97	≈97		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		2.0	-	≈120	≈120		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		1.7	-	≈81	≈81		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		1.6	-	≈64	≈64		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		2.07	52.2	143	143		Kusters, 1990
Sweet pepper	'Tisana'	Tomato	22.9	26/18	2.2	45.5	72	72	Dutch wf	Oostenbrug, 1988; van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Tomato	22.9	26/18	3.2	34.4	62	62	Dutch wf	Oostenbrug, 1988; van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Sweet pepper	24.1	31/19	2.0	35.0	129	129	Hungarian wf	Meyer, 1990; Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	31/19	2.2	36.4	114	114	Hungarian wf	Meyer, 1990; Meyer et al., 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	31/19	1.9	36.8	92	92	Hungarian wf	Meyer, 1990; Meyer et al., 1990
Hibiscus	'Nairobi'	Tomato	22.0		3.64	41.5	64	64		Kusters, 1990
-	-	-	23.1		1	-	-	-	East European wf	Agekyan, 1981

Appendix A7. Development duration (days) of the pupa of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration *cv*(%)	Duration *n*	Duration *n*(wf)	Remarks	Reference
Tomato	'Moneydor'	Cucumber	22.5		4.2	18.3	3	≈456	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Tomato	'Moneydor'	Tomato	10.0		9.8	41.9	-	-	*cv* from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	15.0		7.5	19.2	-	-	*cv* from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	20.0		3.6	54.5	-	-	*cv* from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	25.0		2.7	17.2	-	-	*cv* from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	30.0		3.6	35.4	-	-	*cv* from 1 exp.	Eysackers, 1969
Tomato	'Vesuvius'		20.0		3	-	3	500		Huang, 1988
Tomato	'Vesuvius'		25.0		1	-	3	500		Huang, 1988
Tomato	'Moneydor'	Tomato	11.4	18/7	7.2	14.1	45	45		Christochowitz & van der Fluit, 1981 Christochowitz et al., 1981
Tomato	'Moneydor'	Tomato	22.9	26/18	3.5	37.1	130	130	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	27.5	35/20	3.4	22.9	99	99		van Evert & Schutte, 1983
Bean	'Canadian wonder'	-	18.0		5.9	15.4	49	49		Madueke, 1979 Madueke & Coaker, 1984
Bean	'Canadian wonder'	-	22.5		4.0	15.6	61	61		Madueke, 1979 Madueke & Coaker, 1984
Bean	'Canadian wonder'	-	27.0		2.8	25.3	50	50		Madueke, 1979 Madueke & Coaker, 1984
Bean	'Sarka'	-	20.0		4.3	-	27	27	East European wf	Laska et al., 1980
Cucumber	'IVT 71-240'	Cucumber	22.5		5.5	15.8	3	≈584	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Cucumber	'Profito'	Cucumber	20.0		3.6	-	1	922	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		2.4	-	1	727	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	3.5	-	1	783	50%-point	van Zoest, 1987
Eggplant	'Claresse'	Cucumber	22.5		5.0	0.0	3	≈452	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Tobacco	'N.C.2326'	Tobacco	25.0		2.76	15.9	21	21		Nechols & Tauber, 1977b
Gerbera	'Terra Fame'	Gerbera	15.0		7.6	-	≈97	≈97		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		4.6	-	≈120	≈120		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		2.6	-	≈79	≈79		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		3.5	-	≈56	≈56		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		3.97	24.7	139	139		Kusters, 1990
Sweet pepper	'Marike'	Cucumber	22.5		2.3	32.7	3	≈339	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Sweet pepper	'Tisana'	Tomato	22.9	26/18	3.1	35.5	60	60	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Tomato	22.9	26/18	1.1	127.3	53	53	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Sweet pepper	24.1	31/19	2.7	22.2	122	122	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	31/19	2.6	23.1	108	108	Hungarian wf	Meyer, 1990

Appendix A7 (continued). Development duration (days) of the pupa of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C)		Duration				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(wf)		
Sweet pepper	'Feherozon'	Sweet pepper	24.1	31/19	2.6	23.1	89	89	Hungarian wf	Meyer et al., 1990 Meyer, 1990
Hibiscus	'Nairobi'	Tomato	22.0		3.75	20.3	61	61		Meyer et al., 1990 Kusters, 1990
-	-	-	23.1		4	-	-	-	East European wf	Agekyan, 1981

Appendix A8. Development duration (days) of L4+prepupa+pupa of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration n	Duration n(wf)	Remarks	Reference
Tomato	'Bonnie Best'	Tomato	18.0		9	-	99	99		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	27.0		6	-	265	265		Burnett, 1949
Tomato	'Moneydor'	Cucumber	22.5		9.2	-	3	≈456	50%-point	van Bruggen, 1975
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Tomato	'Moneydor'	Tomato	10.0		27.1	-	-	-	*cv* from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	15.0		16.1	-	-	-	*cv* from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	20.0		9.7	-	-	-	*cv* from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	25.0		7.0	-	-	-	*cv* from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	30.0		7.8	-	-	-	*cv* from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Bean	23.3		9.5	-	1	≈90	50%-point	Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3		13.0	-	1	≈107	50%-point	Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	7.0		>51	-	62	62		van Evert & Schutte, 1983
Tomato	'Moneydor'	Cucumber	24.0		8	-	131	131		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
Tomato	'Vesuvius'		20.0		10	-	3	500		Huang, 1988
Tomato	'Vesuvius'		25.0		6	-	3	500		Huang, 1988
Tomato	-	-	26.7		5.5	-	-	-		Hussey & Gurney, 1957
Tomato	-	-	23.9		6.0	-	-	-		Hussey & Gurney, 1957
Tomato	-	-	21.1		6.0	-	-	-		Hussey & Gurney, 1957
Tomato	'Moneydor'	Bean	23.3	25/20	10.0	-	1	≈110		Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3	20/15	12.0	-	1	≈99		Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	11.4	18/7	18.0	-	45	45		Christochowitz & van der Fluit, 1981
										Christochowitz et al., 1981
Tomato	'Moneydor'	Tomato	22.9	26/18	8.1	-	130	130	Dutch wf	Oostenbrug, 1988
										van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	27.5	35/20	8.3	-	99	99		van Evert & Schutte, 1983
Tomato	-	Tobacco	26.7	30/20	7.1	-	-	-	young plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	26.7	30/20	7.7	-	-	-	old plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	20.0	25/10	12.3	-	-	-	young plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	20.0	25/10	13.3	-	-	-	old plant	Yano, 1988
										Yano, 1989
Tomato	'Tropic'	-	24.0	34/14	7.4	-	-	-	temp.sum measured	Osborne, 1982
Bean	'Canadian wonder'	-	18.0		14.6	-	49	49		Madueke, 1979
										Madueke & Coaker, 1984
Bean	'Canadian wonder'	-	22.5		9.9	-	61	61		Madueke, 1979
										Madueke & Coaker, 1984
Bean	'Canadian wonder'	-	27.0		7.3	-	50	50		Madueke, 1979
										Madueke & Coaker, 1984
Bean	'Nanus'	Bean	12.0		42.0	-	-	-		Stenseth, 1971
Bean	'Nanus'	Bean	15.0		28.7	-	-	-		Stenseth, 1971
										Stenseth, 1977
Bean	'Nanus'	Bean	18.0		13.3	-	-	-		Stenseth, 1971
										Stenseth, 1977

Appendix A8 (continued). Development duration (days) of L4+prepupa+pupa of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C)		Duration				Remarks	Reference
			Mean	Range	Mean	cv(%)	n	n(wf)		
Bean	'Nanus'	Bean	21.0		9.0	-	-	-		Stenseth, 1971 Stenseth, 1977
Bean	'Nanus'	Bean	24.0		8.8	-	-	-		Stenseth, 1971 Stenseth, 1977
Bean	'Nanus'	Bean	30.0		8.5	-	-	-		Stenseth, 1971 Stenseth, 1977
Bean	'Sarka'	-	20.0		11.3	6.9	27	27	East European wf	Laska et al., 1980
Bean	'Contender'	-	26.0		7.4	-	-	-		Collman & All, 1980
Bean	-	-	13.3		19.0	-	13	13		Li Zu-Yin et al., 1980
Bean	-	-	16.2		13.5	-	126	126		Li Zu-Yin et al., 1980
Bean	-	-	19.7		9.0	-	25	25		Li Zu-Yin et al., 1980
Bean	-	-	23.1		9.0	-	22	22		Li Zu-Yin et al., 1980
Bean	-	-	24.5		9.0	-	12	12		Li Zu-Yin et al., 1980
Bean	-	-	25.8		7.3	-	21	21		Li Zu-Yin et al., 1980
Bean	'Nanus'	Bean	21.0	24/18	11.5	-	-	-		Stenseth, 1971 Stenseth, 1977
Bean	'Nanus'	Bean	19.5	24/15	11.0	-	-	-		Stenseth, 1971
Cucumber	'IVT 71-240'	Cucumber	22.5		9.2	-	3	≈584	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Cucumber	'IVT 71-240'	Cucumber	24.0		7	-	153	153		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Cucumber	'Sporu'	Bean	23.3		7.5	-	1	≈106	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	18.3		13.0	-	1	≈105	50%-point	Kraayenbrink, 1972
Cucumber	'Gele Tros'	Cucumber	25.0		8	-	-	-		Hooy, 1984
Cucumber	'Profito'	Cucumber	20.0		10.3	-	1	914	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		6.9	-	1	720	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	8.3	-	1	776	50%-point	van Zoest, 1987
Cucumber	'Sporu'	Bean	23.3	25/20	8.5	-	1	≈129	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	18.3	20/15	13.0	-	1	≈104	50%-point	Kraayenbrink, 1972
Eggplant	'Claresse'	Cucumber	22.5		8.8	-	3	≈452	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Eggplant	'Mammouth'	Cucumber	24.0		7.5	-	180	180		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Tree tobacco	-	-	17.0		15.5	-	203	203		Di Pietro, 1977
Tree tobacco	-	-	22.0		9.93	-	568	568		Di Pietro, 1977
Tree tobacco	-	-	27.0		9.74	-	550	550		Di Pietro, 1977
Tobacco	'Bright Yellow'	Tobacco	15.0		18.9	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	18.0		12.9	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	21.0		9.8	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	24.0		7.9	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	27.0		6.7	-	-	-		Yano, 1981
Tobacco	'N.C.2326'	Tobacco	25.0		7.73	-	21	21		Nechols & Tauber, 1977b
Tobacco	-	-	5.0		>>	-	-	-		Weber, 1931
Tobacco	-	-	22.0		8	-	-	-		Weber, 1931
Tobacco	-	-	25.0		6	-	-	-		Weber, 1931

Appendix A8 (continued). Development duration (days) of L4+prepupa+pupa of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration n	Duration n(wf)	Remarks	Reference
Gerbera	'Terra Fame'	Gerbera	15.0		18.7	-	≈97	≈97		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		10.3	-	≈120	≈120		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		7.0	-	≈79	≈79		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		9.4	-	≈56	≈56		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		9.47	-	139	139		Kusters, 1990
Gerbera	'Mandarine'	Gerbera	15.0		14.4	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	21.0		11.9	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	25.0		6.7	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	30.0		9.3	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Symfonie'	Cucumber	23.5	30/18	9.6	-	1	12	50%-point	Schonherr, 1988
Gerbera	'Terra visa'	Cucumber	23.5	30/18	8.6	-	1	47	50%-point	Schonherr, 1988
Gerbera	'Terra kim'	Cucumber	23.5	30/18	7.3	-	1	43	50%-point	Schonherr, 1988
Sweet pepper	'Mospa'	Cucumber	24.0		7	-	13	13		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Sweet pepper	'Tisana'	Sweet pepper	24.4		12.9	-	24	24	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Sweet pepper	24.4		9.6	-	353	353	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Marike'	Cucumber	22.5		7.5	-	3	≈339	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Sweet pepper	'Tisana'	Tomato	22.9	26/18	8.0	-	60	60	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Tisana'	Sweet pepper	24.4	37/16	12.9	-	24	24	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Tomato	22.9	26/18	6.9	-	53	53	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Sweet pepper	24.4	37/16	9.6	-	353	353	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Sweet pepper	24.1	31/19	7.7	-	122	122	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	31/19	8.0	-	108	108	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	31/19	7.8	-	89	89	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Chrysanthemum	'Altis'	Gerbera	15.0		15.0	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	21.0		18.1	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	25.0		12.3	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	30.0		15.7	-	-	-	50%-point	Mulock Houwer, 1977
Hibiscus	'Nairobi'	Tomato	22.0		12	-	61	61		Kusters, 1990
-	-	-	23.1		9	-	-	-	East European wf	Agekyan, 1981
-	-	-	-		37.0	32.8	17	17		Hargreaves, 1914

¹ *Appendix A9. Total immature development duration (days) of T. vaporariorum. cv, coefficient of variation; n, number of replicates; n(wf), total number of whiteflies (wf).*

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration n	Duration n(wf)	Remarks	Reference
Tomato	'Bonnie Best'	Tomato	18.0		30.2	2.4	99	99		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	21.0		27.7	3.0	434	434		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	24.0		24.6	7.5	419	419		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	27.0		21.3	4.6	265	265		Burnett, 1949
Tomato	'Moneymaker'	Tomato	25.0		27.2	2.8	6	160	50%-point	van Sas, 1978 van Sas et al., 1978
Tomato	'Moneymaker'	Tomato	15.0		50.88	4.0	100	100		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Tomato	'Moneymaker'	Tomato	20.0		33.39	4.1	111	111		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Tomato	'Moneymaker'	Tomato	25.0		21.01	4.4	115	115		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Tomato	'Moneydor'	Cucumber	22.5		27.8	2.7	3	~456	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Tomato	'Moneydor'	Bean	24.5		22.8	5.0	6	1108	50%-point	van Bruggen, 1975
Tomato	'Moneydor'	Tomato	20.0		30.8	-	1	88	50%-point	Jansen, 1974
Tomato	'Moneydor'	Tomato	25.0		24.4	-	1	110	50%-point	Jansen, 1974
Tomato	'Moneydor'	Tomato	10.0		72.7	13.3	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	15.0		50.6	3.9	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	20.0		31.6	14.5	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	25.0		23.9	19.4	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Tomato	30.0		26.5	11.1	-	-	cv from 1 exp.	Eysackers, 1969
Tomato	'Moneydor'	Bean	23.3		28.5	-	1	~90	50%-point	Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3		42.0	-	1	~107	50%-point	Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	7.0		>180	-	61	61		van Evert & Schutte, 1983
Tomato	'Moneydor'	Cucumber	24.0		24	17.4	127	127		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Tomato	'Vesuvius'		20.0		33	-	3	500		Huang, 1988
Tomato	'Vesuvius'		25.0		19	-	3	500		Huang, 1988
Tomato	'Tiny Tim'	-	21.0		48.4	4.5	44	44	female wf	Curry & Pimentel, 1971
Tomato	'Delicious'	-	21.0		47.8	3.0	40	40	female wf	Curry & Pimentel, 1971
Tomato	-	-	20.0		46.2	-	-	-		Ibrahim, 1975 Madueke, 1979
Tomato	-	-	23.0		27.9	-	-	-		Ibrahim, 1975 Madueke, 1979
Tomato	-	-	26.0		21.7	-	-	-		Ibrahim, 1975 Madueke, 1979
Tomato	-	-	26.7		18.2	-	-	-		Hussey & Gurney, 1957
Tomato	-	-	23.9		19.8	-	-	-		Hussey & Gurney, 1957
Tomato	-	-	21.1		22.3	-	-	-		Hussey & Gurney, 1957
Tomato	'Moneydor'	Bean	23.3	25/20	29.0	-	1	~110		Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3	20/15	42.0	-	1	~99		Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	23.1	25/20	30.9	-	1	33	50%-point	Jansen, 1974
Tomato	'Moneydor'	Tomato	11.4	18/7	61.7	-	45	45		Christochowitz & van der Fluit, 1981 Christochowitz et al., 1981
Tomato	'Moneydor'	Tomato	22.9	26/18	28.0	-	130	130	Dutch wf	Oostenbrug, 1988

Appendix A9 (continued). Total immature development duration (days) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration *n*	Duration *n*(wf)	Remarks	Reference
										van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	27.5	35/20	23.8	-	99	99		van Evert & Schutte, 1983
Tomato	'Moneydor'	Tomato	20.0	24/16	26.4	-	64	64		van Es, 1982
Tomato	'Dombo'	Tomato	20.0	24/16	26.2	-	105	105	flesh tomato	van Es, 1982
Tomato	-	Tobacco	26.7	30/20	24.4	-	-	-	young plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	26.7	30/20	27.2	-	-	-	old plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	40.7	-	-	-	young plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	49.3	-	-	-	old plant	Yano, 1988 Yano, 1989
Tomato	'Tropic'	-	24.0	34/14	24.3	6.2	358	358	temp.sum measured	Osborne, 1982
Tomato	-	-	16.6	30.6/8.9	51.1	-	-	-		Lloyd, 1922
Tomato	-	-	23.3	38.3/8.3	31.5	-	870	870		Lloyd, 1922
Bean	'Canadian wonder'	-	18.0		44.9	-	49	49		Madueke, 1979 Madueke & Coaker, 1984
Bean	'Canadian wonder'	-	22.5		30.4	-	61	61		Madueke, 1979 Madueke & Coaker, 1984
Bean	'Canadian wonder'	-	27.0		22.2	-	50	50		Madueke, 1979 Madueke & Coaker, 1984
Bean	'Nanus'	Bean	12.0		113.0	-	-	-		Stenseth, 1971
Bean	'Nanus'	Bean	15.0		68.5	-	-	-		Stenseth, 1971 Stenseth, 1977
Bean	'Nanus'	Bean	18.0		39.5	-	-	-		Stenseth, 1971 Stenseth, 1977
Bean	'Nanus'	Bean	21.0		27.7	-	-	-		Stenseth, 1971 Stenseth, 1977
Bean	'Nanus'	Bean	24.0		23.5	-	-	-		Stenseth, 1971 Stenseth, 1977
Bean	'Nanus'	Bean	30.0		19.4	-	-	-		Stenseth, 1971 Stenseth, 1977
Bean	'Nanus'	Bean	8.3		>>	-	-	-	from Stenseth, 1971	Osborne, 1982
Bean	'Sarka'	-	20.0		29.3	-	-	-	East European wf	Laska et al., 1986
Bean	'Sarka'	-	20.0		34.1	10.3	27	27	East European wf	Laska et al., 1980
Bean	'Contender'	-	26.0		20.4	-	-	-		Collman & All, 1980
Bean	-	Bean	10.0		90.7	-	3	-		Pravisani, 1981
Bean	-	Bean	12.5		57	-	3	-		Pravisani, 1981
Bean	-	Bean	15.0		48	-	2	-		Pravisani, 1981
Bean	-	Bean	17.5		40	-	3	-		Pravisani, 1981
Bean	-	Bean	20.0		36	-	3	-		Pravisani, 1981
Bean	-	Bean	22.0		30	-	3	-		Pravisani, 1981
Bean	-	Bean	25.0		27	-	3	-		Pravisani, 1981
Bean	-	Bean	27.5		22	-	2	-		Pravisani, 1981
Bean	-	Bean	30.0		20.6	-	2	-		Pravisani, 1981
Bean	-	Bean	32.5		30.0	-	2	-		Pravisani, 1981
Bean	-	-	13.3		77.0	-	13	13		Li Zu-Yin et al., 1980

Appendix A9 (continued). Total immature development duration (days) of T. vaporariorum.

Host plant	Cultivar	Pest reared on	Temp. (°C)		Duration				Remarks	Reference
			Mean	Range	Mean	cv(%)	n	n(wf)		
Bean	-	-	16.2		50.5	-	126	126		Li Zu-Yin et al., 1980
Bean	-	-	19.7		32.8	-	25	25		Li Zu-Yin et al., 1980
Bean	-	-	23.1		31.0	-	22	22		Li Zu-Yin et al., 1980
Bean	-	-	24.5		29.0	-	12	12		Li Zu-Yin et al., 1980
Bean	-	-	25.8		21.8	-	21	21		Li Zu-Yin et al., 1980
Bean	'Nanus'	Bean	21.0	24/18	32.5	-	-	-		Stenseth, 1971 Stenseth, 1977
Bean	'Nanus'	Bean	19.5	24/15	37.0	-	-	-		Stenseth, 1971
Bean	-	-	17.3	37.8/6.1	55.5	-	260	260		Lloyd, 1922
Bean	-	-	18.6	38.3/6.1	48.5	-	49	49		Lloyd, 1922
Bean	-	-	21.7	33.3/11.7	25.5	-	-	-		Lloyd, 1922
Cucumber	'IVT 71-240'	Cucumber	22.5		26.2	1.1	3	≈584	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Cucumber	'IVT 71-240'	Bean	24.5		22.1	2.2	8	1124	50%-point	van Bruggen, 1975
Cucumber	'IVT 71-240'	Tomato	20.0		30.5	-	1	132	50%-point	Jansen, 1974
Cucumber	'IVT 71-240'	Tomato	25.0		20.3	-	1	58	50%-point	Jansen, 1974
Cucumber	'IVT 71-240'	Cucumber	24.0		23	9.4	153	153		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Cucumber	'IVT 71-240'	Tomato	25.0		26.0	4.9	6	483	50%-point	van Sas, 1978 van Sas et al., 1978
Cucumber	'Sporu'	Bean	23.3		23.0	-	1	≈106	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	18.3		37.0	-	1	≈105	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	20.0		33.0	-	1	≈50	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	25.0		21.7	-	1	≈50	50%-point	Kraayenbrink, 1972
Cucumber	'Gele Tros'	Cucumber	25.0		20	-	-			Hooy, 1984
Cucumber	'Profito'	Cucumber	20.0		28.9	4.8	1	914	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		20.5	3.9	1	720	50%-point	van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	23.7	5.1	1	776	50%-point	van Zoest, 1987
Cucumber	'IVT 71-240'	Tomato	23.1	25/20	27.5	-	1	41	50%-point	Jansen, 1974
Cucumber	'Sporu'	Bean	23.3	25/20	25.0	-	1	≈129	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	18.3	20/15	36.7	-	1	≈104	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	18.3	20/15	37.0	-	1	≈50	50%-point	Kraayenbrink, 1972
Cucumber	'Sporu'	Bean	23.3	25/20	23.0	-	1	≈50	50%-point	Kraayenbrink, 1972
Eggplant	'Monstrueuse de New York'	Tomato	24.0		22.61	-	-	-		Malausa et al., 1988
Eggplant	'Pusa Purple Cluster'	Tomato	24.0		22.88	-	-	-		Malausa et al., 1988
Eggplant	'Ronde de Valence'	Tomato	24.0		22.64	-	-	-		Malausa et al., 1988
Eggplant	'Ceylan'	Tomato	24.0		22.76	-	-	-		Malausa et al., 1988
Eggplant	'Dourga'	Tomato	24.0		24.04	-	-	-		Malausa et al., 1988
Eggplant	'Shinkuro'	Tomato	24.0		23.22	-	-	-		Malausa et al., 1988
Eggplant	'Liu Ye Kie'	Tomato	24.0		22.86	-	-	-		Malausa et al., 1988
Eggplant	'Ronde de Valence'	-	22.0		28.7	-	-	-		Malausa et al., 1984
Eggplant	'Pusa Purple	-	22.0		27.9	-	-	-		Malausa et al., 1984

Appendix A9 (continued). Total immature development duration (days) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration n	Duration n(wt)	Remarks	Reference
	Cluster'									
Eggplant	'Dourga'	-	22.0		28.1	-	-	-		Malausa et al., 1984
Eggplant	'Monstrueuse de New York'	-	22.0		26.9	-	-	-		Malausa et al., 1984
Eggplant	'Claresse'	Cucumber	22.5		24.8	1.2	3	≈452	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Eggplant	'Claresse'	Bean	24.5		20.8	3.0	8	897	50%-point	van Bruggen, 1975
Eggplant	'Mammouth'	Cucumber	24.0		21.5	8.7	175	175		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Eggplant	'Mammouth'	Tomato	25.0		25.8	3.9	6	260	50%-point	van Sas, 1978 van Sas et al., 1978
Tree tobacco	-	-	17.0		43.26	2.4	203	203		Di Pietro, 1977
Tree tobacco	-	-	22.0		29.34	1.5	568	568		Di Pietro, 1977
Tree tobacco	-	-	27.0		23.74	1.6	550	550		Di Pietro, 1977
Tobacco	'Bright Yellow'	Tobacco	15.0		58.1	5.6	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	18.0		39.1	11.3	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	21.0		29.4	8.5	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	24.0		23.6	4.3	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	27.0		19.7	4.8	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	30.0		32	19.9	-	-		Yano, 1981
Tobacco	'White Burley'	-	25.0		29.7	16.9	-	1394		Zebitz, 1978
Tobacco	'N.C.2326'	Tobacco	25.0		23.7	6.5	20	20		Nechols & Tauber, 1977b
Tobacco	-	-	8.0		>>	-	-	-		Weber, 1931
Tobacco	-	-	5.0		>>	-	-	-		Weber, 1931
Gerbera	'Terra Fame'	Gerbera	15.0		57.1	5.3	≈97	≈97		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		32.2	4.7	≈120	≈120		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		22.1	7.7	≈79	≈79		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		29.6	8.9	≈56	≈56		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	15.0		59.6	5.9	197	197		Dorsman & van de Vrie, 1987
Gerbera	'Terra Fame'	Gerbera	20.0		33.5	8.4	274	274		Dorsman & van de Vrie, 1987
Gerbera	'Terra Fame'	Gerbera	25.0		22.0	7.1	82	82		Dorsman & van de Vrie, 1987
Gerbera	'Terra Fame'	Tomato	22.0		27.8	17.5	94	94		Kusters, 1990
Gerbera	'Clementine'	Gerbera	15.0		60.5	6.5	107	107		Dorsman & van de Vrie, 1987
Gerbera	'Clementine'	Gerbera	20.0		34.0	8.9	413	413		Dorsman & van de Vrie, 1987
Gerbera	'Clementine'	Gerbera	25.0		21.6	5.9	122	122		Dorsman & van de Vrie, 1987
Gerbera	'Terra esperance'	Gerbera	15.0		56.6	6.6	149	149		Dorsman & van de Vrie, 1987
Gerbera	'Terra esperance'	Gerbera	20.0		34.8	8.2	235	235		Dorsman & van de Vrie, 1987
Gerbera	'Terra esperance'	Gerbera	25.0		21.4	5.1	59	59		Dorsman & van de Vrie, 1987
Gerbera	'Appelbloesem'	Gerbera	15.0		58.3	5.1	590	590		Dorsman & van de Vrie, 1987
Gerbera	'Appelbloesem'	Gerbera	20.0		32.4	5.7	244	244		Dorsman & van de Vrie, 1987
Gerbera	'Appelbloesem'	Gerbera	25.0		21.8	5.5	110	110		Dorsman & van de Vrie, 1987
Gerbera	'Hook hybrid'	Tomato	25.0		32.3	10.7	6	100	50%-point	van Sas, 1978 van Sas et al., 1978
Gerbera	'Mandarine'	Gerbera	15.0		46.0	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	21.0		32.8	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	25.0		21.2	-	-	-	50%-point	Mulock Houwer, 1977

Appendix A9 (continued). Total immature development duration (days) of T. vaporariorum.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Duration Mean	Duration cv(%)	Duration n	Duration n(wf)	Remarks	Reference
Gerbera	'Mandarine'	Gerbera	30.0		24.1	-	-	-	50%-point	Mulock Houwer, 1977
Gerbera	'Symfonie'	Cucumber	23.5	30/18	30.4	-	1	12	50%-point	Schonherr, 1988
Gerbera	'Terra visa'	Cucumber	23.5	30/18	28.2	-	1	47	50%-point	Schonherr, 1988
Gerbera	'Terra kim'	Cucumber	23.5	30/18	27.2	-	1	43	50%-point	Schonherr, 1988
Sweet pepper	'Mospa'	Bean	23.3		29.0	-	1	~67	50%-point	Kraayenbrink, 1972
Sweet pepper	'Mospa'	Bean	18.3		47.0	-	1	~92	50%-point	Kraayenbrink, 1972
Sweet pepper	'Mospa'	Cucumber	24.0		27	18.9	11	11		van Merendonk, 1978 van Merendonk & van Lenteren, 1978
Sweet pepper	'Tisana'	Sweet pepper	24.4		35.7	16.0	24	24	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Tisana'	Tomato	24.4		27.4	-	-	-	Dutch wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Sweet pepper	24.4		29.8	8.0	353	353	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Tomato	24.4		27.2	-	-	-	Dutch wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Marike'	Cucumber	22.5		29.8	2.6	3	~339	50%-point	van Bruggen, 1975 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Sweet pepper	'Marike'	Bean	24.5		28.1	3.4	8	204	50%-point	van Bruggen, 1975
Sweet pepper	'CIND'	-	20.0		30.1	2.6	2	715	East European wf	Laska et al., 1986 Laska et al., 1985
Sweet pepper	'California Wonder'	-	20.0		32.4	6.8	2	495	East European wf	Laska et al., 1986 Laska et al., 1985
Sweet pepper	'Granat'	-	20.0		29.1	0.2	2	930	East European wf	Laska et al., 1986 Laska et al., 1985
Sweet pepper	-	Tomato	20.0		52.5	-	1	8	50%-point	Jansen, 1974
Sweet pepper	-	Tomato	25.0		33.6	-	1	5	50%-point	Jansen, 1974
Sweet pepper	-	Tomato	23.1	25/20	30.5	-	1	3	50%-point	Jansen, 1974
Sweet pepper	'Mospa'	Bean	23.3	25/20	31.5	-	1	~98	50%-point	Kraayenbrink, 1972
Sweet pepper	'Mospa'	Bean	18.3	20/15	47.0	-	1	~57	50%-point	Kraayenbrink, 1972
Sweet pepper	'Tisana'	Tomato	22.9	26/18	27.4	-	60	60	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Tisana'	Sweet pepper	24.4	37/16	34.3	-	24	24	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Tomato	22.9	26/18	26.2	-	53	53	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Sweet pepper	24.4	37/16	29.4	-	353	353	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli emleke'	Sweet pepper	24.1	31/19	22.6	12.0	122	122	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	31/19	24.3	15.6	108	108	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	31/19	23.5	16.1	89	89	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Chrysanthemum	'Altis'	Gerbera	15.0		57.6	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	21.0		47.2	-	-	-	50%-point	Mulock Houwer, 1977

Appendix A9 (continued). Total immature development duration (days) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C)		Duration				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(wf)		
Chrysanthemum	'Altis'	Gerbera	25.0		44.4	-	-	-	50%-point	Mulock Houwer, 1977
Chrysanthemum	'Altis'	Gerbera	30.0		44.2	-	-	-	50%-point	Mulock Houwer, 1977
Wild potato	'PI 4733340'	Potato	26.0		23.08	6.4	12	12		Boiteau & Singh, 1988
Potato	'Red Pontiac'	Potato	26.0		21.38	12.4	12	12		Boiteau & Singh, 1988
Gherkin	'Levo'	Tomato	25.0		26.8	2.8	6	394	50%-point	van Sas, 1978 van Sas et al., 1978
Melon	'Ogen'	Tomato	25.0		26.8	5.5	6	83	50%-point	van Sas, 1978 van Sas et al., 1978
Hibiscus	'Nairobi'	Tomato	22.0		33.58	15.8	36	36		Kusters, 1990
-	-	-	23.1		25.0	-	-	-	East European wf	Agekyan, 1981
-	-	-	25.0		26	-	-	-		Woets, 1972a
-	-	-	-		94.8	-	-	-		Hargreaves, 1914
-	-	-	24.5	27/22	22.5	-	-	-		Treifi, 1986

Appendix B1. Mortality of eggs (% of individuals entering the stage) of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Mortality Mean	Mortality cv(%)	Mortality n	Mortality n(wf)	Remarks	Reference
Tomato	'Moneydor'	Tomato	20.0		6.7	-	-	-		Jansen, 1974
Tomato	'Moneydor'	Tomato	25.0		7.0	-	-	-		Jansen, 1974
Tomato	'Moneydor'	Tomato	7.0		0.0	-	1	409		van Evert & Schutte, 1983
Tomato	'Moneydor'	Tomato	35.0		100.0	-	1	82		van Evert & Schutte, 1983
Tomato	'Moneydor'	Cucumber	24.0		8.1	-	1	161		van Merendonk, 1978 van Merendonk & van Lenteren, 1978 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Tomato	'Ponderosa'	Tomato	25.0		0.65	72.2	5	2127		Yasui et al., 1987
Tomato	'Tiny Tim'	-	21.0		4.8	-	1	354		Curry & Pimentel, 1971
Tomato	'Delicious'	-	21.0		4.1	-	1	342		Curry & Pimentel, 1971
Tomato	-	-	14.0		0	-	-	-		Weber, 1931
Tomato	-	-	30.0		0	-	-	-		Weber, 1931
Tomato	-	-	32.0		100	-	-	-		Weber, 1931
Tomato	'Moneydor'	Tomato	22.9	26/18	11.2	-	1	321	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	23.1	25/20	0.0	-	-	-		Jansen, 1974
Tomato	'Moneydor'	Tomato	27.5	35/20	3.8	-	1	210		van Evert & Schutte, 1983
Tomato	'Kyoryoku-beiju'	Tomato	17.0	30/5	1.3	-	1	2297		Kajita, 1982
Tomato	-	Tobacco	26.7	30/20	5.82	-	-	-	young plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	26.7	30/20	0.35	-	-	-	old plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	3.35	-	-	-	young plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	10.00	-	-	-	old plant	Yano, 1988 Yano, 1989
Bean	'Canadian Wonder'	-	18.0		1.85	-	1	54		Madueke, 1979
Bean	'Canadian Wonder'	-	22.5		0.00	-	1	66		Madueke, 1979
Bean	'Canadian Wonder'	-	27.0		0.00	-	1	57		Madueke, 1979
Bean	-	-	20.5	22/19	2.5	12.0	-	-	East European wf	Genchev, 1987
Bean	-	-	20.5	22/19	2.4	16.7	-	-	East European wf	Genchev, 1987
Bean	-	-	20.5	22/19	1.9	21.1	-	-	East European wf	Genchev, 1987
Bean	-	-	20.5	22/19	2.8	17.9	-	-	East European wf	Genchev, 1987
Cucumber	'IVT 71-240'	Tomato	20.0		12.9	-	-	-		Jansen, 1974
Cucumber	'IVT 71-240'	Tomato	25.0		0.0	-	-	-		Jansen, 1974
Cucumber	'IVT 71-240'	Cucumber	24.0		7.0	-	1	171		van Merendonk, 1978 van Merendonk & van Lenteren, 1978 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Cucumber	-	-	13.2		0.0	-	1	39		Li Tzu-Yin & Li zhau-Hwa, 1983
Cucumber	-	-	17.8		0.0	-	1	37		Li Tzu-Yin & Li zhau-Hwa, 1983
Cucumber	'Profito'	Cucumber	20.0		10.3	-	1	1269		van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		11.7	-	1	1144		van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	7.7	-	1	1102		van Zoest, 1987
Cucumber	'IVT 71-240'	Tomato	23.1	25/20	1.1	-	-	-		Jansen, 1974
Eggplant	'Mammouth'	Cucumber	24.0		4.1	-	1	192		van Merendonk, 1978

Appendix B1 (continued). Mortality of eggs (% of individuals entering the stage) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Mortality Mean	Mortality cv(%)	Mortality n	Mortality n(wf)	Remarks	Reference
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Tobacco	'Bright Yellow'	Tobacco	15.0		5	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	18.0		0	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	21.0		6	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	24.0		0	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	27.0		3	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	30.0		0	-	-	-		Yano, 1981
Tree tobacco	-		17.0		4.31	-	1	1160		Di Pietro, 1977
Tree tobacco	-		22.0		4.46	-	1	672		Di Pietro, 1977
Tree tobacco	-		27.0		1.36	-	1	2063		Di Pietro, 1977
Gerbera	'Terra Fame'	Gerbera	15.0		0.9	-	1	104		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		1.1	-	1	128		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		2.4	-	1	92		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		3.0	-	1	113		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		15.1	-	1	384		Kusters, 1990
Gerbera	'Symfonie'	Cucumber	23.5	30/18	9.8	-	1	193	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Visa'	Cucumber	23.5	30/18	7.5	-	1	201	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Kim'	Cucumber	23.5	30/18	6.6	-	1	242	Hungarian wf	Schonherr, 1988
Sweet pepper	'Tisana'	Sweet pepper	24.4		18.2	-	1	461	Hungarian wf	van Vianen et al., 1987
										van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4		3.9	-	1	561	Hungarian wf	van Vianen et al., 1987
										van Lenteren et al., 1989
Sweet pepper	-	Tomato	20.0		0.0	-	-	-		Jansen, 1974
Sweet pepper	-	Tomato	25.0		13.9	-	-	-		Jansen, 1974
Sweet pepper	'Mospa'	Cucumber	24.0		12.3	-	1	146		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Sweet pepper	'Tisana'	Tomato	22.9	26/18	24.8	-	1	306	Dutch wf	Oostenbrug, 1988
										van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Tomato	22.9	26/18	28.8	-	1	240	Dutch wf	Oostenbrug, 1988
										van Lenteren et al., 1989
Sweet pepper	'Tisana'	Sweet pepper	24.4	37/16	17.6	-	1	461	Hungarian wf	van Vianen et al., 1987
										van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4	37/16	2.7	-	1	561	Hungarian wf	van Vianen et al., 1987
										van Lenteren et al., 1989
Sweet pepper	-	Tomato	23.1	25/20	2.6	-	-	-		Jansen, 1974
Strawberry	-	-	6.0		>40	-	-	-		Stenseth, 1983
Hibiscus	'Nairobi'	Tomato	22.0		14.8	-	1	297		Kusters, 1990
-	-	-	24.5	27/22	10.9	65.8	2	-		Treifi, 1986

Appendix B2. Mortality of L1 (% of individuals entering the stage) of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Mortality Mean	Mortality cv(%)	Mortality *n*	Mortality *n*(wf)	Remarks	Reference
Tomato	'Moneydor'	Cucumber	22.5		0.2	70.7	4	2140		van Bruggen, 1975
Tomato	'Moneydor'	Tomato	35.0		0.0	-	1	60		van Evert & Schutte, 1983
Tomato	'Moneydor'	Bean	23.3		4.0	-	-	-		Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	16.3		2.0	-	-	-		Kraayenbrink, 1972
Tomato	'Moneydor'	Cucumber	24.0		8.8	-	1	149		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Tomato	'Moneydor'	Tomato	22.9	26/18	26.7	-	1	285	Dutch wf	Oostenbrug, 1981
										van Lenteren et al., 1989
Tomato	'Moneydor'	Bean	23.3	25/20	4.0	-	-	-		Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	27.5	35/20	2.0	-	1	193		van Evert & Schutte, 1983
Tomato	'Kyoryoku-beiju'	Tomato	17.0	30/5	7.1	-	1	2268		Kajita, 1982
Tomato	-	Tobacco	26.7	30/20	2.06	-	-	-	young plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	26.7	30/20	3.70	-	-	-	old plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	20.0	25/10	7.35	-	-	-	young plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	20.0	25/10	5.06	-	-	-	old plant	Yano, 1988
										Yano, 1989
Bean	'Canadian Wonder'	-	18.0		5.66	-	1	53		Madueke, 1979
Bean	'Canadian Wonder'	-	22.5		6.06	-	1	66		Madueke, 1979
Bean	'Canadian Wonder'	-	27.0		5.26	-	1	57		Madueke, 1979
Cucumber	'IVT 71-240'	Cucumber	22.5		0.1	100.0	3	2083		van Bruggen, 1975
Cucumber	'Sporu'	Bean	16.3		1.0	-	-	-		Kraayenbrink, 1972
Cucumber	'IVT 71-240'	Cucumber	24.0		1.3	-	1	159		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Cucumber	-	-	13.2		7.7	-	1	39		Li Tzu-Yin & Li zhau-Hwa, 1983
Cucumber	-	-	17.8		5.4	-	1	37		Li Tzu-Yin & Li zhau-Hwa, 1983
Cucumber	'Profito'	Cucumber	20.0		0.4	-	1	942		van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		0.5	-	1	735		van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	0.8	-	1	800		van Zoest, 1987
Eggplant	'Claresse'	Cucumber	22.5		0.2	173.2	3	1312		van Bruggen, 1975
Eggplant	'Mammouth'	Cucumber	24.0		2.2	-	1	184		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Tobacco	'Bright Yellow'	Tobacco	15.0		49.5	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	18.0		33.0	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	21.0		1.1	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	24.0		10.0	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	27.0		6.2	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	30.0		33.0	-	-	-		Yano, 1981
Tobacco	'N.C.2326'	Tobacco	25.0		71.2	31.9	7	-		Nechols & Tauber, 1977a

Appendix B2 (continued). Mortality of L1 (% of individuals entering the stage) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Mortality Mean	Mortality cv(%)	Mortality *n*	Mortality *n*(wf)	Remarks	Reference
Tree tobacco	-		17.0		18.29	-	1	1077		Di Pietro, 1977
Tree tobacco	-		22.0		9.35	-	1	642		Di Pietro, 1977
Tree tobacco	-		27.0		28.66	-	1	1748		Di Pietro, 1977
Gerbera	'Terra Fame'	Gerbera	15.0		2.6	-	1	≈103		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		1.6	-	1	≈126		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		8.7	-	1	≈90		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		7.1	-	1	≈110		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		40.1	-	1	326		Kusters, 1990
Gerbera	'Symfonie'	Cucumber	23.5	30/18	62.1	-	1	174	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Visa'	Cucumber	23.5	30/18	26.3	-	1	186	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Kim'	Cucumber	23.5	30/18	48.2	-	1	226	Hungarian wf	Schonherr, 1988
Sweet pepper	'Marike'	Cucumber	22.5		27.9	31.7	3	2394		van Bruggen, 1975
Sweet pepper	'Tisana'	Sweet pepper	24.4		18.8	-	1	377	Hungarian wf	van Vianen et al., 1987
										van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4		8.9	-	1	539	Hungarian wf	van Vianen et al., 1987
										van Lenteren et al., 1989
Sweet pepper	'Mospa'	Bean	23.3		40.0	-	-	-		Kraayenbrink, 1972
Sweet pepper	'Mospa'	Bean	18.3		25.0	-	-	-		Kraayenbrink, 1972
Sweet pepper	'Mospa'	Cucumber	24.0		74.2	-	1	128		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Sweet pepper	'Tisana'	Tomato	22.9	26/18	30.0	-	1	230	Dutch wf	Oostenbrug, 1988
										van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Tomato	22.9	26/18	28.7	-	1	171	Dutch wf	Oostenbrug, 1988
										van Lenteren et al., 1989
Sweet pepper	'Tisana'	Sweet pepper	24.4	37/16	21.1	-	1	380	Hungarian wf	van Vianen et al., 1987
										van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4	37/16	9.5	-	1	546	Hungarian wf	van Vianen et al., 1987
										van Lenteren et al., 1989
Sweet pepper	'Mospa'	Bean	23.3	25/20	66.0	-	-	-		Kraayenbrink, 1972
Hibiscus	'Nairobi'	Tomato	22.0		35.6	-	1	253		Kusters, 1990

Appendix B3. *Mortality of L2 (% of individuals entering the stage) of T. vaporariorum. cv, coefficient of variation; n, number of replicates; n(wf), total number of whiteflies (wf).*

Host plant	Cultivar	Pest reared on	Temp. (°C)		Mortality				Remarks	Reference
			Mean	Range	Mean	cv(%)	n	n(wf)		
Tomato	'Moneydor'	Cucumber	22.5		0.1	120.0	4	2138		van Bruggen, 1975
Tomato	'Moneydor'	Tomato	35.0		0.0	-	1	36		van Evert & Schutte, 1983
Tomato	'Moneydor'	Bean	23.3		2.1	-	-	-		Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3		4.1	-	-	-		Kraayenbrink, 1972
Tomato	'Moneydor'	Cucumber	24.0		3	-	1	136		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Tomato	'Moneydor'	Tomato	22.9	26/18	10.5	-	1	209	Dutch wf	Oostenbrug, 1988
										van Lenteren et al., 1989
Tomato	'Moneydor'	Bean	23.3	25/20	5.2	-	-	-		Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	27.5	35/20	2.7	-	1	148		van Evert & Schutte, 1983
Tomato	'Kyoryoku-beiju'	Tomato	17.0	30/5	6.2	-	1	2107		Kajita, 1982
Tomato	-	Tobacco	26.7	30/20	0.00	-	-	-	young plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	26.7	30/20	1.74	-	-	-	old plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	20.0	25/10	0.69	-	-	-	young plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	20.0	25/10	16.48	-	-	-	old plant	Yano, 1988
										Yano, 1989
Bean	'Canadian Wonder'	-	18.0		0.00	-	1	50		Madueke, 1979
Bean	'Canadian Wonder'	-	22.5		1.61	-	1	62		Madueke, 1979
Bean	'Canadian Wonder'	-	27.0		3.70	-	1	54		Madueke, 1979
Cucumber	'IVT 71-240'	Cucumber	22.5		0.0	0.0	3	2077		van Bruggen, 1975
Cucumber	'Sporu'	Bean	18.3		2.0	-	-	-		Kraayenbrink, 1972
Cucumber	'IVT 71-240'	Cucumber	24.0		1.3	-	1	155		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Cucumber	-	-	13.2		5.6	-	1	36		Li Tzu-Yin & Li zhau-Hwa, 1983
Cucumber	-	-	17.8		8.6	-	1	35		Li Tzu-Yin & Li zhau-Hwa, 1983
Cucumber	'Profito'	Cucumber	20.0		1.4	-	1	938		van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		0.6	-	1	731		van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	1.0	-	1	794		van Zoest, 1987
Eggplant	'Claresse'	Cucumber	22.5		0.2	173.2	3	1308		van Bruggen, 1975
Eggplant	'Mammouth'	Cucumber	24.0		0.0	-	1	180		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Tobacco	'Bright Yellow'	Tobacco	15.0		2.1	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	18.0		0.0	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	21.0		1.1	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	24.0		1.1	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	27.0		0.0	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	30.0		1.5	-	-	-		Yano, 1981
Tobacco	'White Burley'	-	25.0		24.8	-	-	-		Zebitz, 1978

Appendix B3 (continued). Mortality of L2 (% of individuals entering the stage) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Mortality Mean	Mortality cv(%)	Mortality *n*	Mortality *n*(wf)	Remarks	Reference
Tobacco	'N.C.2326'	Tobacco	25.0		53	47.9	4	-		Nechols & Tauber, 1977a
Tree tobacco	-		17.0		5.36	-	1	727		Di Pietro, 1977
Tree tobacco	-		22.0		1.03	-	1	582		Di Pietro, 1977
Tree tobacco	-		27.0		3.91	-	1	1048		Di Pietro, 1977
Gerbera	'Terra Fame'	Gerbera	15.0		2.6	-	1	≈100		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		2.4	-	1	≈123		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		1.0	-	1	≈82		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		1.0	-	1	≈102		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		13.4	-	1	195		Kusters, 1990
Gerbera	'Symfonie'	Cucumber	23.5	30/18	7.0	-	1	66	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Visa'	Cucumber	23.5	30/18	5.8	-	1	137	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Kim'	Cucumber	23.5	30/18	6.8	-	1	117	Hungarian wf	Schonherr, 1988
Sweet pepper	'Marike'	Cucumber	22.5		37.8	25.2	3	1739		van Bruggen, 1975
Sweet pepper	'Tisana'	Sweet pepper	24.4		32.7	-	1	306	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4		4.3	-	1	491	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Mospa'	Cucumber	24.0		42.4	-	1	37		van Merendonk, 1978 van Merendonk & van Lenteren, 1978 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Sweet pepper	'Tisana'	Tomato	22.9	26/18	27.3	-	1	161	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Tomato	22.9	26/18	18.0	-	1	122	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Tisana'	Sweet pepper	24.4	37/16	33.7	-	1	300	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4	37/16	4.9	-	1	494	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.1	31/19	20.0	-	1	230	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	31/19	16.7	-	1	186	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	31/19	25.6	-	1	176	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Hibiscus	'Nairobi'	Tomato	22.0		27.0	-	1	163		Kusters, 1990

Appendix B4. Mortality of L3 (% of individuals entering the stage) of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Mortality Mean	Mortality cv(%)	Mortality n	Mortality n(wf)	Remarks	Reference
Tomato	'Moneydor'	Cucumber	22.5		0.5	115.5	4	2104		van Bruggen, 1975
Tomato	'Moneydor'	Tomato	35.0		6.3	-	1	32		van Evert & Schutte, 1983
Tomato	'Moneydor'	Bean	23.3		4.3	-	-	-		Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3		2.1	-	-	-		Kraayenbrink, 1972
Tomato	'Moneydor'	Cucumber	24.0		0.8	-	1	131		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Tomato	'Moneydor'	Tomato	22.9	26/18	12.8	-	1	187	Dutch wf	Oostenbrug, 1988
										van Lenteren et al., 1989
Tomato	'Moneydor'	Bean	23.3	25/20	2.2	-	-	-		Kraayenbrink, 1972
Tomato	'Moneydor'	Tomato	27.5	35/20	2.4	-	1	125		van Evert & Schutte, 1983
Tomato	'Kyoryoku-beiju'	Tomato	17.0	30/5	7.8	-	1	1977		Kajita, 1982
Tomato	-	Tobacco	26.7	30/20	2.10	-	-	-	young plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	26.7	30/20	2.27	-	-	-	old plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	20.0	25/10	0.35	-	-	-	young plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	20.0	25/10	4.45	-	-	-	old plant	Yano, 1988
										Yano, 1989
Bean	'Canadian Wonder'	-	18.0		0.00	-	1	50		Madueke, 1979
Bean	'Canadian Wonder'	-	22.5		0.00	-	1	61		Madueke, 1979
Bean	'Canadian Wonder'	-	27.0		0.00	-	1	52		Madueke, 1979
Cucumber	'IVT 71-240'	Cucumber	22.5		0.2	100.0	3	2104		van Bruggen, 1975
Cucumber	'Sporu'	Bean	18.3		4.1	-	-	-		Kraayenbrink, 1972
Cucumber	'IVT 71-240'	Cucumber	24.0		0	-	1	155		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Cucumber	-	-	13.2		8.8	-	1	34		Li Tzu-Yin & Li zhau-Hwa, 1983
Cucumber	-	-	17.8		12.5	-	1	32		Li Tzu-Yin & Li zhau-Hwa, 1983
Cucumber	'Profito'	Cucumber	20.0		0.1	-	1	925		van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		0.0	-	1	727		van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	0.1	-	1	786		van Zoest, 1987
Eggplant	'Claresse'	Cucumber	22.5		0.1	173.2	3	1299		van Bruggen, 1975
Eggplant	'Mammouth'	Cucumber	24.0		0.0	-	1	180		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Tobacco	'Bright Yellow'	Tobacco	15.0		48.9	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	18.0		1.5	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	21.0		21.7	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	24.0		4.5	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	27.0		1.1	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	30.0		0.0	-	-	-		Yano, 1981
Tobacco	'White Burley'	-	25.0		28.3	-	-	-		Zebitz, 1978

Appendix B4 (continued). Mortality of L3 (% of individuals entering the stage) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Mortality Mean	Mortality cv(%)	Mortality *n*	Mortality *n*(wf)	Remarks	Reference
Tobacco	'N.C.2326'	Tobacco	25.0		28.5	103.9	5	-		Nechols & Tauber, 1977a
Tree tobacco	-		17.0		6.36	-	1	220		Di Pietro, 1977
Tree tobacco	-		22.0		0.69	-	1	576		Di Pietro, 1977
Tree tobacco	-		27.0		1.63	-	1	983		Di Pietro, 1977
Gerbera	'Terra Fame'	Gerbera	15.0		1.4	-	1	≈97		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		2.4	-	1	≈120		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		0.0	-	1	≈81		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		6.7	-	1	≈101		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		6.2	-	1	169		Kusters, 1990
Gerbera	'Symfonie'	Cucumber	23.5	30/18	9.8	-	1	61	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Visa'	Cucumber	23.5	30/18	12.4	-	1	129	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Kim'	Cucumber	23.5	30/18	10.1	-	1	109	Hungarian wf	Schonherr, 1988
Sweet pepper	'Marike'	Cucumber	22.5		29.1	37.8	3	874		van Bruggen, 1975
Sweet pepper	'Tisana'	Sweet pepper	24.4		65.5	-	1	206	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4		8.3	-	1	470	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Mospa'	Cucumber	24.0		15.8	-	1	20		van Merendonk, 1978 van Merendonk & van Lenteren, 1978 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Sweet pepper	'Tisana'	Tomato	22.9	26/18	28.2	-	1	117	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Tomato	22.9	26/18	29.0	-	1	100	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Tisana'	Sweet pepper	24.4	37/16	67.8	-	1	199	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4	37/16	9.8	-	1	470	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.1	31/19	16.3	-	1	184	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	31/19	12.3	-	1	155	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	31/19	16.8	-	1	131	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Hibiscus	'Nairobi'	Tomato	22.0		23.5	-	1	119		Kusters, 1990

Appendix B5. Mortality of L4 (% of individuals entering the stage) of T. vaporariorum. cv, coefficient of variation; n, number of replicates; n(f), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C)		Mortality				Remarks	Reference
			Mean	Range	Mean	cv(%)	n	n(wf)		
Tomato	'Moneydor'	Tomato	35.0		4.2	-	1	24		van Evert & Schutte, 1983
Tomato	'Moneydor'	Cucumber	24.0		0.0	-	1	131		van Merendonk, 1978 van Merendonk & van Lenteren, 1978 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Tomato	'Moneydor'	Tomato	22.9	26/18	4.9	-	1	163	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	27.5	35/20	1.9	-	1	107		van Evert & Schutte, 1983
Tomato	'Kyoryoku-beiju'	Tomato	17.0	30/5	8.2	-	1	1822		Kajita, 1982
Bean	'Canadian Wonder'	-	18.0		0.00	-	1	50		Madueke, 1979
Bean	'Canadian Wonder'	-	22.5		0.00	-	1	61		Madueke, 1979
Bean	'Canadian Wonder'	-	27.0		0.00	-	1	51		Madueke, 1979
Cucumber	'IVT 71-240'	Cucumber	24.0		0.7	-	1	155		van Merendonk, 1978 van Merendonk & van Lenteren, 1978 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Cucumber	'Profito'	Cucumber	20.0		0.2	-	1	924		van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		0.0	-	1	727		van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	0.3	-	1	785		van Zoest, 1987
Eggplant	'Mammouth'	Cucumber	24.0		0.0	-	1	180		van Merendonk, 1978 van Merendonk & van Lenteren, 1978 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Tobacco	'N.C.2326'	Tobacco	25.0		26.4	95.5	4	-		Nechols & Tauber, 1977a
Tree tobacco	-		17.0		1.46	-	1	206		Di Pietro, 1977
Tree tobacco	-		22.0		0.52	-	1	572		Di Pietro, 1977
Gerbera	'Terra Fame'	Gerbera	15.0		0.0	-	1	≈97		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		0.0	-	1	≈120		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		0.0	-	1	≈81		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		20.6	-	1	≈94		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		9.9	-	1	159		Kusters, 1990
Gerbera	'Symfonie'	Cucumber	23.5	30/18	21.8	-	1	55	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Visa'	Cucumber	23.5	30/18	17.7	-	1	113	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Kim'	Cucumber	23.5	30/18	5.1	-	1	98	Hungarian wf	Schonherr, 1988
Sweet pepper	'Tisana'	Sweet pepper	24.4		62.0	-	1	71	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4		12.3	-	1	431	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Mospa'	Cucumber	24.0		25.0	-	1	15		van Merendonk, 1978 van Merendonk & van Lenteren, 1978 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Sweet pepper	'Tisana'	Tomato	22.9	26/18	9.5	-	1	84	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Tomato	22.9	26/18	5.6	-	1	71	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Tisana'	Sweet pepper	24.4	37/16	59.4	-	1	64	Hungarian wf	van Vianen et al., 1987

Appendix B5 (continued). Mortality of L4 (% of individuals entering the stage) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C)		Mortality				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(wf)		
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4	37/16	11.3	-	1	424	Hungarian wf	van Lenteren et al., 1989 van Vianen et al., 1987
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.1	31/19	16.2	-	1	154	Hungarian wf	van Lenteren et al., 1989 Meyer, 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	31/19	14.7	-	1	136	Hungarian wf	Meyer et al., 1990 Meyer, 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	31/19	12.8	-	1	109	Hungarian wf	Meyer et al., 1990 Meyer, 1990
Hibiscus	'Nairobi'	Tomato	22.0		29.7	-	1	91		Meyer et al., 1990 Kusters, 1990

Appendix B6. Mortality of the prepupa (% of individuals entering the stage) of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C)		Mortality				Remarks	Reference
			Mean	Range	Mean	cv(%)	n	n(wf)		
Tomato	'Moneydor'	Tomato	35.0		30.4	-	1	23		van Evert & Schutte, 1983
Tomato	'Moneydor'	Tomato	22.9	26/18	7.1	-	1	155	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	27.5	35/20	3.8	-	1	105		van Evert & Schutte, 1983
Bean	'Canadian Wonder'	-	18.0		0.00	-	1	50		Madueke, 1979
Bean	'Canadian Wonder'	-	22.5		0.00	-	1	61		Madueke, 1979
Bean	'Canadian Wonder'	-	27.0		0.00	-	1	51		Madueke, 1979
Tobacco	'N.C.2326'	Tobacco	25.0		1.3	200.0	4	-		Nechols & Tauber, 1977a
Gerbera	'Terra Fame'	Gerbera	15.0		0.0	-	1	~97		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		0.0	-	1	~120		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		0.0	-	1	~81		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		14.5	-	1	~75		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		2.9	-	1	143		Kusters, 1990
Sweet pepper	'Tisana'	Tomato	22.9	26/18	1.4	-	1	~73	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Tomato	22.9	26/18	1.6	-	1	~63	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.1	31/19	0.0	-	1	129	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	31/19	1.7	-	1	114	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	31/19	3.2	-	1	92	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Hibiscus	'Nairobi'	Tomato	22.0		4.7	-	1	64		Kusters, 1990

Appendix B7. Mortality of the pupa (% of individuals entering the stage) of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Mortality Mean	Mortality *cv*(%)	Mortality *n*	Mortality *n*(wf)	Remarks	Reference
Tomato	'Moneydor'	Cucumber	22.5		3.2	106.9	3	1201		van Bruggen, 1975
Tomato	'Moneydor'	Tomato	35.0		100.0	-	1	16		van Evert & Schutte, 1983
Tomato	'Moneydor'	Tomato	22.9	26/18	10.4	-	1	144	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	27.5	35/20	2.0	-	1	101		van Evert & Schutte, 1983
Bean	'Canadian Wonder'	-	18.0		2.00	-	1	50		Madueke, 1979
Bean	'Canadian Wonder'	-	22.5		0.00	-	1	61		Madueke, 1979
Bean	'Canadian Wonder'	-	27.0		1.96	-	1	51		Madueke, 1979
Cucumber	'IVT 71-240'	Cucumber	22.5		0.4	0.0	2	1486		van Bruggen, 1975
Eggplant	'Claresse'	Cucumber	22.5		1.1	141.4	3	874		van Bruggen, 1975
Gerbera	'Terra Fame'	Gerbera	15.0		0.0	-	1	≈97		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		0.0	-	1	≈120		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		2.0	-	1	≈81		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		12.2	-	1	≈64		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		28.8	-	1	139		Kusters, 1990
Sweet pepper	'Marike'	Cucumber	22.5		2.6	141.4	2	109		van Bruggen, 1975
Sweet pepper	'Tisana'	Tomato	22.9	26/18	16.7	-	1	≈72	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Tomato	22.9	26/18	14.5	-	1	≈62	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.1	31/19	5.4	-	1	129	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	31/19	5.3	-	1	114	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	31/19	3.3	-	1	92	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Hibiscus	'Nairobi'	Tomato	22.0		41.0	-	1	61		Kusters, 1990
-	-	-	24.5	27/22	10.8	15.7	2	-		Treifi, 1986

Appendix B6. Mortality of L4+prepupa+pupa (% of individuals entering the stage) of T. vaporariorum. cv, coefficient of variation; n, number of replicates; n(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Mortality Mean	Mortality cv(%)	Mortality n	Mortality n(wf)	Remarks	Reference
Tomato	'Moneydor'	Tomato	35.0		100.0	-	1	24		van Evert & Schutte, 1983
Tomato	'Moneydor'	Bean	23.3		3.3	-	-	-		Kraayenbrink, 1972
Tomato	'Moneydor'	Bean	18.3		2.2	-	-	-		Kraayenbrink, 1972
Tomato	'Moneydor'	Cucumber	24.0		3.1	-	1	131		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Tomato	'Moneydor'	Tomato	22.9	26/18	20.9	-	1	163	Dutch wf	Oostenbrug, 1988
										van Lenteren et al., 1989
Tomato	'Moneydor'	Bean	23.3	25/20	2.2	-	-	-		Kraayenbrink, 1972
Tomato	'Kyoryoku-beiju'	Tomato	17.0	30/5	13.1	-	1	1822		Kajita, 1982
Tomato	-	Tobacco	26.7	30/20	8.28	-	-	-	young plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	26.7	30/20	10.08	-	-	-	old plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	20.0	25/10	9.07	-	-	-	young plant	Yano, 1988
										Yano, 1989
Tomato	-	Tobacco	20.0	25/10	14.60	-	-	-	old plant	Yano, 1988
										Yano, 1989
Bean	'Canadian Wonder'	-	18.0		2.00	-	1	50		Madueke, 1979
Bean	'Canadian Wonder'	-	22.5		0.00	-	1	61		Madueke, 1979
Bean	'Canadian Wonder'	-	27.0		1.96	-	1	51		Madueke, 1979
Cucumber	'Sporu'	Bean	18.3		2.2	-	-	-		Kraayenbrink, 1972
Cucumber	'IVT 71-240'	Cucumber	24.0		1.3	-	1	155		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Cucumber	-	-	13.2		16.1	-	1	31		Li Tzu-Yin & Li zhau-Hwa, 1983
Cucumber	-	-	17.8		35.8	-	1	28		Li Tzu-Yin & Li zhau-Hwa, 1983
Cucumber	'Profito'	Cucumber	20.0		1.1	-	1	924		van Zoest, 1987
Cucumber	'Profito'	Cucumber	25.0		1.0	-	1	727		van Zoest, 1987
Cucumber	'Profito'	Cucumber	22.7	25/18	1.2	-	1	785		van Zoest, 1987
Eggplant	'Mammouth'	Cucumber	24.0		2.8	-	1	180		van Merendonk, 1978
										van Merendonk & van Lenteren, 1978
										Woets & van Lenteren, 1976
										van Lenteren et al., 1977
Tobacco	'Bright Yellow'	Tobacco	15.0		20.8	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	18.0		21.2	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	21.0		8.3	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	24.0		4.7	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	27.0		10.0	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	30.0		95.5	-	-	-		Yano, 1981
Tobacco	-	-	22.0		33	-	-	-	60% RH	Weber, 1931
Tobacco	-	-	26.0		34	-	-	-	60% RH	Weber, 1931
Tobacco	-	-	32.0		95	-	-	-	60% RH	Weber, 1931
Tobacco	-	-	37.0		100	-	-	-	60% RH	Weber, 1931
Tobacco	-	-	5.0		5.0	-	300	300		Weber, 1931

Appendix B8 (continued). Mortality of L4+prepupa+pupa (% of individuals entering the stage) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Mortality Mean	Mortality cv(%)	Mortality *n*	Mortality *n*(wf)	Remarks	Reference
Tobacco	-	-	13.5		4.0	-	153	153		Weber, 1931
Tobacco	-	-	22.0		25.3	-	323	323		Weber, 1931
Tobacco	-	-	25.0		36.0	-	218	218		Weber, 1931
Tobacco	-	-	32.0		89.0	-	372	372		Weber, 1931
Tobacco	'White Burley'	-	25.0		42.2	-	-	-		Zebitz, 1978
Tree tobacco	-		17.0		1.5	-	1	206		Di Pietro, 1977
Tree tobacco	-		22.0		0.7	-	1	572		Di Pietro, 1977
Tree tobacco	-		27.0		3.34	-	1	569		Di Pietro, 1977
Gerbera	'Terra Fame'	Gerbera	15.0		0.0	-	1	≈97		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		0.0	-	1	≈120		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		1.9	-	1	≈81		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		≈40.4	-	1	≈94		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		40.9	-	1	159		Kusters, 1990
Gerbera	'Symfonie'	Cucumber	23.5	30/18	50.9	-	1	55	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Visa'	Cucumber	23.5	30/18	54.9	-	1	113	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Kim'	Cucumber	23.5	30/18	53.1	-	1	98	Hungarian wf	Schonherr, 1988
Sweet pepper	'Tisana'	Sweet pepper	24.4		66.2	-	1	71	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4		18.1	-	1	431	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Mospa'	Cucumber	24.0		20.0	-	1	15		van Merendonk, 1978 van Merendonk & van Lenteren, 1978 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Sweet pepper	'Tisana'	Tomato	22.9	26/18	25.0	-	1	84	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Tomato	22.9	26/18	21.1	-	1	71	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Tisana'	Sweet pepper	24.4	37/16	62.5	-	1	64	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4	37/16	16.5	-	1	424	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Hibiscus	'Nairobi'	Tomato	22.0		60.4	-	1	91		Kusters, 1990

Appendix B9. Total immature mortality (% of individuals entering the egg stage) of *T. vaporariorum*. cv, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Mortality Mean	Mortality cv(%)	Mortality *n*	Mortality *n*(wf)	Remarks	Reference
Tomato	'Bonnie Best'	Tomato	18.0		6.6	-	-	-		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	24.0		16.6	-	-	-		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	27.0		32.4	-	-	-		Burnett, 1949
Tomato	'Moneymaker'	Tomato	25.0		12	-	1	182		van Sas, 1978 van Sas et al., 1978
Tomato	'Moneymaker'	Tomato	15.0		2.9	-	1	100		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Tomato	'Moneymaker'	Tomato	20.0		1.8	-	1	111		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Tomato	'Moneymaker'	Tomato	25.0		6.5	-	1	115		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Tomato	'Moneydor'	Tomato	35.0		100.0	-	1	-		van Evert & Schutte, 1983
Tomato	'Moneydor'	Cucumber	24.0		21.2	-	1	127		van Merendonk, 1978 van Merendonk & van Lenteren, 1978 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Tomato	'Tiny Tim'	-	21.0		31.9	-	1	354		Curry & Pimentel, 1971
Tomato	'Delicious'	-	21.0		19.3	-	1	342		Curry & Pimentel, 1971
Tomato	'Vesuvius'	-	20.0		50.7	34.5	3	-	young plant (20d)	Huang, 1988
Tomato	'Vesuvius'	-	20.0		54.5	18.4	3	-	old plant (50d)	Huang, 1988
Tomato	'Immuny'	-	27.0		37.8	-	4	-	East European wf	Zabudskaya, 1989
Tomato	'Moneydor'	Tomato	22.9	26/18	59.8	-	1	321	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	23.1	25/20	0.0	-	-	-		Jansen, 1974
Tomato	'Moneydor'	Tomato	27.5	35/20	22.0	-	1	127		van Evert & Schutte, 1983
Tomato	'Kyoryoku-beiju'	Tomato	17.0	30/5	31.1	-	2297	2297		Kajita, 1982
Tomato	-	Tobacco	26.7	30/20	17.18	-	-	-	young plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	26.7	30/20	17.14	-	-	-	old plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	19.42	-	-	-	young plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	41.77	-	-	-	old plant	Yano, 1988 Yano, 1989
Tomato	'Moneydor'	Tomato	20.0	24/16	9.9	-	1	71		van Es, 1982
Tomato	'Dombo'	Tomato	20.0	24/16	9.5	-	1	116	flesh tomato	van Es, 1982
Tomato	'Moneydor'	Tomato	-		0.0	-	1	3361		Jansen, 1974
Tomato	'Moneydor'	Tomato	-		35.2	35.1	29	2637		Jansen, 1974
Bean	'Canadian Wonder'	-	18.0		9.26	-	1	54		Madueke, 1979
Bean	'Canadian Wonder'	-	22.5		7.57	-	1	66		Madueke, 1979
Bean	'Canadian Wonder'	-	27.0		12.28	-	1	57		Madueke, 1979
Bean	'Sarka'	-	20.0		19.4	-	1	-	East European wf	Laska et al., 1986
Bean	-	-	20.5	22/19	6.6	7.6	-	-	East European wf	Genchev, 1987
Bean	-	-	20.5	22/19	6.4	10.9	-	-	East European wf	Genchev, 1987
Bean	-	-	20.5	22/19	7.8	16.7	-	-	East European wf	Genchev, 1987
Bean	-	-	20.5	22/19	5.6	8.9	-	-	East European wf	Genchev, 1987
Cucumber	'IVT 71-240'	Tomato	25.0		1	-	1	489		van Sas, 1978

Appendix B9 (continued). Total immature mortality (% of individuals entering the egg stage) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Mortality Mean	Mortality cv(%)	Mortality *n*	Mortality *n*(wf)	Remarks	Reference
										van Sas et al., 1978
Cucumber	'IVT 71-240'	Tomato	25.0		37.1	-	-	-		Jansen, 1974
Cucumber	'IVT 71-240'	Cucumber	24.0		10.6	-	1	153		van Merendonk, 1978 van Merendonk & van Lenteren, 1978 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Cucumber	-	-	13.2		33.3	-	1	39		Li Tzu-Yin & Li zhau-Hwa, 1983
Cucumber	-	-	17.8		51.4	-	1	37		Li Tzu-Yin & Li zhau-Hwa, 1983
Cucumber	'Legenda'	-	27.0		15.9	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'Surpriz'	-	27.0		17.4	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'Rodnichok'	-	27.0		10.6	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'Nektar'	-	27.0		6.3	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'Mayak BI'	-	27.0		20.2	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'Hybrid 818x965'	-	27.0		18.7	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'IVT 71-240'	Tomato	21.5	26/20	9.6	-	824	824		van Rongen, 1979
Cucumber	'IVT 77-467' (hairless)	Tomato	21.5	26/20	10.2	-	580	580		van Rongen, 1979
Eggplant	'Mammouth'	Tomato	25.0		2	-	1	265		van Sas, 1978 van Sas et al., 1978
Eggplant	'Monstrueuse de New York'	Tomato	24.0		8.11	-	-	-		Malausa et al., 1988
Eggplant	'Pusa Purple Cluster'	Tomato	24.0		17.74	-	-	-		Malausa et al., 1988
Eggplant	'Ronde de Valence'	Tomato	24.0		19.56	-	-	-		Malausa et al., 1988
Eggplant	'Ceylan'	Tomato	24.0		4.18	-	-	-		Malausa et al., 1988
Eggplant	'Dourga'	Tomato	24.0		16.52	-	-	-		Malausa et al., 1988
Eggplant	'Shinkuro'	Tomato	24.0		20.15	-	-	-		Malausa et al., 1988
Eggplant	'Liu Ye Kie'	Tomato	24.0		5.34	-	-	-		Malausa et al., 1988
Eggplant	'Ronde de Valence'		22.0		39.5	-	-	-		Malausa et al., 1984
Eggplant	'Pusa Purple Cluster'		22.0		23.6	-	-	-		Malausa et al., 1984
Eggplant	'Dourga'		22.0		37.5	-	-	-		Malausa et al., 1984
Eggplant	'Monstrueuse de New York'		22.0		16.2	-	-	-		Malausa et al., 1984
Eggplant	'Mammouth'	Cucumber	24.0		8.8	-	1	175		van Merendonk, 1978 van Merendonk & van Lenteren, 1978 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Tobacco	'Bright Yellow'	Tobacco	15.0		81	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	18.0		48	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	21.0		34	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	24.0		19	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	27.0		19	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	30.0		97	-	-	-		Yano, 1981
Tobacco	'White Burley'	-	25.0		73.9	53.9	-	-		Zebitz, 1978

Appendix B9 (continued). Total immature mortality (% of individuals entering the egg stage) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Mortality Mean	Mortality cv(%)	Mortality n	Mortality n(wf)	Remarks	Reference
Tobacco	'White Burley'	-	25.0		76.1	-	-	-		Zebitz, 1978
Tobacco	'White Burley'	-	20.5	25/16	77.2	12.2	-	-		Zebitz, 1978
Tree tobacco	-		17.0		35.78	-	1	1160		Di Pietro, 1977
Tree tobacco	-		22.0		16.23	-	1	672		Di Pietro, 1977
Tree tobacco	-		27.0		38.90	-	1	2063		Di Pietro, 1977
Gerbera	'Hook Hybrid'	Tomato	25.0		60	-	1	250		van Sas, 1978 van Sas et al., 1978
Gerbera	'Clementine'	Gerbera	15.0		10.1	-	1	107		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Esperance'	Gerbera	15.0		5.7	-	1	149		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Gerbera	'Appelbloesem'	Gerbera	15.0		3.3	-	1	590		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	15.0		7.1	-	1	197		Dorsman & van de Vrie, 1987
Gerbera	'Clementine'	Gerbera	20.0		16.1	-	1	413		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Esperance'	Gerbera	20.0		15.2	-	1	235		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Gerbera	'Appelbloesem'	Gerbera	20.0		10	-	1	244		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		13.4	-	1	274		Dorsman & van de Vrie, 1987
Gerbera	'Clementine'	Gerbera	25.0		9.6	-	1	122		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Esperance'	Gerbera	25.0		13.2	-	1	59		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Gerbera	'Appelbloesem'	Gerbera	25.0		5.2	-	1	110		Dorsman & van de Vrie, 1987 Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		15.5	-	1	82		Dorsman & van de Vrie, 1987
Gerbera	'Terra Fame'	Gerbera	15.0		7.3	-	1	104		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		7.3	-	1	128		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		13.4	-	1	92		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		50.5	-	1	113		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		75.5	-	1	384		Kusters, 1990
Gerbera	'Mandarine'	Gerbera	21.0		66.3	17.0	3	450		Mulock Houwer, 1977
Gerbera	'Symfonie'	Cucumber	23.5	30/18	85.0	-	1	193	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Visa'	Cucumber	23.5	30/18	66.2	-	1	201	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Kim'	Cucumber	23.5	30/18	68.6	-	1	242	Hungarian wf	Schonherr, 1988
Sweet pepper	'CIND'	-	20.0		81.1	2.1	2	715	East European wf	Laska et al., 1986 Laska et al., 1985
Sweet pepper	'California Wonder'	-	20.0		70.1	7.1	2	495	East European wf	Laska et al., 1986 Laska et al., 1985
Sweet pepper	'Granat'	-	20.0		35.2	5.4	2	930	East European wf	Laska et al., 1986 Laska et al., 1985
Sweet pepper	'Tisana'	Sweet pepper	24.4		94.6	-	1	461	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Tisana'	-	22.9		78.0	-	1	-	Dutch wf	van Vianen et al., 1987 van Lenteren et al., 1989

Appendix B9 (continued). Total immature mortality (% of individuals entering the egg stage) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Mortality Mean	Mortality cv(%)	Mortality *n*	Mortality *n*(wf)	Remarks	Reference
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4		37.1	-	1	561	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	-	22.9		76.5	-	1	-	Dutch wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	-	Tomato	20.0		81.2	-	-	-		Jansen, 1974
Sweet pepper	'Mospa'	Cucumber	24.0		92.5	-	1	11		van Merendonk, 1978 van Merendonk & van Lenteren, 1978 Woets & van Lenteren, 1976 van Lenteren et al., 1977
Sweet pepper	'Latino'	-	27.0		40.6	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Lito'	-	27.0		31.6	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Herpa'	-	27.0		100.0	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Novi'	-	27.0		100.0	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Topolyok'	-	27.0		65.5	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Podarok Moldovy'	-	27.0		66.0	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Lastochka'	-	27.0		63.0	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Rubinovy'	-	27.0		76.2	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Tisana'	Tomato	22.9	26/18	79.4	-	1	306	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Tomato	22.9	26/18	76.7	-	1	240	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Tisana'	Sweet pepper	24.4	37/16	94.5	-	1	461	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4	37/16	36.9	-	1	561	Hungarian wf	van Vianen et al., 1987 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.1	31/19	60.1	-	1	306	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	31/19	65.6	-	1	314	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	31/19	70.3	-	1	300	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Gherkin	'Levo'	Tomato	25.0		1	-	1	396		van Sas, 1978 van Sas et al., 1978
Melon	'Ogen'	Tomato	25.0		2	-	1	85		van Sas, 1978 van Sas et al., 1978
Hibiscus	'Nairobi'	Tomato	22.0		87.9	-	1	297		Kusters, 1990

Appendix C. Sexratio (fraction females of total) of *T. vaporariorum*. cv, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C)		Sexratio				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(wf)		
Tomato	'Moneymaker'	Tomato	22.0		0.494	56.1	9	1956		van Boxtel, 1980
Tomato	'Immuny'	-	27.0		0.500	-	4	-	East European wf	Zabudskaya, 1989
Tomato	'Moneydor'	Tomato	21.5	26/20	0.494	-	1	1178		van Rongen, 1979
Tomato	'Moneydor'	Tomato	23.4	28/19	0.500	-	54	6016	Dutch wf	van Lenteren et al., 1989
Tomato	-	-	17.3	37.8/6.1	0.429	-	1	-		Lloyd, 1922
Bean	'Contender'	-	26.0		0.415	-	77	77		Collman & All, 1980
Bean	'Contender'	-	26.0		0.667	-	18	18		Collman & All, 1980
Bean	'Contender'	-	26.0		0.556	-	54	54		Collman & All, 1980
Bean	'Contender'	-	26.0		0.741	-	111	111		Collman & All, 1980
Bean	'Contender'	-	26.0		0.628	-	70	70		Collman & All, 1980
Bean	'Contender'	-	26.0		0.512	-	41	41		Collman & All, 1980
Bean	-	-	23.0		0.553	2.7	-	-	East European wf	Genchev, 1986
Bean	-	-	20.5	22/19	0.512	1.4	-	-	East European wf	Genchev, 1987
Bean	-	-	20.5	22/19	0.474	4.2	-	-	East European wf	Genchev, 1987
Bean	-	-	20.5	22/19	0.489	6.3	-	-	East European wf	Genchev, 1987
Bean	-	-	20.5	22/19	0.491	4.1	-	-	East European wf	Genchev, 1987
Bean	'Canadian Wonder'	-	-		0.600	-	-	-		Madueke, 1979
Cucumber	'IVT 71-240'	Tomato	22.0		0.554	44.8	9	3033		van Boxtel, 1980
Cucumber	'Surpriz'	-	27.0		0.455	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'IVT 71-240'	Tomato	21.5	26/20	0.594	15.8	2	588	generation 2	van Rongen, 1979
Cucumber	'IVT 78-266' (hairless)	Tomato	21.5	26/20	0.673	0.3	2	1528	generation 2	van Rongen, 1979
Cucumber	'IVT 71-240'	Tomato	21.5	26/20	0.723	-	1	1518	generation 4	van Rongen, 1979
Cucumber	'IVT 78-266' (hairless)	Tomato	21.5	26/20	0.681	-	1	2173	generation 4	van Rongen, 1979
Cucumber	-	-	13.2	+/-	0.538	-	1	26		Li Tzu Yin & Li Zhau Hwa, 1983
Cucumber	-	-	16.1	+/-	0.500	-	1	4		Li Tzu Yin & Li Zhau Hwa, 1983
Cucumber	-	-	17.8	+/-	0.667	-	1	18		Li Tzu Yin & Li Zhau Hwa, 1983
Eggplant	'Mammouth'	Tomato	22.0		0.440	62.4	13	6589		van Boxtel, 1980
Tree tobacco	-	-	17.0		0.507	-	1	203		Di Pietro, 1977
Tree tobacco	-	-	22.0		0.520	-	1	564		Di Pietro, 1977
Gerbera	'Symfonie'	Cucumber	23.5	30/18	0.583	-	1	12	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Visa'	Cucumber	23.5	30/18	0.574	-	1	47	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Kim'	Cucumber	23.5	30/18	0.419	-	1	43	Hungarian wf	Schonherr, 1988
Sweet pepper	'Tisana'	Tomato	22.0		0.444	120.0	4	9		van Boxtel, 1980
Sweet pepper	'Podarok Moldovy'	-	27.0		0.556	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Tisana'	Tomato	23.4	28/19	0.501	-	51	2667	Dutch wf	van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Tomato	23.4	28/19	0.501	-	53	4383	Dutch wf	van Lenteren et al., 1989
Sweet pepper	'Tisana'	Sweet pepper	23.2	34/13	0.505	-	53	482	Hungarian wf	van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	23.2	34/13	0.500	-	53	2608	Hungarian wf	van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	25.0	31/19	0.596	-	1	99	Hungarian wf	Meyer, 1990
Sweet pepper	'HRF'	Sweet pepper	25.0	31/19	0.542	-	1	96	Hungarian wf	Meyer, 1990
Sweet pepper	'Feherozon'	Sweet pepper	25.0	31/19	0.577	-	1	78	Hungarian wf	Meyer, 1990
Wild potato	-	Potato	26.0		0.732	3.9	12	1754		Boiteau & Singh, 1988
Potato	'Red Pontiac'	Potato	26.0		0.700	18.2	12	1727		Boiteau & Singh, 1988
Various	-	-	17.3	37.8/6.1	0.558	34.2	6	-		Lloyd, 1922

Appendix D. Longevity (days) of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(♀), total number of females; *n*(♂), total number of males; wf, whitefly.

Host plant	Cultivar	Pest reared on	Temp. (°C)		Longevity					Remarks	Reference
			Mean	Range	Mean	*cv*(%)	*n*	*n*(♀)	*n*(♂)		
Tomato	'Bonnie Best'	Tomato	9.0		9.3	-	60	60	0		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	12.0		36.0	-	49	49	0		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	15.0		50.5	-	54	54	0		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	18.0		42.5	-	56	56	0		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	21.0		28.5	-	57	57	0		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	24.0		17.2	-	57	57	0		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	27.0		8.3	-	44	44	0		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	30.0		5.4	-	54	54	0		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	33.0		4.6	-	32	32	0		Burnett, 1949
Tomato	'Moneymaker'	Tomato	22.0		18.6	51.5	41	41	0	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977 Woets & van Lenteren, 1976
Tomato	'Moneymaker'	Tomato	22.0		8.6	79.1	37	37	0	exp.in winter	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977
Tomato	'Moneymaker'	Cucumber	22.0		6.1	77.0	29	29	0	exp.in winter	van Boxtel, 1980 van Boxtel et al., 1978
Tomato	'Moneymaker'	Tomato	22.0		29.3	75.9	9	9	0	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978
Tomato	'Moneymaker'	Tomato	22.0		10.9	34.4	9	0	9	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978
Tomato	'Moneymaker'	Tomato	25.0		21.9	86.5	21	21	0		van Sas, 1978 van Sas et al., 1978
Tomato	'Moneydor'	Tomato	22.0		32.0	-	55	-	-		van Evert & Schutte, 1983
Tomato	'Tiny Tim'	-	21.0		58.7	38.4	44	44	0		Curry & Pimentel, 1971
Tomato	'Delicious'	-	21.0		29.1	54.3	40	40	0		Curry & Pimentel, 1971
Tomato	-	-	22.0		66.6	-	-	-	-		Castresana Estrada et al., 1982
Tomato	-	-	26.7		22.5	46.2	16	-	-		Hussey & Gurney, 1957
Tomato	-	-	23.9		36.3	57.9	7	-	-		Hussey & Gurney, 1957
Tomato	-	-	15.6		31.3	62.3	12	-	-		Hussey & Gurney, 1957
Tomato	'Immuny'	-	27.0		20.3	-	4	-	0	East European wf	Zabudskaya, 1989
Tomato	'Immuny'	-	27.0		11.3	-	4	0	-	East European wf	Zabudskaya, 1989
Tomato	'Moneydor'	Tomato	23.4	28/19	24.0	92.5	54	54	0	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	23.4	28/19	12.8	167.4	33	0	33	Dutch wf	Oostenbrug, 1988
Tomato	'Moneydor'	Tomato	21.5	26/20	67.1	-	34	34	0		van Rongen, 1979
Tomato	'Moneydor'	-	11.6	18/7	41.9	85.6	91	-	-		Burggraaf & van der Laan, 1983 van der Laan et al., 1982
Tomato	'Moneydor'	Tomato	20.0	24/16	53.0	30.0	6	6	0		van Es, 1982
Tomato	'Moneydor'	Tomato	22.5	26/20	37.1	100.0	15	15	0		van Es, 1982
Tomato	-	Tobacco	26.7	30/20	26.5	45.7	-	-	0	young plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	26.7	30/20	13.7	46.0	-	-	0	old plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	29.8	47.3	-	-	0	young plant	Yano, 1988 Yano, 1989

Appendix D (continued). Longevity (days) of T. vaporariorum.

Host plant	Cultivar	Pest reared on	Temp. (°C)		Longevity					Remarks	Reference
			Mean	Range	Mean	cv(%)	n	n(♀)	n(♂)		
Tomato	-	Tobacco	20.0	25/10	20.3	38.4	-	-	0	old plant	Yano, 1988
											Yano, 1989
Tomato	-	-	17.3	37.8/6.1	34.0	-	1	0	1		Lloyd, 1922
Tomato	-	-	17.3	37.8/6.1	42.5	11.7	2	2	0		Lloyd, 1922
Tomato	'Dombo'	Tomato	20.0	24/16	66.1	18.8	7	7	0	flesh tomato	van Es, 1982
Tomato	'Dombo'	Tomato	22.5	26/20	57.4	45.1	14	14	0	flesh tomato	van Es, 1982
Tomato	'Portante'	Tomato	22.5	26/20	68.6	25.5	10	10	0	flesh tomato	van Es, 1982
Tomato	'Melchior'	Sweet pepper	26.5	35/18	19.5	79.0	45	45	0	Hungarian wf	van Steenis, 1990
Tomato	'Melchior'	Sweet pepper	26.5	35/18	18.4	57.6	46	0	46	Hungarian wf	van Steenis, 1990
Bean	'Canadian Wonder'	-	18.0		37.3	29.8	15	15	0		Madueke, 1979
Bean	'Canadian Wonder'	-	22.5		25.3	13.2	15	15	0		Madueke, 1979
Bean	'Canadian Wonder'	-	27.0		14.8	44.9	17	17	0		Madueke, 1979
Bean	'Contender'	-	26.0		5.74	77.7	82	82	0		Collman & All, 1980
Bean	'Contender'	-	26.0		4.10	62.7	39	0	39		Collman & All, 1980
Bean	-	-	23.0		11.7	8.5	2	0	-	East European wf	Genchev, 1986
Bean	-	-	23.0		11.8	3.6	2	-	0	East European wf	Genchev, 1986
Cucumber	'IVT 71-240'	Cucumber	22.0		12.8	83.3	31	31	0	exp.in winter	van Boxtel, 1980
											van Boxtel et al., 1978
Cucumber	'IVT 71-240'	Tomato	22.0		20.2	42.2	40	40	0	exp.in spring	van Boxtel, 1980
											van Boxtel et al., 1978
											van Lenteren et al., 1977
											Woets & van Lenteren, 1976
Cucumber	'IVT 71-240'	Tomato	22.0		16.7	48.8	21	21	0	exp.in winter	van Boxtel, 1980
											van Boxtel et al., 1978
											van Lenteren et al., 1977
Cucumber	'IVT 71-240'	Tomato	22.0		38.2	52.7	9	9	0	exp.in spring	van Boxtel, 1980
											van Boxtel et al., 1978
Cucumber	'IVT 71-240'	Tomato	22.0		21.3	54.2	9	0	9	exp.in spring	van Boxtel, 1980
											van Boxtel et al., 1978
Cucumber	'IVT 71-240'	Tomato	25.0		28.1	38.0	22	22	0		van Sas, 1978
											van Sas et al., 1978
Cucumber	'Legenda'	-	27.0		22.5	-	4	-	0	East European wf	Zabudskaya, 1989
Cucumber	'Surpriz'	-	27.0		22.5	-	4	-	0	East European wf	Zabudskaya, 1989
Cucumber	'Surpriz'	-	27.0		22.5	-	4	-	0	East European wf	Zabudskaya, 1989
Cucumber	'Rodnichok'	-	27.0		22.0	-	4	-	0	East European wf	Zabudskaya, 1989
Cucumber	'Nektar'	-	27.0		24.2	-	4	-	0	East European wf	Zabudskaya, 1989
Cucumber	'Mayak Bl'	-	27.0		21.0	-	4	-	0	East European wf	Zabudskaya, 1989
Cucumber	'Hybrid 818x965'	-	27.0		19.6	-	4	-	0	East European wf	Zabudskaya, 1989
Cucumber	'Legenda'	-	27.0		16.0	-	4	0	-	East European wf	Zabudskaya, 1989
Cucumber	'Surpriz'	-	27.0		12.7	-	4	0	-	East European wf	Zabudskaya, 1989
Cucumber	'Surpriz'	-	27.0		16.0	-	4	0	-	East European wf	Zabudskaya, 1989
Cucumber	'Rodnichok'	-	27.0		12.5	-	4	0	-	East European wf	Zabudskaya, 1989
Cucumber	'Nektar'	-	27.0		14.2	-	4	0	-	East European wf	Zabudskaya, 1989
Cucumber	'Mayak Bl'	-	27.0		16.0	-	4	0	-	East European wf	Zabudskaya, 1989
Cucumber	'Hybrid 818x965'	-	27.0		14.0	-	4	0	-	East European wf	Zabudskaya, 1989
Cucumber	'Farbio'	Sweet pepper	26.5	35/18	34.1	57.2	47	47	0	Hungarian wf	van Steenis, 1990
Cucumber	'Farbio'	Sweet pepper	26.5	35/18	22.7	66.1	46	0	46	Hungarian wf	van Steenis, 1990

Appendix D (continued). Longevity (days) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp (°C)		Longevity					Remarks	Reference
			Mean	Range	Mean	cv(%)	n	n(♀)	n(♂)		
Eggplant	'Bonica'	-	17.0		52.85	23.0	20	20	0		Di Pietro, 1977
Eggplant	'Bonica'	-	22.0		38.30	48.0	30	30	0		Di Pietro, 1977
Eggplant	'Bonica'	-	27.0		18.11	47.3	35	35	0		Di Pietro, 1977
Eggplant	'Bonica'	-	17.0		20.71	106.4	20	0	20		Di Pietro, 1977
Eggplant	'Bonica'	-	22.0		15.43	57.2	30	0	30		Di Pietro, 1977
Eggplant	'Bonica'	-	27.0		9.09	75.7	35	0	35		Di Pietro, 1977
Eggplant	'Mammouth'	Tomato	22.0		30.4	58.2	44	44	0	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977 Woets & van Lenteren, 1976
Eggplant	'Mammouth'	Tomato	22.0		43.9	50.2	21	21	0	exp.in winter	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977
Eggplant	'Mammouth'	Tomato	22.0		49.8	38.7	13	13	0	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978
Eggplant	'Mammouth'	Tomato	22.0		30.3	60.5	13	0	13	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978
Eggplant	'Mammouth'	Tomato	25.0		60.1	52.2	21	21	0		van Sas, 1978 van Sas et al., 1978
Eggplant	'Monstrueuse de New York'	Tomato	24.0		97.0	-	-	-	-		Malausa et al., 1988
Eggplant	'Pusa Purple Cluster'	Tomato	24.0		69.0	-	-	-	-		Malausa et al., 1988
Eggplant	'Ronde de Valence'	Tomato	24.0		77.0	-	-	-	-		Malausa et al., 1988
Eggplant	'Ceylan'	Tomato	24.0		64.8	-	-	-	-		Malausa et al., 1988
Eggplant	'Dourga'	Tomato	24.0		71.5	-	-	-	-		Malausa et al., 1988
Eggplant	'Shinkuro'	Tomato	24.0		76.8	-	-	-	-		Malausa et al., 1988
Eggplant	'Liu Ye Kie'	Tomato	24.0		58.6	-	-	-	-		Malausa et al., 1988
Eggplant	'Ronde de Valence'	-	22.0		58.8	-	-	-	0		Malausa et al., 1984
Eggplant	'Pusa Purple Cluster'	-	22.0		72.2	-	-	-	0		Malausa et al., 1984
Eggplant	'Dourga'	-	22.0		71.2	-	-	-	0		Malausa et al., 1984
Eggplant	'Monstrueuse de New York'	-	22.0		75.9	-	-	-	0		Malausa et al., 1984
Eggplant	'Ronde de Valence'	-	22.0		25.7	-	-	0	-		Malausa et al., 1984
Eggplant	'Pusa Purple Cluster'	-	22.0		47.5	-	-	0	-		Malausa et al., 1984
Eggplant	'Dourga'	-	22.0		35.4	-	-	0	-		Malausa et al., 1984
Eggplant	'Monstrueuse de New York'	-	22.0		22.7	-	-	0	-		Malausa et al., 1984
Tobacco	'Bright Yellow'	Tobacco	15.0		29	44.8	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	18.0		25	52.0	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	21.0		40	32.5	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	24.0		33	33.3	-	-	-		Yano, 1981

Appendix D (continued). Longevity (days) of T. vaporariorum.

Host plant	Cultivar	Pest reared on	Temp (°C) Mean	Temp (°C) Range	Longevity Mean	Longevity cv(%)	Longevity n	Longevity n(♀)	Longevity n(♂)	Remarks	Reference
Tobacco	'Bright Yellow'	Tobacco	27.0		25	44.0	-	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	30.0		16	25.0	-	-	-		Yano, 1981
Tobacco	-	-	22.0		21	-	-	-	-	estim. of 50% point	Weber, 1931
Tobacco	-	-	32.0		2	-	-	-	-	estim. of 50% point	Weber, 1931
Tobacco	-	-	36.0		0.25	-	-	-	-	estim. of 50% point	Weber, 1931
Tobacco	-	-	5.0		24.5	-	-	-	-	estim. of 50% point	Weber, 1931
Gerbera	'Hook Hybrid'	Tomato	25.0		41.0	35.8	21	21	0		van Sas, 1978
											van Sas et al., 1978
Gerbera	'Terra Fame'	Gerbera	15.0		58.3	71.6	24	24	0		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		60.5	43.8	21	21	0		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		33.3	49.7	23	23	0		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		21.8	28.7	24	24	0		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		28.0	97.5	12	12	0		Kusters, 1990
Gerbera	'Mandarine'	Gerbera	15.0		32.8	81.1	11	11	0	removed leaves	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	21.0		15.5	52.9	23	23	0	removed leaves	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	25.0		19.8	63.1	22	22	0	removed leaves	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	30.0		11.3	44.3	21	21	0	removed leaves	Mulock Houwer, 1977
Gerbera	'Symfonie'	Cucumber	20.3	31/10	40.2	45.3	22	22	0	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Visa'	Cucumber	20.3	31/10	36.2	62.0	19	19	0	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Kim'	Cucumber	20.3	31/10	37.5	59.8	22	22	0	Hungarian wf	Schonherr, 1988
Sweet pepper	'Tisana'	Sweet pepper	22.0		10.2	96.3	14	14	0	exp.in spring	van Boxtel, 1980
											van Boxtel et al., 1978
Sweet pepper	'Tisana'	Tomato	22.0		4.4	33.8	47	47	0	exp.in spring	van Boxtel, 1980
											van Boxtel et al., 1978
											van Lenteren et al., 1977
											Woets & van Lenteren, 1976
Sweet pepper	'Tisana'	Tomato	22.0		3.2	35.8	29	29	0	exp.in winter	van Boxtel, 1980
											van Boxtel et al., 1978
											van Lenteren et al., 1977
Sweet pepper	'Tisana'	Tomato	22.0		4.0	50.0	9	9	0	exp.in spring	van Boxtel, 1980
											van Boxtel et al., 1978
Sweet pepper	'Tisana'	Cucumber	22.0		5.5	82.1	9	9	0	exp.in spring	van Boxtel, 1980
											van Boxtel et al., 1978
Sweet pepper	'Tisana'	Tomato	22.0		3.1	45.5	20	20	0	exp.in spring	van Boxtel, 1980
											van Boxtel et al., 1978
Sweet pepper	'Tisana'	Tomato	22.0		2.3	63.2	20	0	20	exp.in spring	van Boxtel, 1980
											van Boxtel et al., 1978
Sweet pepper	'Latino'	-	27.0		19.8	-	4	-	0	East European wf	Zabudskaya, 1989
Sweet pepper	'Lito'	-	27.0		16.4	-	4	-	0	East European wf	Zabudskaya, 1989
Sweet pepper	'Herpa'	-	27.0		11.2	-	4	-	0	East European wf	Zabudskaya, 1989
Sweet pepper	'Novi'	-	27.0		11.8	-	4	-	0	East European wf	Zabudskaya, 1989
Sweet pepper	'Topolyok'	-	27.0		3.8	-	4	-	0	East European wf	Zabudskaya, 1989
Sweet pepper	'Podarok Moldovy'	-	27.0		9.8	-	4	-	0	East European wf	Zabudskaya, 1989
Sweet pepper	'Podarok Moldovy'	-	27.0		8.8	-	4	-	0	East European wf	Zabudskaya, 1989
Sweet pepper	'Lastochka'	-	27.0		16.4	-	4	-	0	East European wf	Zabudskaya, 1989
Sweet pepper	'Rubinovy'	-	27.0		18.0	-	4	-	0	East European wf	Zabudskaya, 1989
Sweet pepper	'Latino'	-	27.0		8.8	-	4	0	-	East European wf	Zabudskaya, 1989

Appendix D (continued). Longevity (days) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Longevity Mean	Longevity cv(%)	Longevity *n*	Longevity *n*(♀)	Longevity *n*(♂)	Remarks	Reference
Sweet pepper	'Lito'	-	27.0		14.0	-	4	0	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Herpa'	-	27.0		5.4	-	4	0	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Novi'	-	27.0		4.8	-	4	0	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Topolyok'	-	27.0		2.4	-	4	0	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Podarok Moldovy'	-	27.0		5.2	-	4	0	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Podarok Moldovy'	-	27.0		4.6	-	4	0	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Lastochka'	-	27.0		6.6	-	4	0	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Rubinovy'	-	27.0		5.4	-	4	0	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Tisana'	Tomato	23.4	28/19	13.9	104.3	51	51	0	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Tisana'	Tomato	23.4	28/19	2.7	270.9	41	0	41	Dutch wf	Oostenbrug, 1988
Sweet pepper	'Tisana'	Sweet pepper	23.2	34/13	7.7	59.7	53	53	0	Hungarian wf	van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Tomato	23.4	28/19	17.6	103.4	53	53	0	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Tomato	23.4	28/19	4.0	266.8	42	0	42	Dutch wf	Oostenbrug, 1988
Sweet pepper	'Angeli Emleke'	Sweet pepper	23.2	34/13	13.9	73.4	53	53	0	Hungarian wf	van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.1	34/20	10.3	106.8	49	49	0	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	34/20	14.4	78.5	44	44	0	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	34/20	10.8	95.4	50	50	0	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	26.5	35/18	12.0	101.7	46	46	0	Hungarian wf	van Steenis, 1990
Sweet pepper	'HRF'	Sweet pepper	26.5	35/18	9.0	97.8	44	0	44	Hungarian wf	van Steenis, 1990
Gherkin	'Levo'	Tomato	25.0		32.7	56.0	23	23	0		van Sas, 1978 van Sas et al., 1978
Melon	'Ogen'	Tomato	25.0		12.0	39.7	45	45	0		van Sas, 1978 van Sas et al., 1978
Hibiscus	'Nairobi'	Tomato	22.0		18.7	91.3	20	20	0		Kusters, 1990
Various	-	-	17.3	37.8/6.1	38.2	70.1	13	13	0		Lloyd, 1922
Various	-	-	17.3	37.8/6.1	25.7	67.0	9	0	9		Lloyd, 1922
-	-	-	25.0		20	-	-	-	-		Woets, 1972a
Glass	-	-	4.0		6.5	-	-	-	-		Weber, 1931
Glass	-	-	20.0		0.9	-	-	-	-		Weber, 1931
Glass	-	-	46.0		0.04	-	-	-	-		Weber, 1931
Glass	-	-	0.0		6.5	-	-	-	-	estim. of 50% point	Weber, 1931
Glass	-	-	-12.0		1	-	-	-	-	estim. of 50% point	Weber, 1931

Appendix E. Pre-oviposition period (days) of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C)		Pre-oviposition period				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(wf)		
Tomato	'Bonnie Best'	Tomato	18.0		1.16	-	-	-		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	21.0		1.88	-	-	-		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	24.0		0.40	-	-	-		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	27.0		1.57	-	-	-		Burnett, 1949
Bean	'Nanus'	Bean	18.0		1.5	-	-	-		Stenseth, 1971
Bean	'Nanus'	Bean	24.0		1.5	-	-	-		Stenseth, 1971
Bean	'Canadian Wonder'	-	18.0		2.2	61.6	15	15		Madueke, 1979
Bean	'Canadian Wonder'	-	22.5		0.8	92.0	15	15		Madueke, 1979
Bean	'Canadian Wonder'	-	27.0		0.6	123.7	17	17		Madueke, 1979
Bean	'Contender'	-	26.0		1.5	-	-	-		Coliman & All, 1980
Eggplant	'Bonica'	-	17.0		2.95	28.0	20	20		Di Pietro, 1977
Eggplant	'Bonica'	-	22.0		0.93	93.0	30	30		Di Pietro, 1977
Eggplant	'Bonica'	-	27.0		0.51	128.0	35	35		Di Pietro, 1977

Appendix F. Fecundity (eggs per female per lifetime) of *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C)		Fecundity				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(wf)		
Tomato	'Bonnie Best'	Tomato	12.0		40.7	57.5	49	49		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	15.0		93.6	54.4	54	54		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	18.0		319.6	41.5	56	56		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	21.0		209.5	51.5	57	57		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	24.0		123.9	55.4	57	57		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	27.0		29.5	99.3	44	44		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	30.0		19.1	89.2	54	54		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	33.0		5.5	81.2	32	32		Burnett, 1949
Tomato	'Moneymaker'	Tomato	22.0		81.2	78.8	41	41	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977 Woets & van Lenteren, 1976
Tomato	'Moneymaker'	Tomato	22.0		8.2	163.1	37	37	exp.in winter	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977
Tomato	'Moneymaker'	Cucumber	22.0		2.2	134.2	29	29	exp.in winter	van Boxtel, 1980 van Boxtel et al., 1978
Tomato	'Moneymaker'	Tomato	25.0		95.5	112.0	21	21		van Sas, 1978 van Sas et al., 1978
Tomato	'Moneymaker'	Tomato	15.0		166.2	-	25	25		Dorsman & van de Vrie, 1987
Tomato	'Moneymaker'	Tomato	20.0		210.7	-	25	25		Dorsman & van de Vrie, 1987
Tomato	'Moneymaker'	Tomato	25.0		107.0	-	25	25		Dorsman & van de Vrie, 1987
Tomato	'Moneydor'	Tomato	18.0		71.7	21.7	9	51	during 17 days	Christochowitz & van der Fluit, 1981
Tomato	'Tiny Tim'	-	21.0		249.7	50.7	44	44		Curry & Pimentel, 1971
Tomato	'Delicious'	-	21.0		92.1	81.0	40	40		Curry & Pimentel, 1971
Tomato	-	-	22.0		172	-	-	-		Castresana Estrada et al., 1982
Tomato	-	-	26.7		243.0	-	16	16		Hussey & Gurney, 1957
Tomato	-	-	23.9		210.5	-	7	7		Hussey & Gurney, 1957
Tomato	-	-	15.6		131.5	-	12	12		Hussey & Gurney, 1957
Tomato	-	-	20.0		144.0	-	-	-		Ibrahim, 1975 Madueke, 1979
Tomato	-	-	23.0		108.3	-	-	-		Ibrahim, 1975 Madueke, 1979
Tomato	'Vesuvius'	-	20.0		73.2	41.1	3	-	young plant (20 d)	Huang, 1988
Tomato	'Vesuvius'	-	20.0		24.4	39.8	3	-	old plant (50 d)	Huang, 1988
Tomato	'Vesuvius'	-	20.0		22.3	23.2	2	50		Huang, 1988
Tomato	-	-	26.0		81.5	-	-	-		Ibrahim, 1975 Madueke, 1979
Tomato	'Immuny'	-	27.0		41.0	-	4	-		Zabudskaya, 1989
Tomato	'Moneydor'	Tomato	23.4	28/19	111.4	-	54	54	Dutch wf	van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	21.5	26/20	486.6	-	34	34		van Rongen, 1979
Tomato	'Moneydor'	-	11.6	18/7	124.5	-	21	107		Burggraaf & van der Laan, 1983 van der Laan et al., 1982
Tomato	'Moneydor'	Tomato	11.4	18/7	31.5	33.0	10	55	during 17 days	Christochowitz & van der Fluit, 1981
Tomato	-	-	17.3	37.8/6.1	92.0	27.7	2	2		Lloyd, 1922
Tomato	-	Tobacco	26.7	30/20	69.5	56.7	-	-	young plant	Yano, 1988 Yano, 1989

Appendix F (continued). Fecundity (eggs per female per lifetime) of T. vaporariorum.

Host plant	Cultivar	Pest reared on	Temp (°C) Mean	Temp (°C) Range	Fecundity Mean	Fecundity cv(%)	Fecundity n	Fecundity n(wf)	Remarks	Reference
Tomato	-	Tobacco	26.7	30/20	52.8	71.6	-	-	old plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	73.7	61.3	-	-	young plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	52.7	54.8	-	-	old plant	Yano, 1988 Yano, 1989
Tomato	'Moneydor'	Tomato	20.0	24/16	219.2	26.6	6	6		van Es, 1982
Tomato	'Moneydor'	Tomato	22.5	26/20	90.4	93.5	15	15		van Es, 1982
Tomato	'Dombo'	Tomato	20.0	24/16	215.3	41.5	7	7	flesh tomato	van Es, 1982
Tomato	'Dombo'	Tomato	22.5	26/20	215.6	45.9	14	14	flesh tomato	van Es, 1982
Tomato	'Portante'	Tomato	22.5	26/20	219.0	44.8	10	10	flesh tomato	van Es, 1982
Tomato	'Melchior'	Sweet pepper	26.5	35/18	44.2	81.2	45	45	Hungarian wf	van Steenis, 1990
Bean	'Canadian Wonder'	-	18.0		118.4	46.9	15	15		Madueke, 1979
Bean	'Canadian Wonder'	-	22.5		100.5	25.1	15	15		Madueke, 1979
Bean	'Canadian Wonder'	-	27.0		62.4	60.0	17	17		Madueke, 1979
Bean	'Contender'	-	26.0		19.78	130.9	82	82		Collman & All, 1980
Bean	-	Bean	7.5		0	0.0	-	-		Pravisani, 1981
Bean	-	Bean	37.5		0	0.0	-	-		Pravisani, 1981
Cucumber	'IVT 71-240'	Cucumber	22.0		96.9	126.8	31	31	exp.in winter	van Boxtel, 1980 van Boxtel et al., 1978
Cucumber	'IVT 71-240'	Tomato	22.0		176.4	57.8	40	40	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977 Woets & van Lenteren, 1976
Cucumber	'IVT 71-240'	Tomato	22.0		123.5	86.0	21	21	exp.in winter	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977
Cucumber	'IVT 71-240'	Tomato	25.0		211	56.3	22	22		van Sas, 1978 van Sas et al., 1978
Cucumber	'Legenda'	-	27.0		78.5	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'Surpriz'	-	27.0		69.7	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'Surpriz'	-	27.0		67.9	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'Rodnichok'	-	27.0		72.7	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'Nektar'	-	27.0		79.0	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'Mayak BI'	-	27.0		62.0	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'Hybrid 818x965'	-	27.0		66.5	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'Farbio'	Sweet pepper	26.5	35/18	323.3	67.6	47	47	Hungarian wf	van Steenis, 1990
Eggplant	'Bonica'	-	17.0		441.45	29.9	20	20		Di Pietro, 1977
Eggplant	'Bonica'	-	22.0		362.17	45.7	30	30		Di Pietro, 1977
Eggplant	'Bonica'	-	27.0		134.71	41.1	35	35		Di Pietro, 1977
Eggplant	'Mammouth'	Tomato	22.0		339.2	71.1	44	44	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977 Woets & van Lenteren, 1976
Eggplant	'Mammouth'	Tomato	22.0		416.5	55.2	21	21	exp.in winter	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977

Appendix F (continued). Fecundity (eggs per female per lifetime) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Fecundity Mean	Fecundity cv(%)	Fecundity *n*	Fecundity *n*(wf)	Remarks	Reference
Eggplant	'Mammouth'	Tomato	25.0		694.2	58.5	21	21		van Sas, 1978
										van Sas et al., 1978
Eggplant	'Monstrueuse de New York'	Tomato	24.0		666.0	-	-	-		Malausa et al., 1988
Eggplant	'Pusa Purple Cluster'	Tomato	24.0		536.0	-	-	-		Malausa et al., 1988
Eggplant	'Ronde de Valence'	Tomato	24.0		510.0	-	-	-		Malausa et al., 1988
Eggplant	'Ceylan'	Tomato	24.0		408.8	-	-	-		Malausa et al., 1988
Eggplant	'Dourga'	Tomato	24.0		437.5	-	-	-		Malausa et al., 1988
Eggplant	'Shinkuro'	Tomato	24.0		419.5	-	-	-		Malausa et al., 1988
Eggplant	'Liu Ye Kie'	Tomato	24.0		314.8	23.9	7	7		Malausa et al., 1988
Eggplant	'Ronde de Valence'	-	22.0		687	-	-	-		Malausa et al., 1984
Eggplant	'Pusa Purple Cluster'	-	22.0		678	-	-	-		Malausa et al., 1984
Eggplant	'Dourga'	-	22.0		667	-	-	-		Malausa et al., 1984
Eggplant	'Monstrueuse de New York'	-	22.0		643	-	-	-		Malausa et al., 1984
Tobacco	'Bright Yellow'	Tobacco	15.0		121	43.0	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	18.0		129	73.6	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	21.0		304	36.5	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	24.0		290	50.0	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	27.0		221	59.7	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	30.0		115	31.3	-	-		Yano, 1981
Gerbera	'Hook Hybrid'	Tomato	25.0		228.9	44.6	21	21		van Sas, 1978
										van Sas et al., 1978
Gerbera	'Clementine'	Gerbera	15.0		143.0	-	25	25		Dorsman & van de Vrie, 1987
Gerbera	'Terra Esperance'	Gerbera	15.0		168.0	-	25	25		Dorsman & van de Vrie, 1987
Gerbera	'Appelbloesem'	Gerbera	15.0		163.6	-	25	25		Dorsman & van de Vrie, 1987
Gerbera	'Terra Fame'	Gerbera	15.0		142.3	-	25	25		Dorsman & van de Vrie, 1987
										Dorsman & van de Vrie, unpubl.
Gerbera	'Clementine'	Gerbera	20.0		234.3	-	25	25		Dorsman & van de Vrie, 1987
Gerbera	'Terra Esperance'	Gerbera	20.0		274.2	-	25	25		Dorsman & van de Vrie, 1987
Gerbera	'Appelbloesem'	Gerbera	20.0		195.1	-	25	25		Dorsman & van de Vrie, 1987
Gerbera	'Terra Fame'	Gerbera	20.0		249.1	-	25	25		Dorsman & van de Vrie, 1987
										Dorsman & van de Vrie, unpubl.
Gerbera	'Clementine'	Gerbera	25.0		158.2	-	25	25		Dorsman & van de Vrie, 1987
Gerbera	'Terra Esperance'	Gerbera	25.0		289.2	-	25	25		Dorsman & van de Vrie, 1987
Gerbera	'Appelbloesem'	Gerbera	25.0		174.2	-	25	25		Dorsman & van de Vrie, 1987
Gerbera	'Terra Fame'	Gerbera	25.0		206.6	-	25	25		Dorsman & van de Vrie, 1987
										Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		157.2	-	24	24		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Tomato	22.0		162.5	-	12	12		Kusters, 1990
Gerbera	'Mandarine'	Gerbera	15.0		118.5	85.7	11	11	removed leaves	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	21.0		100.7	39.1	23	23	removed leaves	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	25.0		106.9	95.0	22	22	removed leaves	Mulock Houwer, 1977

Appendix F (continued). Fecundity (eggs per female per lifetime) of T. vaporariorum.

Host plant	Cultivar	Pest reared on	Temp. (°C)		Fecundity				Remarks	Reference
			Mean	Range	Mean	cv(%)	n	n(wf)		
Gerbera	'Mandarine'	Gerbera	30.0		30.4	67.8	21	21	removed leaves	Mulock Houwer, 1977
Gerbera	'Symfonie'	Cucumber	20.3	31/10	227.2	49.1	22	22	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Visa'	Cucumber	20.3	31/10	179.8	64.1	19	19	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Kim'	Cucumber	20.3	31/10	199.7	58.9	22	22	Hungarian wf	Schonherr, 1988
Sweet pepper	'Tisana'	Sweet pepper	22.0		38.6	172.9	14	14	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978
Sweet pepper	'Tisana'	Tomato	22.0		3.2	163.0	47	47	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977 Woets & van Lenteren, 1976
Sweet pepper	'Tisana'	Tomato	22.0		0.9	317.4	29	29	exp.in winter	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977
Sweet pepper	'Tisana'	Tomato	22.0		4.8	174.1	9	9	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978
Sweet pepper	'Tisana'	Cucumber	22.0		2.0	132.3	9	9	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978
Sweet pepper	'Latino'	-	27.0		147.0	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Lito'	-	27.0		52.2	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Herpa'	-	27.0		60.2	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Novi'	-	27.0		17.4	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Topolyok'	-	27.0		14.6	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Podarok Moldovy'	-	27.0		8.5	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Podarok Moldovy'	-	27.0		8.5	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Lastochka'	-	27.0		163.0	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Rubinovy'	-	27.0		118.5	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Tisana'	Tomato	23.4	28/19	52.3	-	51	51	Dutch wf	van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Tomato	23.4	28/19	82.7	-	53	53	Dutch wf	van Lenteren et al., 1989
Sweet pepper	'Tisana'	Sweet pepper	23.2	34/13	9.1	-	53	53	Hungarian wf	van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	23.2	34/13	49.2	-	53	53	Hungarian wf	van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.1	34/20	54.4	125.6	49	49	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	34/20	92.1	91.3	44	44	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	34/20	57.4	124.9	50	50	Hungarian wf	Meyer, 1990 Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	26.5	35/18	63.4	142.6	46	46	Hungarian wf	van Steenis, 1990
Gherkin	'Levo'	Tomato	25.0		283	64.5	21	21		van Sas, 1978 van Sas et al., 1978
Melon	'Ogen'	Tomato	25.0		66.7	76.3	45	45		van Sas, 1978 van Sas et al., 1978
Hibiscus	'Nairobi'	Tomato	22.0		53.0	-	20	20		Kusters, 1990
Various	-	-	17.3	37.8/6.1	129.8	107.3	13	13		Lloyd, 1922
Various	-	-	-		120	-	-	-		Weber, 1931
-	-	-	25.0		150	-	-	-		Woets, 1972a

Appendix G. Oviposition frequency (eggs per (still living) female per day) of *T. vaporariorum*. cv, coefficient of variation; *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Oviposition frequency Mean	Oviposition frequency cv(%)	Oviposition frequency *n*	Oviposition frequency *n*(wf)	Remarks	Reference
Tomato	'Bonnie Best'	Tomato	12.0		1.2	35.3	49	49		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	15.0		2.2	33.7	54	54		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	18.0		8.2	21.1	56	56		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	21.0		8.4	25.2	57	57		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	24.0		7.5	28.2	57	57		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	27.0		5.1	66.3	44	44		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	30.0		4.0	47.3	54	54		Burnett, 1949
Tomato	'Bonnie Best'	Tomato	33.0		2.1	54.7	32	32		Burnett, 1949
Tomato	'Moneymaker'	Tomato	22.0		4.4	45.3	41	41	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977 Woets & van Lenteren, 1976
Tomato	'Moneymaker'	Tomato	25.0		4.4	28.3	21	21		van Sas, 1978 van Sas et al., 1978
Tomato	'Moneydor'	Tomato	18.0		4.5	9.6	9	51	during 17 days	Christochowitz & van der Fluit, 1981 Christochowitz et al., 1981
Tomato	-	-	26.7		10.8	34.3	16	16		Hussey & Gurney, 1957
Tomato	-	-	23.9		5.8	58.6	7	7		Hussey & Gurney, 1957
Tomato	-	-	15.6		4.2	26.2	12	12		Hussey & Gurney, 1957
Tomato	-	-	23.9		5.9	33.3	37	-		Hussey & Gurney, 1959
Tomato	-	-	22.0		2.84	-	-	-		Castresana Estrada et al, 1982
Tomato	'Allround'	-	18.0		7.5	15.5	16	16	during 23 days	Steenhuis, unpubl.
Tomato	'Moneymaker'	Tomato	22.0		0.96	111.6	37	37	exp.in winter	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977
Tomato	'Moneymaker'	Cucumber	22.0		0.36	128.1	29	29	exp.in winter	van Boxtel, 1980 van Boxtel et al., 1978
Tomato	'Moneydor'	Bean	22.5		5.7	35.1	8	70	during 1 day	van Bruggen, 1975
Tomato	'Ponderosa'	Tomato	25.0		6.68	10.4	5	15	during 3 days	Yasui et al., 1987
Tomato	'Moneydor'	Tomato	10.0		0.12	-	25	25	during 1 day	Hulspas-Jordaan & van Lenteren, 1989
Tomato	'Moneydor'	Tomato	15.0		1.13	-	23	23	during 1 day	Hulspas-Jordaan & van Lenteren, 1989
Tomato	'Moneydor'	Tomato	20.0		1.93	-	29	29	during 1 day	Hulspas-Jordaan & van Lenteren, 1989
Tomato	'Moneydor'	Tomato	20.0		2.20	-	30	30	during 1 day	Hulspas-Jordaan & van Lenteren, 1989
Tomato	'Moneydor'	Tomato	25.0		1.73	-	26	26	during 1 day	Hulspas-Jordaan & van Lenteren, 1989
Tomato	'Moneydor'	Tomato	30.0		1.69	-	26	26	during 1 day	Hulspas-Jordaan & van Lenteren, 1989
Tomato	'Moneydor'	Tomato	35.0		1.94	-	17	17	during 1 day	Hulspas-Jordaan & van Lenteren, 1989
Tomato	'Immuny'	-	27.0		2.4	5.4	4	-	East European wf	Zabudskaya, 1989
Tomato	'Moneydor'	Tomato	21.5	26/20	6.5	13.0	2	34		van Rongen, 1979
Tomato	'Moneydor'	Tomato	15.0	20/10	0.48	-	25	25	during 1 day	Hulspas-Jordaan & van Lenteren, 1989
Tomato	'Moneydor'	Tomato	17.5	20/15	1.26	-	23	23	during 1 day	Hulspas-Jordaan & van Lenteren, 1989
Tomato	'Moneydor'	Tomato	22.5	25/20	1.41	-	27	27	during 1 day	Hulspas-Jordaan & van Lenteren, 1989
Tomato	'Moneydor'	Tomato	25.0	30/20	1.48	-	29	29	during 1 day	Hulspas-Jordaan & van Lenteren, 1989
Tomato	'Moneydor'	Tomato	27.5	35/20	3.39	-	31	31	during 1 day	Hulspas-Jordaan & van Lenteren, 1989
Tomato	'Moneydor'	Tomato	23.4	28/19	4.10	60.9	54	54	Dutch wf	Oostenbrug, 1988 van Lenteren et al., 1989
Tomato	'Moneydor'	Tomato	24.5	28/18	2.1	55.9	28	28	during 3 days	van Bruggen, 1975
Tomato	'Extase'	Tomato	24.5	28/18	1.9	75.6	30	30	during 3 days	van Bruggen, 1975

Appendix G (continued). Oviposition frequency (eggs per (still living) female per day) of T. vaporariorum.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Oviposition frequency Mean	cv(%)	n	n(wf)	Remarks	Reference
Tomato	'Sonata'	Tomato	24.5	28/18	1.6	55.4	21	21	during 3 days	van Bruggen, 1975
Tomato	'Latina'	Tomato	24.5	28/18	1.8	59.7	25	25	during 3 days	van Bruggen, 1975
Tomato	'Moneydor'	-	11.6	18/7	3.1	19.7	21	107		Burggraaf & van der Laan, 1983 van der Laan et al., 1982
Tomato	'Moneydor'	Tomato	11.4	18/7	2.1	38.8	10	55	during 17 days	Christochowitz & van der Fluit, 1981 Christochowitz et al., 1981
Tomato	-	-	17.3	37.8/6.1	2.1	16.3	2	2		Lloyd, 1922
Tomato	-	Tobacco	26.7	30/20	2.6	-	-	-	young plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	26.7	30/20	3.9	-	-	-	old plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	2.5	-	-	-	young plant	Yano, 1988 Yano, 1989
Tomato	-	Tobacco	20.0	25/10	2.6	-	-	-	old plant	Yano, 1988 Yano, 1989
Tomato	'Moneydor'	Tomato	20.0	24/16	4.5	-	26	26		van Es, 1982
Tomato	'Moneydor'	Tomato	22.5	26/20	2.4	-	21	21		van Es, 1982
Tomato	'Dombo'	Tomato	20.0	24/16	4.2	-	23	23	flesh tomato	van Es, 1982
Tomato	'Dombo'	Tomato	22.5	26/20	3.5	-	22	22	flesh tomato	van Es, 1982
Tomato	'Portanto'	Tomato	22.5	26/20	3.5	-	20	20	flesh tomato	van Es, 1982
Tomato	'Melchior'	Sweet pepper	26.5	35/18	2.54	69.1	45	45	Hungarian wf	van Steenis, 1990
Bean	'Canadian Wonder'	-	18.0		3.5	-	15	15		Madueke, 1979
Bean	'Canadian Wonder'	-	22.5		4.7	-	15	15		Madueke, 1979
Bean	'Canadian Wonder'	-	27.0		3.0	-	17	17		Madueke, 1979
Bean	'Contender'	-	26.0		2.59	81.1	82	82		Collman & All, 1980
Bean	-	Bean	7.5		0	0.0	-	-		Pravisani, 1981
Bean	-	Bean	37.5		0	0.0	-	-		Pravisani, 1981
Bean	-	-	20.5	22/19	11.1	-	-	-	during 1 day	Genchev, 1987
Bean	-	-	20.5	22/19	10.6	-	-	-	during 1 day	Genchev, 1987
Cucumber	'IVT 71-240'	Cucumber	22.0		7.6	82.7	31	31	exp.in winter	van Boxtel, 1980 van Boxtel et al., 1978
Cucumber	'IVT 71-240'	Tomato	22.0		8.7	35.5	40	40	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977 Woets & van Lenteren, 1976
Cucumber	'IVT 71-240'	Tomato	22.0		7.4	55.3	21	21	exp.in winter	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977
Cucumber	'IVT 71-240'	Tomato	25.0		7.5	31.7	22	22		van Sas, 1978 van Sas et al., 1978
Cucumber	'IVT 71-240'	Bean	22.5		6.8	55.9	9	75	during 1 day	van Bruggen, 1975
Cucumber	'Surpriz'	-	27.0		5.4	-	4	-	East European wf	Zabudskaya, 1989
Cucumber	'IVT 71-240'	Tomato	21.5	26/20	12.3	15.0	36	36	during 7 days	van Rongen, 1979
Cucumber	'IVT 77-467' (hairless)	Tomato	21.5	26/20	11.5	15.8	38	38	during 7 days	van Rongen, 1979
Cucumber	'IVT 71-240'	Cucumber	-	-/-	9.6	47.2	10	10	during 7 days	van Venetie, 1978
Cucumber	'IVT 77-467'	Cucumber	-	-/-	5.5	58.9	9	9	during 7 days	van Venetie, 1978

Appendix G (continued). Oviposition frequency (eggs per (still living) female per day) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Oviposition frequency Mean	Oviposition frequency cv(%)	Oviposition frequency *n*	Oviposition frequency *n*(wf)	Remarks	Reference
Cucumber	(hairless) 'Farbio'	Sweet pepper	26.5	35/18	8.08	48.1	47	47	Hungarian wf	van Steenis, 1990
Eggplant	'Bonica'	-	17.0		8.31	24.0	20	20		Di Pietro, 1977
Eggplant	'Bonica'	-	22.0		9.95	23.9	30	30		Di Pietro, 1977
Eggplant	'Bonica'	-	27.0		8.13	36.4	35	35		Di Pietro, 1977
Eggplant	'Mammouth'	Tomato	22.0		11.2	25.8	44	44	exp.in spring	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977 Woets & van Lenteren, 1976
Eggplant	'Mammouth'	Tomato	22.0		9.5	43.9	21	21	exp.in winter	van Boxtel, 1980 van Boxtel et al., 1978 van Lenteren et al., 1977
Eggplant	'Mammouth'	Tomato	25.0		11.6	22.2	21	21		van Sas, 1978 van Sas et al., 1978
Eggplant	'Ronde de Valence'	-	22.0		12.1	-	-	-		Malausa et al., 1984
Eggplant	'Pusa Purple Cluster'	-	22.0		10.6	-	-	-		Malausa et al., 1984
Eggplant	'Dourga'	-	22.0		9.8	-	-	-		Malausa et al., 1984
Eggplant	'Monstrueuse de New York'	-	22.0		9.1	-	-	-		Malausa et al., 1984
Eggplant	'Claresse'	Bean	22.5		5.8	69.0	9	68	during 1 day	van Bruggen, 1975
Tobacco	'Bright Yellow'	Tobacco	15.0		4.4	52.3	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	18.0		5.5	60.0	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	21.0		8.0	57.5	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	24.0		9.5	53.7	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	27.0		9.2	74.2	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	30.0		7.9	67.1	-	-		Yano, 1981
Tobacco	-	-	10.0		0.00	-	150	150	during 1 day in dark	Weber, 1931
Tobacco	-	-	15.0		0.16	-	150	150	during 1 day in dark	Weber, 1931
Tobacco	-	-	20.0		0.80	-	150	150	during 1 day in dark	Weber, 1931
Tobacco	-	-	24.0		1.60	-	150	150	during 1 day in dark	Weber, 1931
Tobacco	-	-	32.0		0.90	-	150	150	during 1 day in dark	Weber, 1931
Tobacco	-	-	37.0		0.00	-	150	150	during 1 day in dark	Weber, 1931
Gerbera	'Terra Fame'	Gerbera	15.0		2.41	-	5	24		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	20.0		4.23	-	5	21		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	25.0		6.05	-	5	23		Dorsman & van de Vrie, unpubl.
Gerbera	'Terra Fame'	Gerbera	30.0		6.82	-	5	24		Dorsman & van de Vrie, unpubl.
Gerbera	'Hook Hybrid'	Tomato	25.0		5.6	16.0	21	21		van Sas, 1978 van Sas et al., 1978
Gerbera	'Terra Fame'	Tomato	22.0		6.13	-	12	12		Kusters, 1990
Gerbera	'Mandarine'	Gerbera	15.0		3.4	35.3	11	11	removed leaves	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	21.0		7.7	31.2	23	23	removed leaves	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	25.0		6.1	42.6	22	22	removed leaves	Mulock Houwer, 1977
Gerbera	'Mandarine'	Gerbera	30.0		4.2	71.4	21	21	removed leaves	Mulock Houwer, 1977
Gerbera	'Symfonie'	Cucumber	20.3	31/10	5.7	26.6	22	22	Hungarian wf	Schonherr, 1988
Gerbera	'Terra Visa'	Cucumber	20.3	31/10	5.0	25.3	19	19	Hungarian wf	Schonherr, 1988

Appendix G (continued). Oviposition frequency (eggs per (still living) female per day) of T. vaporariorum.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Oviposition frequency Mean	cv(%)	*n*	*n*(wf)	Remarks	Reference
Gerbera	'Terra Kim'	Cucumber	20.3	31/10	5.3	29.7	22	22	Hungarian wf	Schonherr, 1988
Sweet pepper	'Tisana'	Sweet pepper	22.0		3.8	139.5	14	14	exp.in spring	van Boxtel, 1980
										van Boxtel et al., 1978
Sweet pepper	'Tisana'	Tomato	22.0		0.72	133.6	47	47	exp.in spring	van Boxtel, 1980
										van Boxtel et al., 1978
										van Lenteren et al., 1977
										Woets & van Lenteren, 1976
Sweet pepper	'Tisana'	Tomato	22.0		0.28	317.4	29	29	exp.in winter	van Boxtel, 1980
										van Boxtel et al., 1978
										van Lenteren et al., 1977
Sweet pepper	'Tisana'	Tomato	22.0		1.2	129.8	9	9	exp.in spring	van Boxtel, 1980
										van Boxtel et al., 1978
Sweet pepper	'Tisana'	Cucumber	22.0		0.36	134.5	9	9	exp.in spring	van Boxtel, 1980
										van Boxtel et al., 1978
Sweet pepper	'Marike'	Bean	22.5		3.5	42.9	8	84	during 1 day	van Bruggen, 1975
Sweet pepper	'CIND'	-	20.0		6.5	-	1	100	during 8 days	Laska et al., 1986
Sweet pepper	'CW'	-	20.0		1.7	-	1	100	during 8 days	Laska et al., 1986
Sweet pepper	'Granat'	-	20.0		7.8	-	1	100	during 8 days	Laska et al., 1986
Sweet pepper	'Tisana'	Sweet pepper	24.4		4.4	-	150	150	Hungarian wf	van Vianen et al., 1987
Sweet pepper	'Tisana'	-	24.4		3.2	-	150	150	Dutch wf	van Vianen et al., 1987
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.4		5.6	-	150	150	Hungarian wf	van Vianen et al., 1987
Sweet pepper	'Angeli Emleke'	-	24.4		2.8	-	150	150	Dutch wf	van Vianen et al., 1987
Sweet pepper	'Latino'	-	27.0		7.4	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Lito'	-	27.0		3.7	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Herpa'	-	27.0		5.3	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Novi'	-	27.0		1.5	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Topolyok'	-	27.0		1.8	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Podarok Moldovy'	-	27.0		2.4	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Podarok Moldovy'	-	27.0		2.3	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Lastochka'	-	27.0		8.8	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Rubinovy'	-	27.0		6.5	-	4	-	East European wf	Zabudskaya, 1989
Sweet pepper	'Tisana'	Tomato	23.4	28/19	4.16	42.0	51	51	Dutch wf	Oostenbrug, 1988
										van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Tomato	23.4	28/19	4.63	47.1	53	53	Dutch wf	Oostenbrug, 1988
										van Lenteren et al., 1989
Sweet pepper	'Tisana'	Sweet pepper	23.2	34/13	4.12	-	53	53	Hungarian wf	van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	23.2	34/13	5.41	-	53	53	Hungarian wf	van Lenteren et al., 1989
Sweet pepper	'Angeli Emleke'	Sweet pepper	24.1	34/20	5.05	95.9	49	49	Hungarian wf	Meyer, 1990
										Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	24.1	34/20	6.20	73.3	44	44	Hungarian wf	Meyer, 1990
										Meyer et al., 1990
Sweet pepper	'Feherozon'	Sweet pepper	24.1	34/20	5.25	101.3	50	50	Hungarian wf	Meyer, 1990
										Meyer et al., 1990
Sweet pepper	'HRF'	Sweet pepper	26.5	35/18	3.37	74.3	46	46	Hungarian wf	van Steenis, 1990
Gherkin	'Levo'	Tomato	25.0		8.6	16.9	21	21		van Sas, 1978
										van Sas et al., 1978
Melon	'Ogen'	Tomato	25.0		5.5	44.2	45	45		van Sas, 1978

Appendix G (continued) Oviposition frequency (eggs per (still living) female per day) of *T. vaporariorum*.

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Oviposition frequency Mean	cv(%)	n	n(wf)	Remarks	Reference
										van Sas et al., 1978
Hibiscus	'Nairobi'	Tomato	22.0		1.66	-	20	20		Kusters, 1990
Wild potato	'PI 473340'	Potato	26.0		4.90	74.1	31	31	during 1 day	Boiteau & Singh, 1988
Potato	'Red Pontiac'	Potato	26.0		4.76	90.1	37	37	during 1 day	Boiteau & Singh, 1988
Various	-	-	17.3	37.8/6.1	3.1	42.2	13	13		Lloyd, 1922

Appendix H. Maturation period (days) (pre-oviposition period included) of *T. vaporariorum*. *n*, number of replicates; *n*(wf), total number of whiteflies (wf).

Host plant	Cultivar	Pest reared on	Temp. (°C) Mean	Temp. (°C) Range	Maturation period Mean	n	n(wf)	Remarks	Reference
Tomato	'Moneymaker'	Tomato	22		5	41	41		van Boxtel, 1980
									van Boxtel et al., 1978
Cucumber	'IVT 71-240'	Tomato				40	40		
Eggplant	'Mammouth'	Tomato				44	44		
Tomato	'Moneymaker'	Tomato	22		5	21	21		van Sas, 1978
									van Sas et al., 1978
Cucumber	'IVT 71-240'	Tomato				22	22		
Eggplant	'Mammouth'	Tomato				21	21		
Gerbera	'Hook Hybrid'	Tomato				21	21		
Gherkin	'Levo'	Tomato				21	21		
Melon	'Ogen'	Tomato				45	45		
Tomato	'Allround'	-	18		6	-	-		Steenhuis, unpubl.
Tobacco	'Bright Yellow'	Tobacco	15		7	-	-		Yano, 1981
Tobacco	'Bright Yellow'	Tobacco	24		4	-	-		Yano, 1981
Tomato	'Moneydor'	-	11.6	18/7	15	21	107		Burggraaf & van der Laan, 1983
									v.d. Laan et al. 1982

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The parasite-host relationship between *Encarsia formosa* (Hymenoptera: Aphelinidae) and *Trialeurodes vaporariorum* (Homoptera: Aleyrodidae) XXXV. Life-history parameters of the greenhouse whitefly parasitoid *Encarsia formosa* as a function of host stage and temperature.

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Contents

Abstract

Life-history parameters of *Encarsia formosa*, parasitoid of the greenhouse whitefly are reviewed. The relationship immature development rate, immature mortality, sex ratio, longevity, pre-oviposition period, fecundity, oviposition frequency and temperature have been assessed by non-linear regression. Five mathematical models were fitted, the best being selected on the basis of comparison of coefficients of determination (r^2) and of curves by eye. Coefficients to describe life-history parameters and coefficients of variation (*cv*) among individuals of each life-history parameter are summarized. These will be used as inputs into a simulation model of the population dynamics of the parasitoid.

1. Introduction

The greenhouse whitefly, *Trialeurodes vaporariorum* (Westwood) (Homoptera, Aleyrodidae) is an important pest on many crops. One of its natural enemies, the parasitoid *Encarsia formosa* Gahan (Hymenoptera, Aphelinidae) was used in biological control programs in the 1920s in England (Speyer, 1927) and subsequently populations were shipped to Australia, New Zealand, Canada and other countries (Tonnoir, 1937). The use of the parasitoid was discontinued in the fourties and fifties when chemical pesticides were used extensively. In the seventies when the first problems with pesticide resistance occurred, interest in the parasitoid increased again and introduction schemes were developed. *Encarsia formosa* is now used commercially in 90% of the tomato growing areas in the Netherlands and in many other countries (van Lenteren & Woets, 1988). As yet there is no explanation as to why the parasitoid cannot be applied successfully on some other crops.

A simulation model based on behavioural aspects of individuals in relation to host plant, pest insect and environment is being developed to find out more about the tritrophic system 'host plant-greenhouse whitefly-parasitoid'. One of the submodels simulates the population dynamics of *Encarsia formosa*. Inputs in this model are life-history parameters such as immature development, immature mortality, sex ratio, adult longevity, fecundity, oviposition frequency and pre-oviposition period.

Life-history parameters of *Encarsia formosa* and other whitefly parasitoids have been reviewed to some extent by Vet et al. (1980), Vet & van Lenteren (1981), van Lenteren & Hulspas-Jordaan (1983) and Artigues et al. (1987). *E. formosa* behaviour has been reviewed by Noldus & van Lenteren (1990). In this article a more comprehensive review has been given and the relationship between life-history parameters and temperature has been estimated by non-linear regression.

2. Material & Methods

Many studies have been done on *Encarsia formosa* as parasitoid of the greenhouse whitefly, *Trialeurodes vaporariorum*. In some experiments the cotton whitefly, *Bemisia tabaci*, was used as host (Lopez Avila, 1988). Life-history parameters of *Encarsia formosa* included in these studies were development rate of immature stages, percentage mortality of the immature stages, sex ratio, longevity, pre-oviposition period, fecundity and oviposition frequency. All collected data are given in Appendices A-F, in which the number of decimals have been copied from the original study. Most experiments have focused on the effect of temperature on these parameters with little attention to other environmental factors such as humidity and light. Host feeding of the parasitoid (hosts killed by predation) is not included in this study, because host feeding is not a life-history parameter.

Host and temperature are the most important factors influencing life-history parameters for many insect species. The relationship between life-history parameters and temperature was estimated by non-linear regression based on a least squares method of Marquard (Statgraphics User's Manual, version 4.0, 1989). For each parameter, several equations were used to describe the relationship to temperature. The best fitted curve was selected on the basis of the coefficient of determination (r^2, based on the corrected total sum of squares) and on visual comparison of the curves, which was necessary to check whether a curve was biologically realistic, particularly the tails.

Five mathematical equations were used, in which Y is the life-history parameter and X is the temperature (°C):

1) Linear: $Y = a + b*X$

2) Exponential: $Y = \exp(a + b*X)$

3) Third degree polynomial: $Y = a + b*X + c*X^2 + d*X^3$

4) Logan (et al., 1976): $Y = a * \{\exp(b*(X-d)) - \exp(b*(e-d)-(e-X)/c)\}$

5) Weibull (1951, in Campbell & Madden, 1990):

$$Y = c/b * ((X-a)/b)^{c-1} * \exp(-((X-a)/b)^c) * d$$

These models are described in van Roermund & van Lenteren (1992).

As four of these models descibe a non-linear relation, only life-history parameters measured at a constant temperature were used in the regression procedure. Experiments done at fluctuating temperature can only be used to validate the models in case hourly temperature data are available.

3. Results

3.1 Life-history parameters

Encarsia formosa females are black in colour with a yellow abdomen, and males are completely black. They feed on honey or honeydew, as well as on smaller whitefly larvae (host feeding). Like the whitefly, the adult is the only stage that can migrate to other leaves or plants. Females lay one egg per host preferably in the third, fourth and prepupal stages of the greenhouse whitefly (Nell et al., 1976). For terminology of whitefly stages (L1, L2, L3, L4, PP, PU), see van Roermund & van Lenteren (1992). The egg stage of the parasitoid lasts four days at 25°C (Hooy, 1984; also Fransen, 1987), after which there are three larval stages. The immature whitefly is translucent and parasitization can only be observed after dissection. The *Encarsia* larva can pupate only when the immature whitefly reaches the fourth instar (Nechols & Tauber, 1977). After pupation of the parasitoid larva, the immature whitefly turns black and parasitism can easily be seen from the outward appearance of the whitefly. Most studies only distinguished two immature 'stages' of *Encarsia*. In this article these are referred to as the 'white' and 'black' stage.

3.1.1 Immature development rate

The development rate of each immature stage was calculated as the reciprocal of its duration. Only experiments done at a constant temperature were included. Linear regression of the development rate of the white and black stage yielded lower temperature thresholds of 10.7 and 10.2°C respectively ($n = 53$ and 54 respectively, data not shown). Therefore, a mean value of 10.5°C was taken as lower temperature threshold.

Osborne (1982) calculated a lower temperature threshold of 12.7°C, based only on data from Burnett (1949). Madueke & Coaker (1984) using their own data ($n = 3$) calculated a lower temperature threshold of 13.0°C. As data at super-optimal temperatures are lacking, the Logan model was used to estimate an upper lethal temperature. Gerling et al. (1986) showed for the cotton whitefly that this model estimated realistic tails at super-optimal temperatures. An upper lethal temperature of 38.3°C for the total immature stage was estimated (with 10.5°C as lower temperature threshold, $n = 80$). Therefore, 38°C was taken for all stages, as was done for greenhouse whitefly immatures (Van Roermund & van Lenteren, 1992).

The Logan model resulted in slightly higher coefficients of determination (r^2) than the linear model. Regressions in which whitefly stages were separated yielded higher r^2, showing a difference in development rate of *E. formosa* depending on whitefly stage being parasitized. Similar findings were also obtained by Madueke (1979), Eijsackers (1969), Nechols & Tauber (1977), Arakawa (1982) and Di Pietro (1977).

Differences between development rate on whitefly L4 and prepupa as host were not clear, and because there were few experiments on these host stages, the two stages were combined. The relationships between development rate of white stage, black stage and total immature stage of *E. formosa* and temperature are shown in Tables 1 to 3 and in Figures 1 to 13.

Host plant effects on development rate of *E. formosa* cannot be examined, because of the shortage of data points at different host plants. The high r^2 in Tables 1-3 indicates that host plant effect can be disregarded. Jansen (1974) could not show a difference in development rate among host plants.

Data points of Eijsackers (1969) on L1 and L2 whitefly at 20°C were excluded from the regression because they differed greatly from other studies.

Table 1. Relationship between the development rate of *E. formosa* white stage in *T. vaporariorum* and temperature based on the Logan model where *a*, *b* and *c* are coefficients, *d* and *e* are the lower threshold and upper lethal temperature of 10.5 and 38°C respectively, r^2 is the coefficient of determination, n_i and n_e are the number of data points included and excluded respectively.

Host stage	a	b	c	r^2	n_i	n_e
L1	0.0326	0.115	6.19	0.867	4	1
L2	0.0305	0.152	5.21	0.848	7	1
L3	0.0705	0.160	5.73	0.914	16	0
L4 + Prepupa	0.0571	0.142	6.01	0.943	11	0
Pupa	0.0249	0.164	4.77	0.976	4	0
All stages	0.0393	0.135	5.61	0.715	53	0

Table 2. Relationship between the development rate of *E. formosa* black stage in *T. vaporariorum* and temperature based on the Logan model where *a*, *b* and *c* are coefficients, *d* and *e* are the lower threshold and upper lethal temperature of 10.5 and 38°C respectively, r^2 is the coefficient of determination, n_i and n_e are the number of data points included and excluded respectively.

Host stage	a	b	c	r^2	n_i	n_e
L1	0.0291	0.187	4.76	0.887	4	1
L2	0.0339	0.152	5.25	0.921	7	1
L3	0.0687	0.118	6.97	0.756	16	0
L4 + Prepupa	0.0643	0.133	6.35	0.869	11	0
Pupa	0.0346	0.153	5.33	0.894	4	0
All stages	0.0526	0.133	6.15	0.798	54	0

Table 3. Relationship between total immature development rate of *E. formosa* in *T. vaporariorum* and temperature based on the Logan model where *a*, *b* and *c* are coefficients, *d* and *e* are the lower threshold and upper lethal temperature of 10.5 and 38 °C respectively, r^2 is the coefficient of determination, n_i and n_e are the number of data points included and excluded respectively.

Host stage	*a*	*b*	*c*	r^2	n_i	n_e
L1	0.0222	0.157	5.69	0.977	5	1
L2	0.0230	0.159	5.52	0.960	8	1
L3	0.0302	0.135	6.28	0.896	17	0
L4 + Prepupa	0.0314	0.138	6.19	0.918	13	0
Pupa	0.0247	0.166	5.39	0.927	5	0
All stages	0.0188	0.133	5.56	0.809	80	0

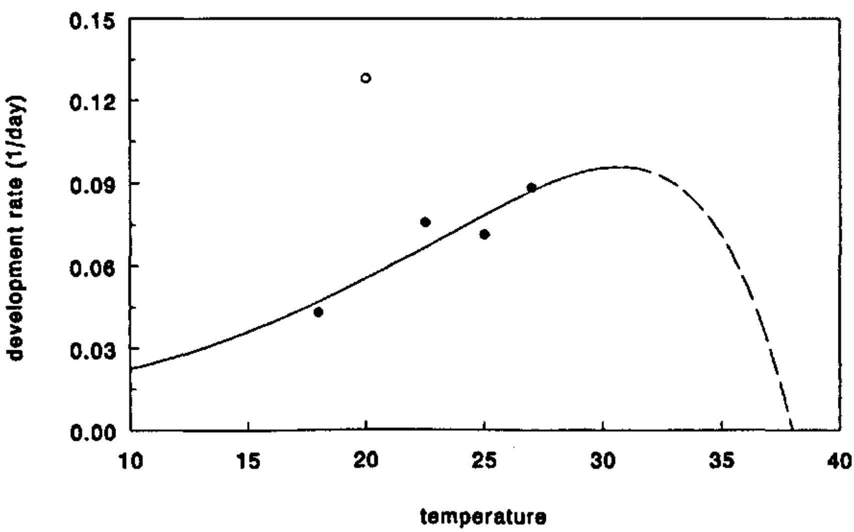

Fig. 1. Relationship between the development rate (1/day) of the white stage of *Encarsia formosa* in the first larval stage of the greenhouse whitefly and temperature. Open dots represent data points excluded from the regression.

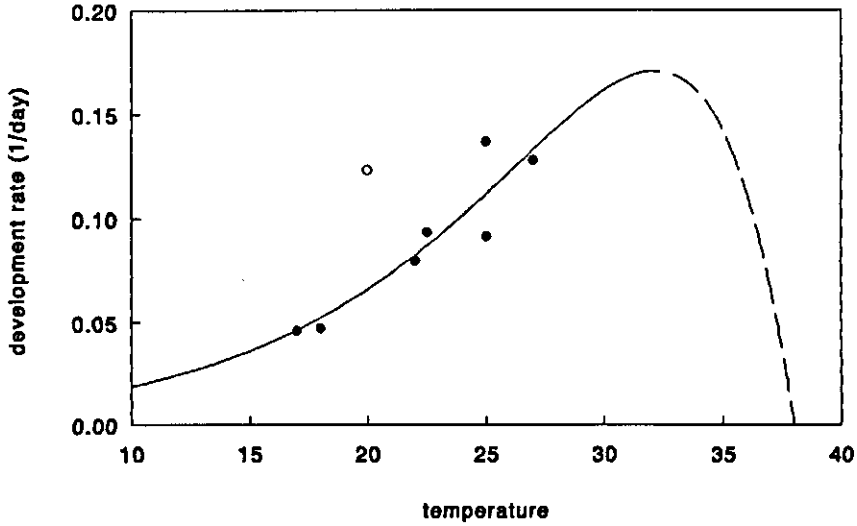

Fig. 2. Relationship between the development rate (1/day) of the white stage of *Encarsia formosa* in the second larval stage of the greenhouse whitefly and temperature. Open dots represent data points excluded from the regression.

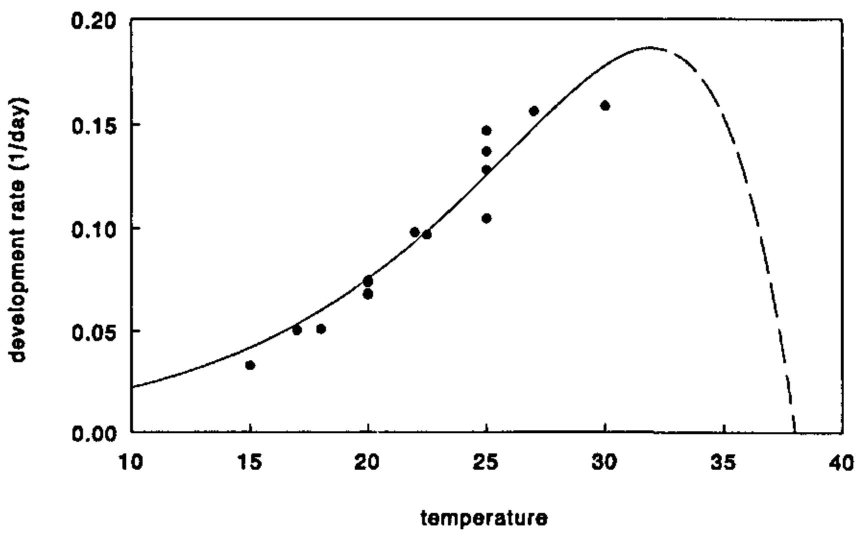

Fig. 3. Relationship between the development rate (1/day) of the white stage of *Encarsia formosa* in the third larval stage of the greenhouse whitefly and temperature.

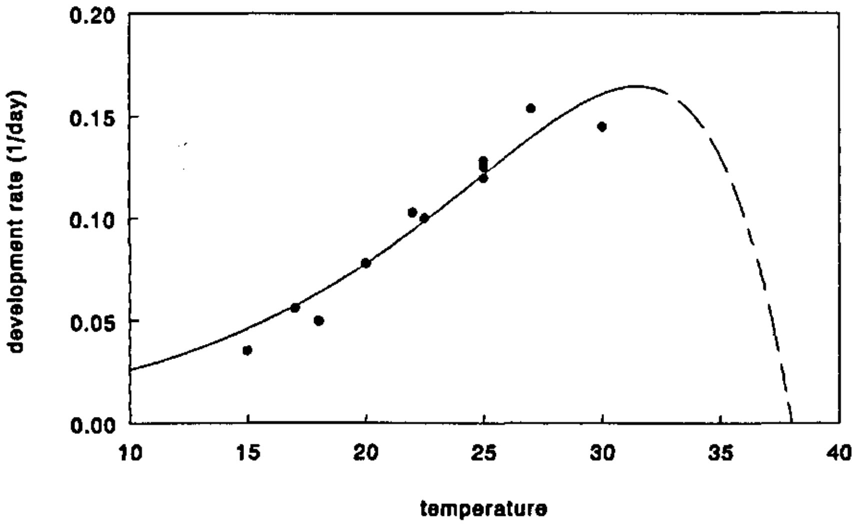

Fig. 4. Relationship between the development rate (1/day) of the white stage of *Encarsia formosa* in the fourth larval stage and prepupa of the greenhouse whitefly and temperature.

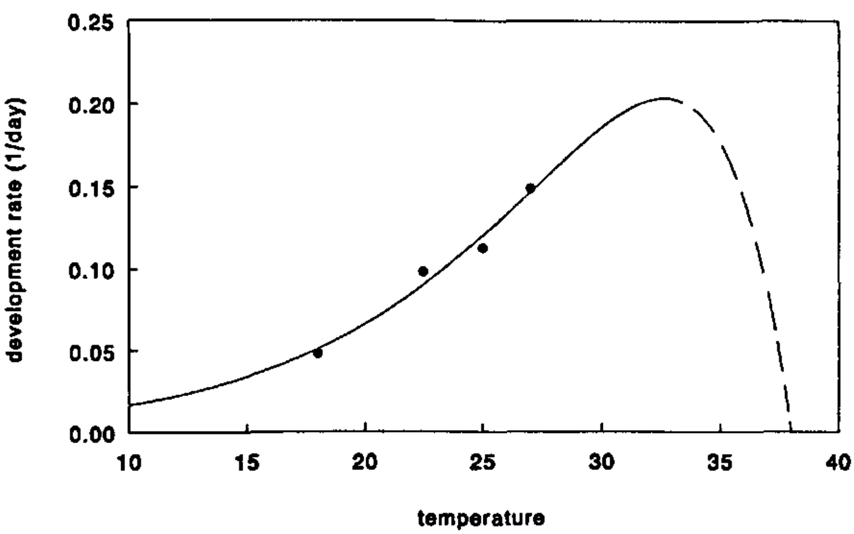

Fig. 5. Relationship between the development rate (1/day) of the white stage of *Encarsia formosa* in the pupa of the greenhouse whitefly and temperature.

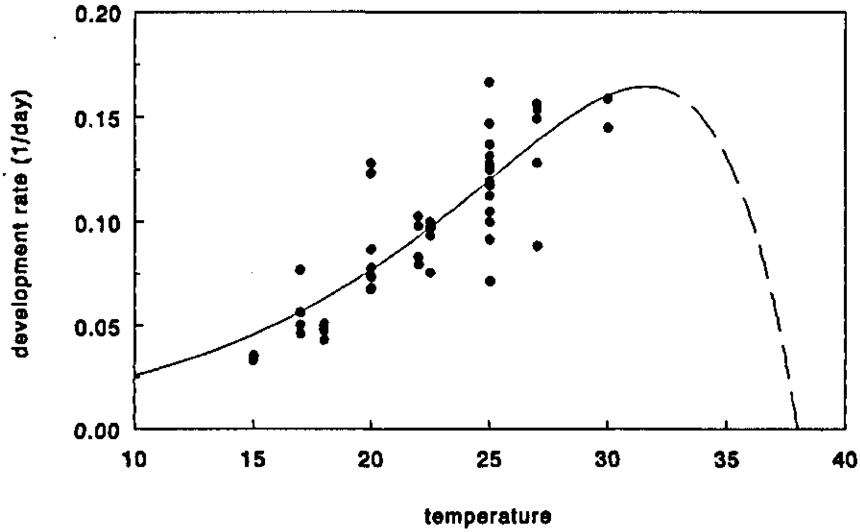

Fig. 6. Relationship between the development rate (1/day) of the white stage of *Encarsia formosa* in all immature stages of the greenhouse whitefly and temperature.

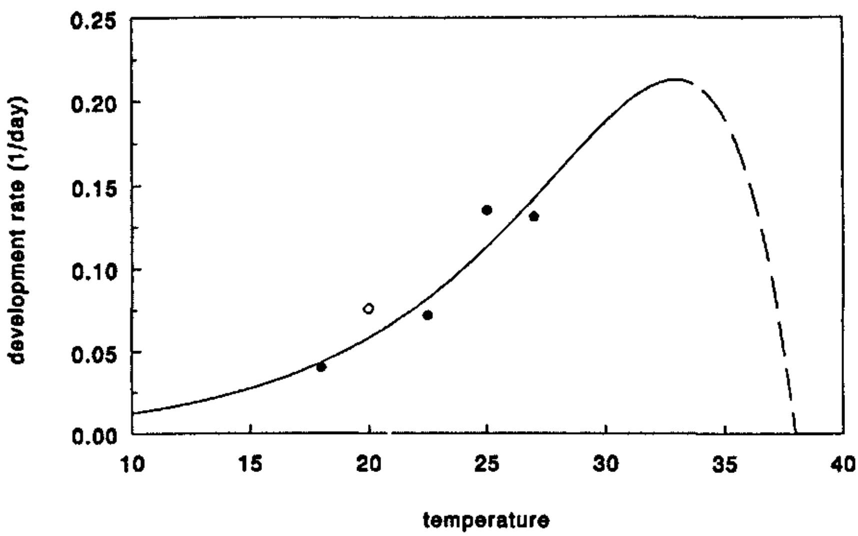

Fig. 7. Relationship between the development rate (1/day) of the black stage of *Encarsia formosa* in the first larval stage of the greenhouse whitefly and temperature. Open dots represent data points excluded from the regression.

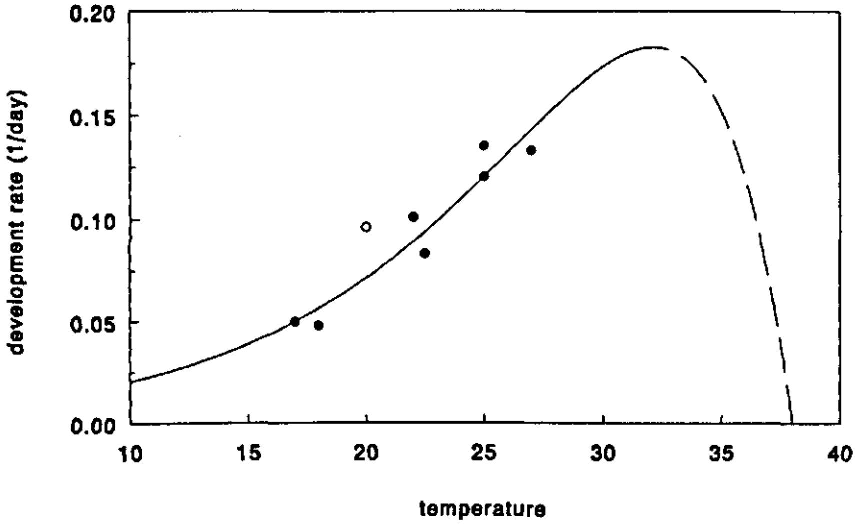

Fig. 8. Relationship between the development rate (1/day) of the black stage of *Encarsia formosa* in the second larval stage of the greenhouse whitefly and temperature. Open dots represent data points excluded from the regression.

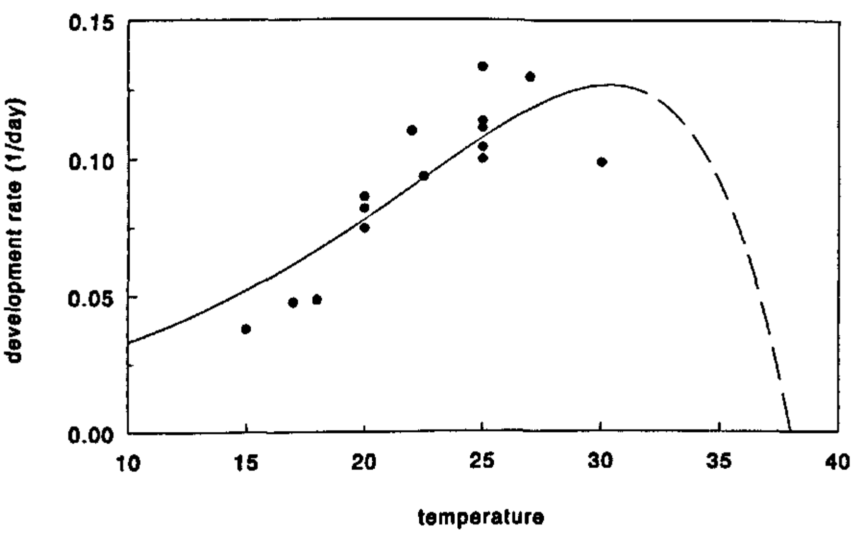

Fig. 9. Relationship between the development rate (1/day) of the black stage of *Encarsia formosa* in the third larval stage of the greenhouse whitefly and temperature.

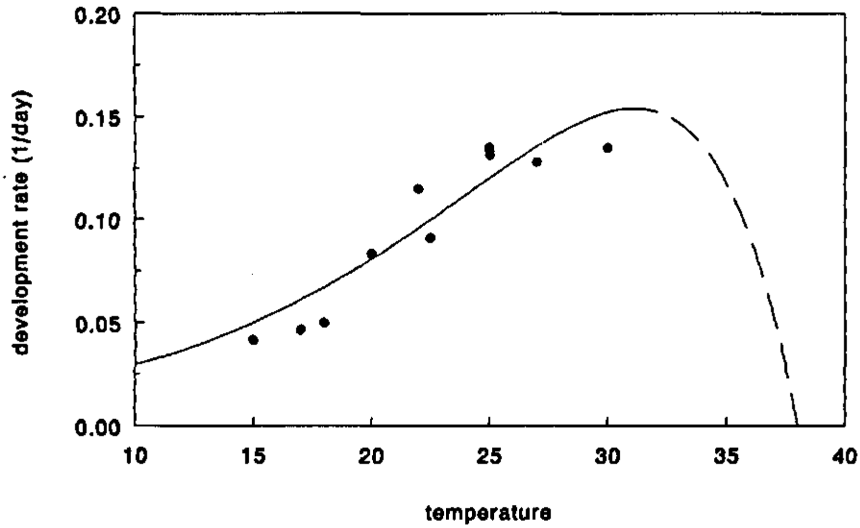

Fig. 10. Relationship between the development rate (1/day) of the black stage of *Encarsia formosa* in the fourth larval stage and prepupa of the greenhouse whitefly and temperature.

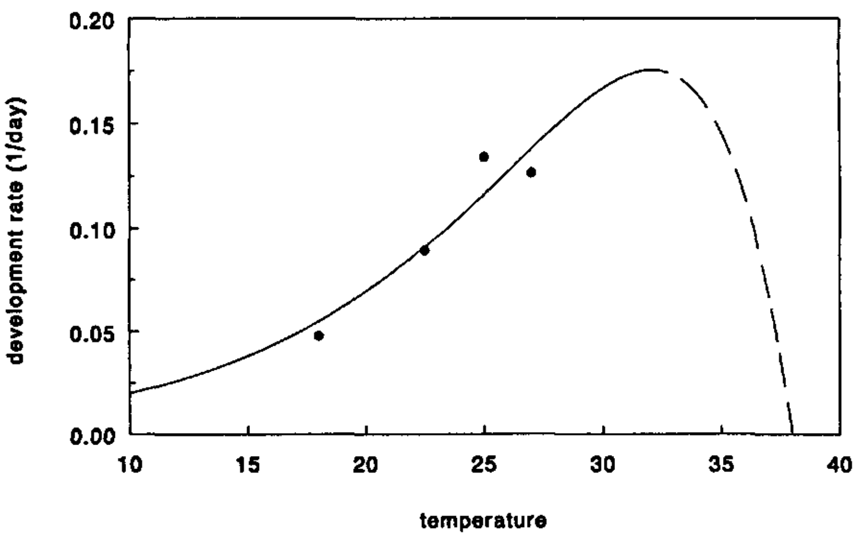

Fig. 11. Relationship between the development rate (1/day) of the black stage of *Encarsia formosa* in the pupa of the greenhouse whitefly and temperature.

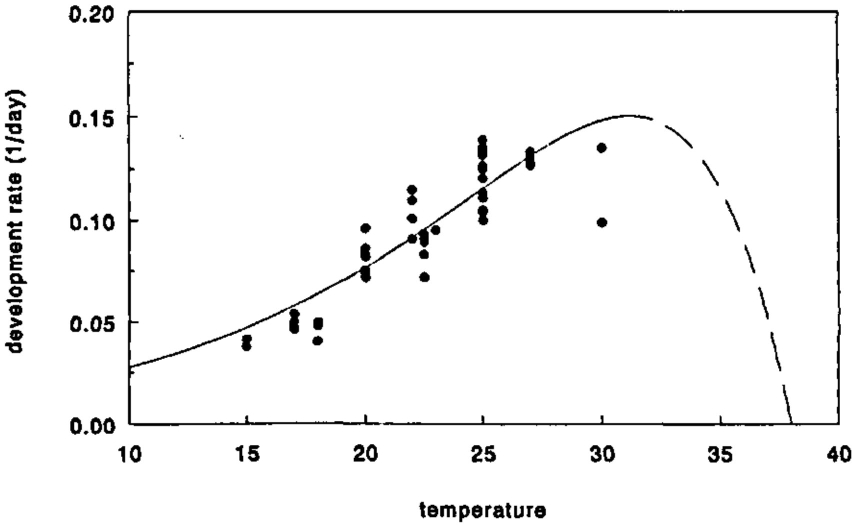

Fig. 12. Relationship between the development rate (1/day) of the black stage of *Encarsia formosa* in all immature stages of the greenhouse whitefly and temperature.

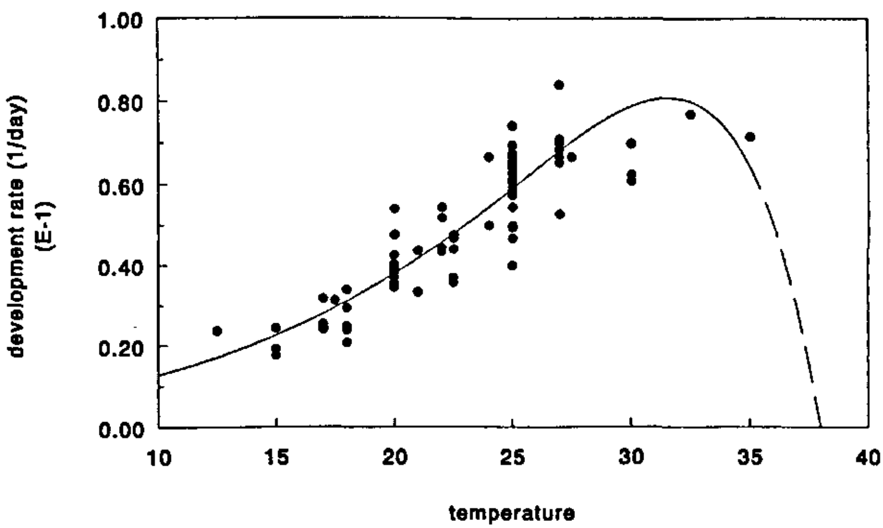

Fig. 13. Relationship between the development rate (1/day) of the total immature stage of *Encarsia formosa* in all immature stages of the greenhouse whitefly and temperature.

3.1.2 Immature mortality

Immature mortality was expressed as a percentage of the number of individuals entering a particular stage. It was only measured in experiments for the black stage and for the total immature stage. Mortality during the white or total immature stage is difficult to measure because it is not possible to see whether an egg has been laid from an intact whitefly larva. *E. formosa* does not always lay an egg during an oviposition posture, as was shown by Hulspas-Jordaan (1978) who found that 93% of the oviposition postures in unparasitized L3/L4 larvae led to the deposition of an egg. The 7% difference cannot be ascribed to mortality. In most studies the experimental set up to measure mortality during the white stage or total immature stage was not clearly described. However, Nechols & Tauber (1977) did explain how they derived mortality during the white stage from total mortality and mortality during black stage.

The relationship between percentage mortality and temperature was studied for the black stage and total immature stage of *E. formosa* on each whitefly stage separately and for all whitefly stages together. From visual inspection of the data, it was conluded that only the linear model should be tested. Eight regressions were possible, but none showed a significant relationship (data not shown). Therefore, it was concluded that percentage mortality was not related to temperature. Thus experiments conducted at fluctuating temperature could be used in the analysis.

Tables 4 and 5 give the mean percentage mortality during the black stage and during the total immature stage for each whitefly stage parasitized. Percentage mortality during the white stage derived from the total immature mortality and mortality during the black stage is presented in Table 6.

Table 4. Mean mortality during the black stage of *E. formosa* on *T. vaporariorum*, expressed as the percentage of the number entering the stage, *cv* is the coefficient of variation and n_i and n_e are the number of data points included and excluded respectively.

Host stage	Mean	*cv*	n_i	n_e
L1	7.4	0.137	3	0
L2	2.9	0.796	6	0
L3	3.3	0.672	5	0
L4	1.3	1.416	2	0
Prepupa	–	–	0	0
L2+L3+L4+Prepupa	3.4	0.737	19	4
Pupa	10.6	0.240	3	0
All stages	5.6	0.673	26	4

Table 5. Mean total immature mortality of *E. formosa* on *T. vaporariorum* expressed as percentage of number entering the egg stage, *cv* is the coefficient of variation and n_i and n_e are number of data points included and excluded respectively.

Host stage	Mean	*cv*	n_i	n_e
L1	41.9	1.154	2	0
L2	25.0	–	1	0
L3	11.8	0.151	2	0
L4	11.1	0.134	2	0
Prepupa	9.1	0.320	2	0
L3+L4+Prepupa	10.6	0.196	6	0
Pupa	26.5	0.134	2	0
All stages	21.7	0.895	12	0

Table 6. Calculated mean mortality during the white stage of *E. formosa* on *T. vaporariorum* expressed as percentage of the number entering the stage.

Host stage	Mean
L1	37.2
L2	22.3
L3+L4+Prepupa	7.5
Pupa	17.8
All stages	17.0

3.1.3 Sex ratio

Males are seldom observed. Females produce daughters parthenogenetically. Thus the sex ratio, expressed as the proportion of females of total offspring, is almost 1. As with the females, males are produced after oviposition in unparasitized hosts, unlike many other Aphelinidae, were it is thought that males are produced by parasitization of female parasitoid larvae (hyper-parasitization).

3.1.4 Longevity

Only experiments conducted at a constant temperature were used in examining the relationship between longevity and temperature. Female longevity has been studied at temperatures between 12 and 40 °C. In most cases, hosts were offered during longevity tests. The exponential model yields the highest r^2 (Table 7). Extrapolation to lower temperatures with this model is unreliable; the best estimate of longevity is at 12 °C. A higher longevity was observed in the absence of whitefly larvae and in the presence of honey or honeydew. Similar findings were also observed by Vet & van Lenteren (1981) and Gast & Kortenhoff (1983; also in van Lenteren et al., 1987). Results are given in Table 7 and Figures 14 and 15.

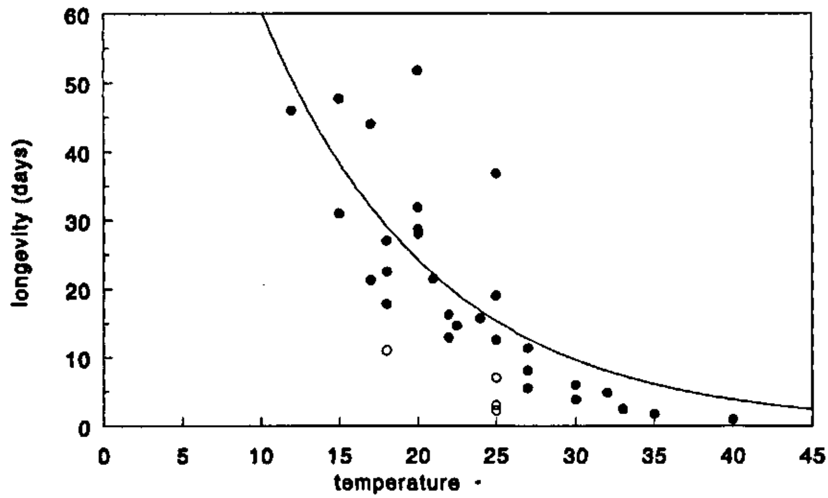

Fig. 14. Relationship between the longevity (day) of *Encarsia formosa* and temperature in the presence of greenhouse whitefly immatures. Open dots represent data points excluded from the regression.

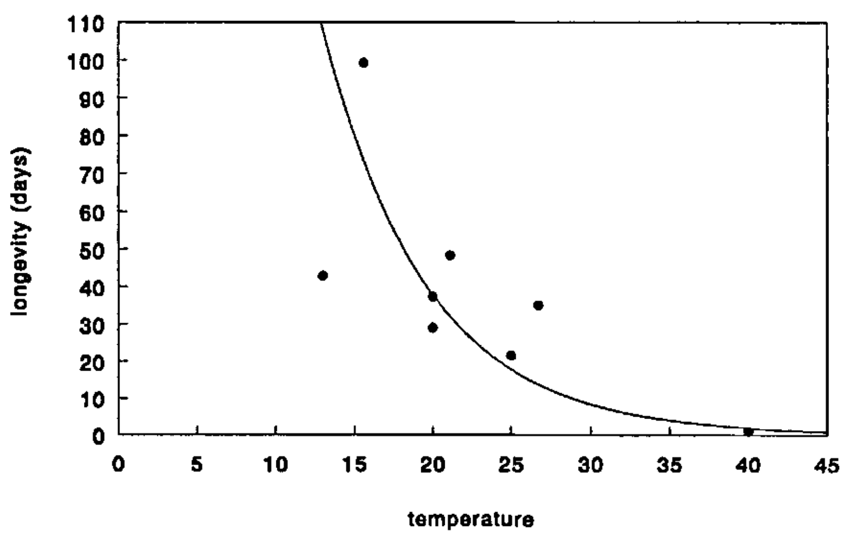

Fig. 15. Relationship between the longevity (day) of *Encarsia formosa* and temperature in the absence of greenhouse whitefly immatures and in the presence of honey or honeydew.

Table 7. Relationship between female longevity and temperature based on the exponential model where a and b are coefficients, r^2 is the coefficient of determination and n_i and n_e are number of data points included and excluded respectively.

Host	Honey/honeydew	a	b	r^2	n_i	n_e
Present	Present	5.03	-0.0921	0.635	29	5
Absent	Present	6.63	-0.150	0.813	8	0

Extreme situations were excluded from the regression, for example non-preferred whitefly stages (L2) offered (Di Pietro, 1977; Burnett, 1949) and at very low or high humidity (three times, Kajita, 1979). A longevity of 1 day at 40 °C when whitefly larvae were present (Kajita, 1979) was assumed also to be valid when whitefly larvae were absent.

There are few reports on male longevity. Gast & Kortenhoff (1983; also in van Lenteren et al., 1987) found an average male longevity at 13 °C of 53 days (n = 15), which was 68% of female longevity.

The survival pattern of adults in relation to age has been studied by Burggraaf-van Nierop & van der Laan (1983; also in van der Laan et al., 1982) and Kajita (1989). Both studies report a linear decline in number during ageing, starting immediately at low temperatures (daily temperature range 18 to 7 °C) according to Burggraaf-van Nierop & van der Laan (1983) and starting after 20 days at 20 °C according to Kajita (1989). The survival can be reproduced by a (cumulative) normal distribution, because in both cases the mean longevity is halfway the decline.

3.1.5 Pre-oviposition period

Few data have been published on the pre-oviposition period of *E. formosa*. Only data between 18 and 30 °C (Burnett, 1949) were found. The exponential model described the best relation with temperature (Table 8 and Figure 16), but extrapolation of the pre-oviposition period to temperatures below 18 °C is unreliable. The most reliable estimate at low temperatures is the value calculated at 18 °C.

Table 8. Relationship between pre-oviposition period and temperature based on the exponential model where a and b are coefficients, r^2 is the coefficient of determination and n_i and n_e are the number of data points included and excluded respectively.

Host	a	b	r^2	n_i	n_e
All stages	5.56	-0.290	0.859	4	0

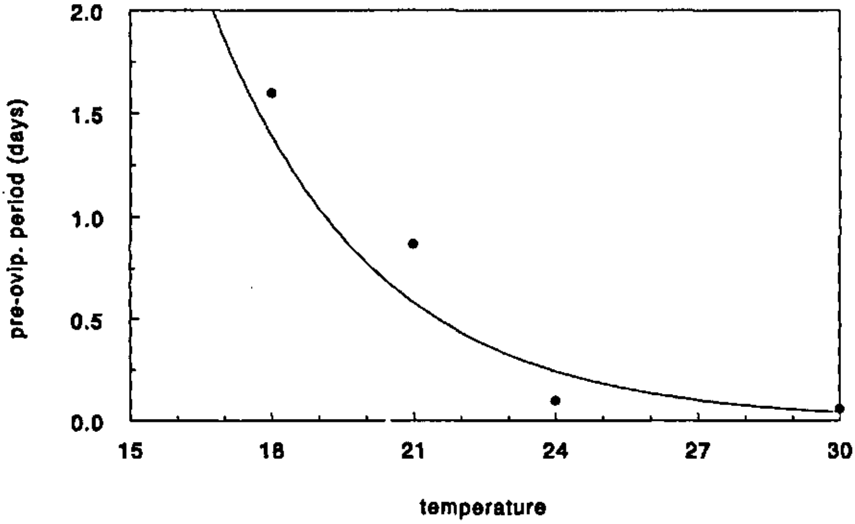

Fig. 16. Relationship between the pre-oviposition period (day) of *Encarsia formosa* and temperature in the presence of greenhouse whitefly immatures on tomato.

3.1.6 Fecundity

Data on total number of eggs laid by a female vary greatly. Data from experiments in which preferred whitefly stages were offered at a constant temperature were included. Data from less preferred whitefly L2 or L2/L3 larvae were excluded in order not to underestimate the fecundity. In most experiments, a mixture of all whitefly immature stages was offered, but numbers of preferred immatures per *E. formosa* female were not given. Direct observations indicated that about 10 eggs per day could be laid by a female if the whitefly number was not a limiting factor (Hulspas-Jordaan, 1978; Gast & Kortenhoff, 1983). Host feeding was not obligatory to maintain or enhance egg production or to promote longevity, as long as honey or honeydew was available (Gast & Kortenhoff, 1983; also in van Lenteren et al., 1987). Under these conditions the ratio between parasitization and host feeding was 5:1 (Arakawa, 1982; Gast & Kortenhoff, 1983; also in van Lenteren et al, 1987).

The lower threshold temperature for egg laying was 11.4°C (van der Schaal, 1980; also in van Lenteren & van der Schaal, 1981). Only from the experimental set up of Burnett (1949), was it clear that the numbers of available whitefly larvae were not sufficient (5 larvae per female per day), which resulted in underestimation of fecundity. Low fecundity was also reported by Woets (1972), Madueke (1977), Ibrahim (1975), Di Pietro (1977), Kajita (1979) and Kajita (1989). Kajita (1979) did experiments at a low (31 and 55%) and high (100%) relative humidity. The reasons for the low fecundity data could not be ascertained from the other studies.

The Weibull model gave the highest coefficient of determination and a biologically realistic description of the curve tails (Table 9 and Figure 17). The r^2 was very low when all data were used. A reliable curve of maximum fecundity could only be obtained when 30 of the total 38 data points from the studies were omitted. Data were included were data from Biggerstaf (in Parr et al., 1976), Arakawa (1982), van der Schaal (1980; also in van Lenteren & van der Schaal, 1981), Christochowitz & van der Fluit (1981; also in Christochowitz et al, 1981), Vet & van Lenteren (1981) and Gast & Kortenhoff (1983; also in van Lenteren et al, 1987). Data on fecundity at 35 and 40°C (at 70% RH) from Kajita (1979) were also included, because host density is unlikely to be a limiting factor at extreme temperatures. The low fecundities obtained in many experiments may be explained by the fact that it is difficult to handle the minute, delicate *E. formosa* females. Only with the utmost care do females survive daily transfer from one patch to another. We are confident that the fecundity data on which the fitted curve presented in Figure 17 do not overestimate egg production of *E. formosa*.

Table 9. Relationship between fecundity and temperature based on the Weibull model where *b*, *c* and *d* are coefficients, *a* is the lower threshold temperature of 11.4°C, r^2 is the coefficient of determination and n_i and n_e are the number of data points included and excluded respectively.

Host	*b*	*c*	*d*	r^2	n_i	n_e
L1-Pupa or L3-L4	12.9	2.48	1510	0.135	38	0
L1-Pupa or L3-L4	14.1	3.03	4780	0.963	8	30

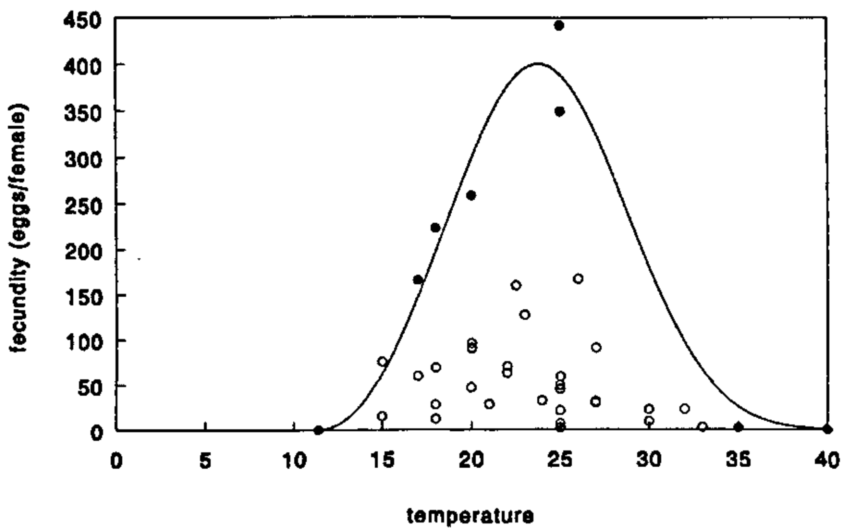

Fig. 17. Relationship between the fecundity (egg/female) of *Encarsia formosa* in greenhouse whitefly immatures of third larval stage or up and temperature. Open dots represent data points excluded from the regression.

3.1.7 Oviposition frequency

Data on the number of eggs laid per female per day vary greatly. The oviposition frequency measured over a few days only did not differ from the average oviposition frequency during a lifetime. The coefficient of determination (r^2) was the same (data not shown). Two reasons are given for this. Firstly, the observed wide variation in oviposition frequency among the various studies might have obscured differences. Secondly, oviposition frequency may change little with ageing. Our experience supports the second proposition. Thus data on oviposition frequency based on only a few days were not excluded.

Low oviposition frequencies were observed by Burnett (1949), Woets (1972b), Madueke (1977), Di Pietro (1977), Kajita (1979, 1983, 1989), Kajita & van Lenteren (1982). Burnett (1949) used too few whitefly. Hulspas-Jordaan (1978) found a low oviposition frequency when leaves were covered with large amounts of honeydew, hampering the parasitoid during searching. A reliable curve of maximum oviposition frequency was fitted when 26 of a total of 36 data points were omitted. Data points were included from Arakawa (1982), van der Schaal (1980; also in van Lenteren & van der Schaal, 1981), Christochowitz & van der Fluit (1981; also in Christochowitz et al., 1981), Vet & van Lenteren (1981) and Gast & Kortenhoff (1983; also in van Lenteren et al., 1987), Pravisani (1981), Hulspas-Jordaan (1978) and Fransen & van Montfort (1987). Data at 35 and 40°C (at 70% RH) from Kajita (1979) were included, because host density is unlikely to be a limiting factor at extreme temperatures. The Weibull model yielded the best fit; results are shown in Table 10 and Figure 18.

Table 10. Relationship between mean oviposition frequency and temperature based on the Weibull model where *b*, *c* and *d* are coefficients, *a* is the lower threshold temperature of 11.4°C, r^2 is the coefficient of determination and n_i and n_e are the number of data points included and excluded respectively.

Host	*b*	*c*	*d*	r^2	n_i	n_e
All stages	15.8	2.92	101	0.300	36	0
All stages	15.8	3.12	201	0.825	10	26

3.1.8 Change in oviposition frequency during ageing

Direct observation studies have shown that immediately after a pre-oviposition period, young *E. formosa* females can lay up to 10 eggs per day (Hulspas-Jordaan, 1978; Gast & Kortenhoff, 1983). This does not change over the subsequent few days, thus *E. formosa* has a very short maturation period in which the egg laying capacity increases, if at all.

Burggraaf-van Nierop & van der Laan (1983; also in van der Laan et al., 1982) have shown that oviposition frequency remains constant until the maximum longevity is reached. Arakawa (1982) and Kajita (1989) demonstrated a

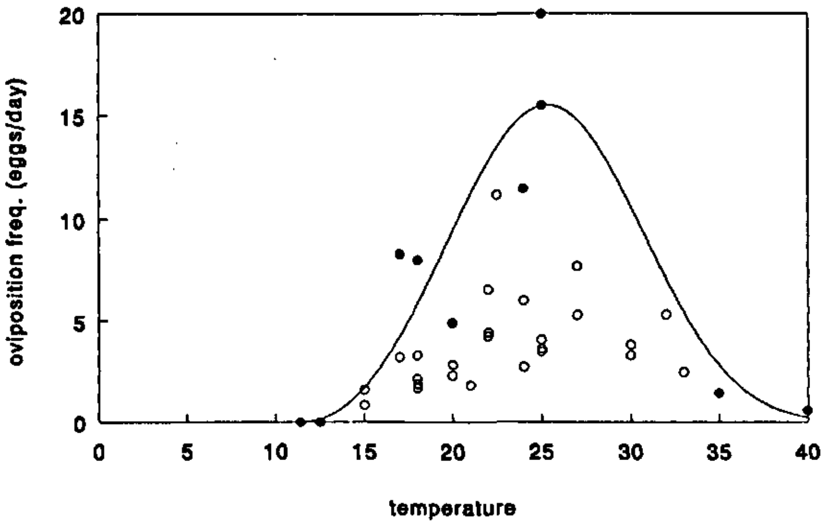

Fig. 18. Relationship between the oviposition frequency (egg/female/day) of *Encarsia formosa* in all immature stages of the greenhouse whitefly and temperature. Open dots represent data points excluded from the regression.

linear decline after about 20 days at 20-25 °C, but did not specify whether oviposition frequency was calculated per still living female or per introduced female. Comparison of data on longevity and oviposition frequency of Kajita (1989) suggest that oviposition frequency was calculated per introduced female, indicating that the decline is probably due to adult mortality instead of a reduction in oviposition frequency.

3.2 Variation among individuals

In the non-linear regression only mean values of the life-history parameters were taken from each study in order to estimate the coefficients to describe the relationship with temperature. As a measure of variation among individuals, the coefficient of variation (*cv*) can be calculated as the population standard deviation divided by the mean ($cv = sd_{n-1}$ /mean). These *cv* values (or relative dispersion) should be used as input parameters in simulation models when stochasticity is desired and normality can be assumed, as for developmental dispersion (Goudriaan & van Roermund, 1989; Schaub & Baumgärtner, 1989).

Mean *cv* values were calculated and are presented in Tables 11-13. Data were not included when the number of replicates was lower than the total number of parasitoids used in the experiments, if the observation had been excluded from the regression analysis or if the *cv* value was exceptional because it was measured at an extreme temperature. The latter two categories are given as the number of data points excluded (n_e).

Only experiments done at a constant temperature were included. If the relationship between *cv* value and temperature was not significant, then *cv* values obtained at fluctuating temperature were also used to calculate the mean *cv* value when all data were combined.

3.2.1 Immature development duration

cv values of immature development duration (which are almost equal to the *cv* values of the development rate) obtained at a constant temperature were analysed to assess a possible host stage effect. A Kruskall-Wallis test ($\alpha = 0.05$) did not show a host stage effect (data not shown). These data were then combined to study the relationship between *cv* and temperature. After visual inspection of the data, it was concluded that only the linear model should be tested. A significant linear relationship between *cv* of the white stage and temperature was found ($\alpha = 0.05$, $n = 28$), but the r^2 was very low (0.245). The relationship was not significant for the black stage and was just significant ($\alpha = 0.05$, $n = 56$) for the total immature stage, but the r^2 was very low (0.071).

In spite of a significant linear relationship, only 25 and 7% respectively of the variation in *cv* value can be explained by differences in temperature. Thus *cv* values were assumed not to relate to temperature. Therefore, data points measured at fluctuating temperature could also be included in the calculation of the mean *cv* value. Table 11 shows the mean *cv*s of the development duration of *E. formosa* in each whitefly stage and number of observations included (n_i). No observations were excluded ($n_e = 0$). No significant effect of host stage could be found (Kruskall-Wallis, $\alpha = 0.05$); the *cv* values are relatively low.

Table 11. Mean coefficient of variation (*cv*) of the immature development duration of *E. formosa* on each whitefly larval stage.

	White stage		Black stage		Total stage	
Host stage	*cv*	n_i	*cv*	n_i	*cv*	n_i
L1	0.10	4	0.19	1	0.083	6
L2	0.071	6	0.29	1	0.073	9
L3	0.077	6	0.10	1	0.10	11
L4+Prepupa	0.11	7	0.26	2	0.074	12
Pupa	0.070	4	0.06	1	0.058	5
All stages	0.084	30	0.17	7	0.083	60
Kruskall-Wallis	p=0.953, $n=27$		p=0.446, $n=6$		p=0.973, $n=43$	

Sequential dependence of development duration of individuals during successive stages, that is individuals developing slowly during one stage and compensating for this by developing faster in the next stage, can be studied if development duration of each individual is known. This was not done for *E. formosa*. If sequential dependence occurs, then the observed variance (sd^2) of the total immature development duration will be lower than when calculated from the variances of the separate stages. When data of Nechols & Tauber (1977a) were used to compare the observed variance of the total immature development duration to the calculated variance, no significant difference was found (Wilcoxon signed rank test, $p = 0.402$, $n = 6$ pairs). Thus sequential dependence appears to be absent.

3.2.2 Longevity and pre-oviposition period

Only data obtained when whitefly larvae were available for parasitization were used in asssessing the relationship between *cv* of longevity and temperature. After visual inspection of the data, it was concluded that the linear model only should be tested. No significant linear regression was found ($\alpha = 0.05$, $n = 18$). The mean *cv* values of longevity with and without the presence of whitefly larvae and honeydew are given in Table 12. No significant differences were found (Kruskall-Wallis, $\alpha = 0.05$, $n = 24$). Data on *cv* of pre-oviposition period have not been published.

Table 12. Mean coefficient of variation (*cv*) of longevity with and without the presence of whitefly larvae and honeydew and number of data points included (n_i) and excluded (n_e).

Host stage	*cv*	n_i	n_e
Larvae present, honeydew present	0.40	21	5
Larvae absent, honeydew present	0.37	3	0
Larvae absent, honeydew absent	0.30	1	0
All data	0.39	25	5
Kruskall-Wallis	$p = 0.798$, $n = 25$		

3.2.3 Fecundity and oviposition frequency

After visual inspection of the *cv* values, it was concluded that only the linear model should be tested. The regressions of *cv* of fecundity ($n = 29$) and of oviposition frequency ($n = 23$) on temperature were not significant ($\alpha = 0.05$) when data at temperatures below 35 °C were included ($\alpha = 0.05$, $n = 29$ resp. 23). Only when data obtained at 35 and 40 °C were added (Kajita, 1979), the relationship between *cv* of fecundity and temperature was significant ($\alpha = 0.05$, $n = 31$), but r^2 was still very low (0.408). Thus it was concluded that *cv* of fecundity and oviposition frequency are not related to temperature under 'normal' circumstances.

Table 13 presents data on *cv* in two ways. Firstly, data used for the non-linear regression in Sections 3.1.6 and 3.1.7 were included except those of Kajita (1979) obtained at 35 and 40 °C. Secondly, data not used in the regression were included

Table 13. Mean coefficient of variation (*cv*) of fecundity and oviposition frequency based on (*n*) data included or excluded in the non-linear regression of Sections 3.1.6 and 3.1.7.

	Fecundity		Oviposition frequency	
Non-linear regression	*cv*	*n*	*cv*	*n*
Only included data	0.29	6	0.35	8
Only excluded data	0.45	25	0.39	19
All data	0.42	31	0.38	27
Kruskall-Wallis	p = 0.0643, $n=31$		p = 0.490, $n=27$	

except those of Kajita (1979) at low or high humidity. The majority of data points was excluded from the regression because they were low. Since both sets of data were not significantly different (Kruskall-Wallis test, $\alpha = 0.05$), the mean *cv* can be calculated from all the data.

4. Discussion

Most studies on the life-history parameters of *Encarsia formosa* have focused on their relationship to temperature and have given little attention to other environmental factors. Relative humidity and light intensity have in most case not been quantified accurately. Milliron (1940) found the highest percentage parasitation at 50-70% RH; Burnett (1948) noted that *E. formosa* avoids higher humidities; and Ekbom (1977) reported that biological control failed more often when *E. formosa* was released at high humidities. Kajita (1979) concluded that longevity and fecundity were reduced to about 14, 37 and 8% at a constant RH of 31, 51 and 100% respectively at 25°C compared to the value of 19 days and 59.5 eggs at 74% RH.

McDevitt (1973, also in Scopes, 1973) observed maximum oviposition at light intensity above 7300 lux over a 16-hour period, and observed no oviposition at 4200 lux. However, we have frequently observed oviposition at about 100 lux. Van Alphen (1972) found no oviposition in the dark. Scopes (1973) reported a reduction in longevity at light intensities of 4200 lux over a 16-hour period, but did not give mean values. Hussey et al. (1976) did not obtain differences in percentage parasitation between shaded and unshaded plants. Burnett (1948) noted a higher dispersion in light.

As discussed for the greenhouse whitefly (van Roermund & van Lenteren, 1992), the method used to calculate the average value of each life-history parameter is not always clearly explained. It was not always clear whether longevity and development rate were calculated as mean or 50% point. Three calculation methods were used for oviposition frequency. Where ageing effects were studied, it was not always clear whether oviposition was expressed per still living female or per introduced female.

Immature mortality of *E. formosa* during the white stage and during the total immature development is difficult to quantify. Oviposition behaviour has firstly to be observed and then the number of observed oviposition postures corrected for postures not resulting in oviposition. This means that at first an experiment should be carried out to measure number of oviposition 'failures'. Hulspas-Jordaan (1978) measured 7% oviposition 'failures' when unparasitized L3 larvae were offered. In many of the studies on mortality, the procedure followed has not been specified.

The whitefly density was often not specified in studies on fecundity and oviposition frequency. Mean values differed greatly, as expressed by the low r^2 values in Tables 9 and 10. Oviposition frequency of the parasitoid does not depend on temperature alone, but also on the total number of encounters which is related to whitefly larval density and the searching capacity of the parasitoid. Direct observations of parasitization behaviour and checking for parasitoid eggs at the end of the experiment gives the most reliable assessment.

The coefficients which describe the life-history parameters in relation to temperature and sometimes host stage will be used as inputs in a simulation model of the population dynamics of the parasitoid *E. formosa* in a single whitefly colony. Population dynamics will be explained from integration of individual life-history parameters and their separate effects studied. A different approach will be followed for oviposition frequency, because it does not depend on temperature alone. Whitefly larval density, host plant effects and parasitoid behaviour have also to be taken into account. Thus the coefficients of Tables 9 and 10 will not be used in the simulation model.

The relationship between oviposition frequency (or number of hosts parasitized) and whitefly density is expressed by the functional response, which can be obtained empirically (e.g., Yano, 1987), but experiments often result in estimates for specific situations in which the parasitoid cannot always leave the colony freely. Thus generalizations cannot be made about large whitefly densities under natural conditions. Therefore, in our simulation model of the population dynamics of *E. formosa*, a functional response curve will be used as simulated by a separate model of the parasitization behaviour and not by using measured oviposition frequencies. This model also simulates the number of hosts killed by host feeding (van Roermund, in prep.).

The model of population dynamics of the parasitoid will be used as a submodel in a simulation model of the tritrophic interaction between host plant, greenhouse whitefly and parasitoid (van Roermund & van Lenteren, 1990). Knowledge of such complicated tritrophic systems is important in understanding whether biological control is feasible. It is essential to be able to predict under which conditions biological control will be successful, particularly when new crops and other environmental factors are involved.

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Appendix A1. Development duration (days) of the white stage of *E. formosa* in *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(ef), total number of *Encarsia*'s (ef).

Host stage	Host plant	Cultivar	Temp. (°C)		Duration				Remarks	Reference
			Mean	Range	Mean	cv(%)	n	n(ef)		
L1	Bean	'Canadian Wonder'	18.0		23.2	1.6	40	40		Madueke, 1979
L1	Bean	'Canadian Wonder'	22.5		13.2	3.2	36	36		Madueke, 1979
L1	Bean	'Canadian Wonder'	27.0		11.3	13.5	32	32		Madueke, 1979
L1	Tomato	'Moneydor'	20.0		7.8	-	-	-		Eysackers, 1969
L1	Tobacco	'N.C.2326'	25.0		13.97	22.6	6	6		Nechols & Tauber, 1977a
L2	Bean	'Canadian Wonder'	18.0		21.1	1.3	31	31		Madueke, 1979
L2	Bean	'Canadian Wonder'	22.5		10.7	2.4	41	41		Madueke, 1979
L2	Bean	'Canadian Wonder'	27.0		7.8	5.2	34	34		Madueke, 1979
L2	Bean	-	17.0		21.66	6.2	92	92		Di Pietro, 1977
L2	Bean	-	22.0		12.54	2.7	197	197		Di Pietro, 1977
L2	Tomato	'Moneydor'	20.0		8.1	-	-	-		Eysackers, 1969
L2	Tomato	'Moneydor'	25.0		7.3	-	-	-		Eysackers, 1969
L2	Tobacco	'N.C.2326'	25.0		10.92	24.9	8	8		Nechols & Tauber, 1977a
L3	Bean	'Canadian Wonder'	18.0		19.6	2.4	45	45		Madueke, 1979
L3	Bean	'Canadian Wonder'	22.5		10.3	4.4	41	41		Madueke, 1979
L3	Bean	'Canadian Wonder'	27.0		6.4	7.9	40	40		Madueke, 1979
L3	Bean	-	17.0		19.80	3.8	125	125		Di Pietro, 1977
L3	Bean	-	22.0		10.18	2.6	152	152		Di Pietro, 1977
L3	Tomato	'Moneydor'	20.0		14.8	-	-	28	50%-point	Jansen, 1974
L3	Cucumber	'IVT 71-240'	20.0		14.6	-	-	76	50%-point	Jansen, 1974
L3	Sweet pepper	-	20.0		13.6	-	-	18	50%-point	Jansen, 1974
L3	Tomato	'Moneydor'	25.0		6.8	-	-	21	50%-point	Jansen, 1974
L3	Cucumber	'IVT 71-240'	25.0		6.8	-	-	6	50%-point	Jansen, 1974
L3	Sweet pepper	-	25.0		7.8	-	-	9	50%-point	Jansen, 1974
L3	Tomato	'Moneydor'	15.0		30.1	-	-	-		Eysackers, 1969
L3	Tomato	'Moneydor'	20.0		13.4	-	-	-		Eysackers, 1969
L3	Tomato	'Moneydor'	25.0		7.3	-	-	-		Eysackers, 1969
L3	Tomato	'Moneydor'	30.0		6.3	-	-	-		Eysackers, 1969
L3	Tobacco	'N.C.2326'	25.0		9.53	24.9	6	6		Nechols & Tauber, 1977a
L4	Bean	-	17.0		17.77	4.4	128	128		Di Pietro, 1977
L4	Bean	-	22.0		9.73	2.3	241	241		Di Pietro, 1977
L4	Tobacco	'N.C.2326'	25.0		8.01	31.8	8	8		Nechols & Tauber, 1977a
PP	Tobacco	'N.C.2326'	25.0		8.36	20.6	7	7		Nechols & Tauber, 1977a
PU	Bean	'Canadian Wonder'	18.0		20.8	2.0	35	35		Madueke, 1979
PU	Bean	'Canadian Wonder'	22.5		10.2	17.0	41	41		Madueke, 1979
PU	Bean	'Canadian Wonder'	27.0		6.7	6.4	37	37		Madueke, 1979
PU	Tobacco	'N.C.2326'	25.0		8.88	2.9	2	2		Nechols & Tauber, 1977a
L3+L4	Cucumber	'Gele Tros'	25.0		8.5	-	-	-	egg stage: 4.5 day	Hooy, 1984
L4+PP	Bean	'Canadian Wonder'	18.0		20.0	1.4	50	50		Madueke, 1979 Madueke & Coaker, 1984
L4+PP	Bean	'Canadian Wonder'	22.5		10.0	7.6	40	40		Madueke, 1979 Madueke & Coaker, 1984
L4+PP	Bean	'Canadian Wonder'	27.0		6.5	7.6	38	38		Madueke, 1979 Madueke & Coaker, 1984
L4+PP	Tomato	'Moneydor'	15.0		28.0	-	-	-		Eysackers, 1969
L4+PP	Tomato	'Moneydor'	20.0		12.8	-	-	-		Eysackers, 1969
L4+PP	Tomato	'Moneydor'	25.0		7.8	-	-	-		Eysackers, 1969

Appendix A1 (continued). Development duration (days) of the white stage of *E. formosa* in *T. vaporariorum*.

Host stage	Host plant	Cultivar	Temp. (°C)		Duration				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(ef)		
L4+PP	Tomato	'Moneydor'	30.0		6.9	-	-	-		Eysackers, 1969
L3-PP	Sweet pepper	'Marike'	25.0		7.6	9.6	8	-	50%-point	van Bruggen, 1975
L3-PP	Tomato	'Moneydor'	25.0		7.9	12.6	8	-	50%-point	van Bruggen, 1975
L3-PP	Eggplant	'Claresse'	25.0		6	8.9	8	-	50%-point	van Bruggen, 1975
L3-PP	Cucumber	'IVT 71-240'	25.0		7.8	6.0	8	-	50%-point	van Bruggen, 1975
L3-PU	Bean	'Sarka'	20.0		11.5	7.0	66	66		Laska et al., 1980
L3-PU	Tree tobacco	-	17.0		13.0	-	-	-		Vet & van Lenteren, 1981
L1-PU	-	-	25.0		10	-	-	-		Woets, 1972b
L1-PU	Tree tobacco	-	22.0		12	-	-	-		Delorme et al., 1985
L3	Tomato	'Moneydor'	23.1	25/20	12.8	-	-	50	50%-point	Jansen, 1974
L3	Cucumber	'IVT 71-240'	23.1	25/20	11.7	-	-	43	50%-point	Jansen, 1974
L3	Sweet pepper	-	23.1	25/20	14.0	-	-	3	50%-point	Jansen, 1974
L3+L4	Tomato	'Tropic'	24.0	34/14	7.7	7.0	480	480	temp.sum measured	Osborne, 1982
L3+L4	Tomato	'Moneydor'	11.4	18/7	17.2	4.4	21	21		Christochowitz & van der Fluit, 1981 Christochowitz et al., 1981
L2	Tomato	-	26.7	30/20	11.5	-	-	-	ef density low	Yano, 1988
L3+L4	Tomato	-	26.7	30/20	9.7	-	-	-	ef density low	Yano, 1988
L3+L4	Tomato	-	20.0	25/10	17.9	-	-	-	ef density low	Yano, 1988
L3+L4	Tomato	-	26.7	30/20	9.7	-	-	-	ef density medium	Yano, 1988
L3+L4	Tomato	-	26.7	30/20	10.1	-	-	-	ef density high	Yano, 1988
L3+L4	Tomato	-	20.0	25/10	16.9	-	-	-	ef density medium	Yano, 1988
L3+L4	Tomato	-	20.0	25/10	17.6	-	-	-	ef density high	Yano, 1988
PP+PU	Tomato	-	26.7	30/20	9.7	-	-	-	ef density low	Yano, 1988
-	-	-	22.5	24/21	9	-	-	-	-	Agekyan, 1981
-	-	-	-		11	-	-	-		Milliron, 1940
-	Tomato	-	-		16.5	-	-	-		Speyer, 1927

Appendix A2. Development duration (days) of the black stage of *E. formosa* in *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(ef), total number of *Encarsia*'s (ef).

Host stage	Host plant	Cultivar	Temp. (°C)		Duration				Remarks	Reference
			Mean	Range	Mean	cv(%)	n	n(ef)		
L1	Bean	'Canadian Wonder'	18.0		24.7	-	-	-		Madueke, 1979
L1	Bean	'Canadian Wonder'	22.5		13.9	-	-	-		Madueke, 1979
L1	Bean	'Canadian Wonder'	27.0		7.6	-	-	-		Madueke, 1979
L1	Tomato	'Moneydor'	20.0		13.2	-	-	-		Eysackers, 1969
L1	Tobacco	'N.C.2326'	25.0		7.38	19.3	6	6		Nechols & Tauber, 1977a
L2	Bean	'Canadian Wonder'	18.0		20.8	-	-	-		Madueke, 1979
L2	Bean	'Canadian Wonder'	22.5		12.0	-	-	-		Madueke, 1979
L2	Bean	'Canadian Wonder'	27.0		7.5	-	-	-		Madueke, 1979
L2	Bean	-	17.0		20.0	-	-	-		Di Pietro, 1977
L2	Bean	-	22.0		9.9	-	-	-		Di Pietro, 1977
L2	Tomato	'Moneydor'	20.0		10.4	-	-	-		Eysackers, 1969
L2	Tomato	'Moneydor'	25.0		8.3	-	-	-		Eysackers, 1969
L2	Tobacco	'N.C.2326'	25.0		7.39	28.7	8	8		Nechols & Tauber, 1977a
L3	Bean	'Canadian Wonder'	18.0		20.6	-	-	-		Madueke, 1979
L3	Bean	'Canadian Wonder'	22.5		10.7	-	-	-		Madueke, 1979
L3	Bean	'Canadian Wonder'	27.0		7.7	-	-	-		Madueke, 1979
L3	Bean	-	17.0		21.0	-	-	-		Di Pietro, 1977
L3	Bean	-	22.0		9.1	-	-	-		Di Pietro, 1977
L3	Tomato	'Moneydor'	20.0		13.4	-	-	28	50%-point	Jansen, 1974
L3	Cucumber	'IVT 71-240'	20.0		11.6	-	-	76	50%-point	Jansen, 1974
L3	Sweet pepper	-	20.0		13.4	-	-	18	50%-point	Jansen, 1974
L3	Tomato	'Moneydor'	25.0		8.8	-	-	21	50%-point	Jansen, 1974
L3	Cucumber	'IVT 71-240'	25.0		9.6	-	-	6	50%-point	Jansen, 1974
L3	Sweet pepper	-	25.0		9.0	-	-	9	50%-point	Jansen, 1974
L3	Tomato	'Moneydor'	15.0		26.3	-	-	-		Eysackers, 1969
L3	Tomato	'Moneydor'	20.0		12.2	-	-	-		Eysackers, 1969
L3	Tomato	'Moneydor'	25.0		10.0	-	-	-		Eysackers, 1969
L3	Tomato	'Moneydor'	30.0		10.1	-	-	-		Eysackers, 1969
L3	Tobacco	'N.C.2326'	25.0		7.51	9.5	6	6		Nechols & Tauber, 1977a
L4	Bean	-	17.0		21.5	-	-	-		Di Pietro, 1977
L4	Bean	-	22.0		8.7	-	-	-		Di Pietro, 1977
L4	Tobacco	'N.C.2326'	25.0		7.48	33.3	8	8		Nechols & Tauber, 1977a
PP	Tobacco	'N.C.2326'	25.0		7.60	18.1	7	7		Nechols & Tauber, 1977a
PU	Bean	'Canadian Wonder'	18.0		20.8	-	-	-		Madueke, 1979
PU	Bean	'Canadian Wonder'	22.5		11.2	-	-	-		Madueke, 1979
PU	Bean	'Canadian Wonder'	27.0		7.9	-	-	-		Madueke, 1979
PU	Tobacco	'N.C.2326'	25.0		7.46	5.7	2	2		Nechols & Tauber, 1977a
L3+L4	Cucumber	'Gele Tros'	25.0		8.0	-	-	-		Hooy, 1984
L4+PP	Bean	'Canadian Wonder'	18.0		20.1	-	-	-		Madueke, 1979 Madueke & Coaker, 1984
L4+PP	Bean	'Canadian Wonder'	22.5		11.0	-	-	-		Madueke, 1979 Madueke & Coaker, 1984
L4+PP	Bean	'Canadian Wonder'	27.0		7.8	-	-	-		Madueke, 1979 Madueke & Coaker, 1984
L4+PP	Tomato	'Moneydor'	15.0		24.0	-	-	-		Eysackers, 1969
L4+PP	Tomato	'Moneydor'	20.0		12.0	-	-	-		Eysackers, 1969
L4+PP	Tomato	'Moneydor'	25.0		7.4	-	-	-		Eysackers, 1969

Appendix A2 (continued). Development duration (days) of the black stage of *E. formosa* in *T. vaporariorum*.

Host stage	Host plant	Cultivar	Temp. (°C)		Duration				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(ef)		
L4+PP	Tomato	'Moneydor'	30.0		7.4	-	-	-		Eysackers, 1969
L3-PP	Sweet pepper	'Marike'	25.0		7.2	-	8	57	50%-point	van Bruggen, 1975
L3-PP	Tomato	'Moneydor'	25.0		7.9	-	8	837	50%-point	van Bruggen, 1975
L3-PP	Eggplant	'Claresse'	25.0		9.5	-	8	1691	50%-point	van Bruggen, 1975
L3-PP	Cucumber	'IVT 71-240'	25.0		7.6	-	8	1436	50%-point	van Bruggen, 1975
L3-PU	Bean	'Sarka'	20.0		13.9	-	-	-		Laska et al., 1980
L3-PU	Tree tobacco	-	17.0		18.6	-	-	-		Vet & van Lenteren, 1981
L1-PU	-	-	25.0		10	-	-	-		Woets, 1972b
L1-PU	Tree tobacco	-	22.0		11	-	-	-		Delorme et al., 1985
-	Tomato	-	23.0		10.5	-	-	-		Keymeulen & Degheele, 1977
L3	Tomato	'Moneydor'	23.1	25/20	11.6	-	-	50	50%-point	Jansen, 1974
L3	Cucumber	'IVT 71-240'	23.1	25/20	8.9	-	-	43	50%-point	Jansen, 1974
L3	Sweet pepper	-	23.1	25/20	11.0	-	-	3	50%-point	Jansen, 1974
L3+L4	Tomato	'Tropic'	24.0	28/22	9.0	3.9	70	70	temp.sum measured	Osborne, 1982
L3+L4	Tomato	'Moneydor'	11.4	18/7	22.3	-	-	-		Christochowitz & van der Fluit, 1981 Christochowitz et al., 1981
L2	Tomato	-	26.7	30/20	7.5	-	-	-	ef density low	Yano, 1988
L3+L4	Tomato	-	26.7	30/20	8.9	-	-	-	ef density low	Yano, 1988
L3+L4	Tomato	-	20.0	25/10	17.1	-	-	-	ef density low	Yano, 1988
L3+L4	Tomato	-	26.7	30/20	8.9	-	-	-	ef density medium	Yano, 1988
L3+L4	Tomato	-	26.7	30/20	9.7	-	-	-	ef density high	Yano, 1988
L3+L4	Tomato	-	20.0	25/10	19.1	-	-	-	ef density medium	Yano, 1988
L3+L4	Tomato	-	20.0	25/10	20.6	-	-	-	ef density high	Yano, 1988
PP+PU	Tomato	-	26.7	30/20	10.3	-	-	-	ef density low	Yano, 1988
-	-	-	22.5	24/21	8.5	-	-	-		Agekyan, 1981
-	Tomato	-	16.0	19/13	19.5	-	-	-		Keymeulen & Degheele, 1977
-	-	-	-		17	-	-	-		Milliron, 1940

Appendix A3. Total immature development duration (days) of *E. formosa* in *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(ef), total number of *Encarsia*'s (ef).

Host stage	Host plant	Cultivar	Temp. (°C)		Duration				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(ef)		
L1	Bean	'Canadian Wonder'	18.0		47.9	2.4	37	37		Madueke, 1979
L1	Bean	'Canadian Wonder'	22.5		27.1	6.6	33	33		Madueke, 1979
L1	Bean	'Canadian Wonder'	27.0		18.9	8.4	30	30		Madueke, 1979
L1	Tomato	'Moneydor'	20.0		21.0	3.4	-	-		Eysackers, 1969
L1	Tobacco	'N.C.2326'	25.0		21.35	18.6	6	6		Nechols & Tauber, 1977a
L1	Tobacco	-	25.0		20.2	10.3	12	12		Arakawa, 1982
L2	Bean	'Canadian Wonder'	18.0		41.9	1.4	30	30		Madueke, 1979
L2	Bean	'Canadian Wonder'	22.5		22.7	5.0	39	39		Madueke, 1979
L2	Bean	'Canadian Wonder'	27.0		15.3	5.6	32	32		Madueke, 1979
L2	Bean	-	17.0		41.63	3.8	92	92		Di Pietro, 1977
L2	Bean	-	22.0		22.49	3.2	195	195		Di Pietro, 1977
L2	Tomato	'Moneydor'	20.0		18.5	7.2	-	-		Eysackers, 1969
L2	Tomato	'Moneydor'	25.0		15.6	5.5	-	-		Eysackers, 1969
L2	Tobacco	'N.C.2326'	25.0		18.31	20.7	8	8		Nechols & Tauber, 1977a
L2	Tobacco	-	25.0		17.4	13.4	15	15		Arakawa, 1982
L3	Bean	'Canadian Wonder'	18.0		40.2	2.9	43	43		Madueke, 1979
L3	Bean	'Canadian Wonder'	22.5		21.0	6.2	39	39		Madueke, 1979
L3	Bean	'Canadian Wonder'	27.0		14.1	2.2	38	38		Madueke, 1979
L3	Bean	-	17.0		40.8	3.8	125	125		Di Pietro, 1977
L3	Bean	-	22.0		19.28	3.0	149	149		Di Pietro, 1977
L3	Tomato	'Moneydor'	20.0		28.2	-	-	28	50%-point	Jansen, 1974
L3	Cucumber	'IVT 71-240'	20.0		26.2	-	-	76	50%-point	Jansen, 1974
L3	Sweet pepper	-	20.0		27.0	-	-	18	50%-point	Jansen, 1974
L3	Tomato	'Moneydor'	25.0		15.6	-	-	21	50%-point	Jansen, 1974
L3	Cucumber	'IVT 71-240'	25.0		16.4	-	-	6	50%-point	Jansen, 1974
L3	Sweet pepper	-	25.0		16.8	-	-	9	50%-point	Jansen, 1974
L3	Tomato	'Moneydor'	15.0		56.4	5.0	-	-		Eysackers, 1969
L3	Tomato	'Moneydor'	20.0		25.6	34.6	-	-		Eysackers, 1969
L3	Tomato	'Moneydor'	25.0		17.3	7.5	-	-		Eysackers, 1969
L3	Tomato	'Moneydor'	30.0		16.4	17.3	-	-		Eysackers, 1969
L3	Tobacco	'N.C.2326'	25.0		17.04	17.1	6	6		Nechols & Tauber, 1977a
L3	Tobacco	-	25.0		15.9	11.0	34	34		Arakawa, 1982
L4	Bean	-	17.0		39.31	2.7	128	128		Di Pietro, 1977
L4	Bean	-	22.0		18.38	2.2	235	235		Di Pietro, 1977
L4	Tobacco	'N.C.2326'	25.0		15.49	11.0	8	8		Nechols & Tauber, 1977a
L4	Tobacco	-	25.0		15.0	10.2	58	58		Arakawa, 1982
PP	Tobacco	'N.C.2326'	25.0		15.96	14.8	7	7		Nechols & Tauber, 1977a
PP	Tobacco	-	25.0		15.0	7.5	32	32		Arakawa, 1982
PU	Bean	'Canadian Wonder'	18.0		41.6	3.0	32	32		Madueke, 1979
PU	Bean	'Canadian Wonder'	22.5		21.4	6.5	37	37		Madueke, 1979
PU	Bean	'Canadian Wonder'	27.0		14.6	7.0	32	32		Madueke, 1979
PU	Tobacco	'N.C.2326'	25.0		16.30	3.6	2	2		Nechols & Tauber, 1977a
PU	Tobacco	-	25.0		14.4	9.1	19	19		Arakawa, 1982
L2+L3	Tomato	'Selandia'	18.0		34	14.7	-	-		Stenseth, 1975
										Stenseth, 1976
										Stenseth, 1977
L2+L3	Tomato	'Selandia'	21.0		30	16.7	-	-		Stenseth, 1975

Appendix A3 (continued). Total immature development duration (days) of *E. formosa* in *T. vaporariorum*.

Host stage	Host plant	Cultivar	Temp. (°C)		Duration				Remarks	Reference
			Mean	Range	Mean	cv(%)	n	n(ef)		
										Stenseth, 1976
										Stenseth, 1977
L2+L3	Tomato	'Selandia'	24.0		20	20.0	-	-		Stenseth, 1975
										Stenseth, 1976
										Stenseth, 1977
L2+L3	Tomato	'Selandia'	27.0		15	13.3	-	-		Stenseth, 1975
										Stenseth, 1976
										Stenseth, 1977
L3+L4	Tomato	'Bonnie Best'	18.0		29.5	3.1	70	70		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	21.0		22.9	5.8	177	177		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	24.0		15	9.4	69	69		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	27.0		11.9	4.9	134	134		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	30.0		10	11.2	35	35		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	12.7		>>	-	-	-	from Burnett, 1949	Osborne, 1982
L3+L4	Cucumber	'Gele Tros'	25.0		16.5	-	-	-	egg stage: 4.5 day	Hooy, 1984
L4+PP	Bean	'Canadian Wonder'	18.0		40.1	5.4	46	46		Madueke, 1979
										Madueke & Coaker, 1984
L4+PP	Bean	'Canadian Wonder'	22.5		21.0	7.2	37	37		Madueke, 1979
										Madueke & Coaker, 1984
L4+PP	Bean	'Canadian Wonder'	27.0		14.3	3.3	35	35		Madueke, 1979
										Madueke & Coaker, 1984
L4+PP	Tomato	'Moneydor'	15.0		52.0	-	-	-		Eysackers, 1969
L4+PP	Tomato	'Moneydor'	20.0		24.8	5.3	-	-		Eysackers, 1969
L4+PP	Tomato	'Moneydor'	25.0		15.2	14.1	-	-		Eysackers, 1969
L4+PP	Tomato	'Moneydor'	30.0		14.3	5.2	-	-		Eysackers, 1969
PP+PU	Bean	-	20.0		23.5	3.4	15	15		Kajita, unpubl.
PP+PU	Bean	-	25.0		13.5	2.6	15	15		Kajita, unpubl.
L3-PP	Sweet pepper	'Marike'	25.0		14.8	2.5	8	57	50%-point	van Bruggen, 1975
L3-PP	Tomato	'Moneydor'	25.0		15.8	6.1	8	837	50%-point	van Bruggen, 1975
L3-PP	Eggplant	'Claresse'	25.0		15.5	3.5	8	1691	50%-point	van Bruggen, 1975
L3-PP	Cucumber	'IVT 71-240'	25.0		15.4	2.1	8	1436	50%-point	van Bruggen, 1975
L3-PU	Bean	'Sarka'	20.0		25.4	6.7	66	66		Laska et al., 1980
L3-PU	Tree tobacco	-	17.0		31.6	5.7	786	786		Vet & van Lenteren, 1981
L2-PU	Bean	-	12.5		42.3	-	3	-		Pravisani, 1981
L2-PU	Bean	-	15.0		41	-	3	-		Pravisani, 1981
L2-PU	Bean	-	17.5		32	-	1	-		Pravisani, 1981
L2-PU	Bean	-	20.0		29	-	2	-		Pravisani, 1981
L2-PU	Bean	-	22.5		28	-	2	-		Pravisani, 1981
L2-PU	Bean	-	25.0		25	-	3	-		Pravisani, 1981
L2-PU	Bean	-	27.5		15	-	3	-		Pravisani, 1981
L2-PU	Bean	-	30.0		16	-	3	-		Pravisani, 1981
L2-PU	Bean	-	32.5		13	-	2	-		Pravisani, 1981
L2-PU	Bean	-	35.0		14	-	3	-		Pravisani, 1981
L1-PU	-	-	25.0		20	-	-	-		Woets, 1972b
L1-PU	Tree tobacco	-	22.0		23	-	-	-		Delorme et al., 1985
L2+L3	Tomato	'Selandia'	22.0	24/18	26	15.4	-	-		Stenseth, 1975
										Stenseth, 1976

Appendix A3 (continued). Total immature development duration (days) of *E. formosa* in *T. vaporariorum*.

Host stage	Host plant	Cultivar	Temp. (°C)		Duration				Remarks	Reference
			Mean	Range	Mean	cv(%)	n	n(ef)		
										Stenseth, 1977
L2+L3	Tomato	'Selandia'	25.0	27/21	17	11.8	-	-		Stenseth, 1975
										Stenseth, 1976
										Stenseth, 1977
L3	Tomato	'Moneydor'	23.1	25/20	24.4	-	-	50	50%-point	Jansen, 1974
L3	Cucumber	'IVT 71-240'	23.1	25/20	20.6	-	-	43	50%-point	Jansen, 1974
L3	Sweet pepper	-	23.1	25/20	25.0	-	-	3	50%-point	Jansen, 1974
L3+L4	Tomato	'Tropic'	24.0	34/14	16.7	5.8	239	239	temp.sum measured	Osborne, 1982
L3+L4	Tomato	'Moneydor'	11.4	18/7	39.5	1.7	21	21		Christochowitz & van der Fluit, 1981
										Christochowitz et al., 1981
L2	Tomato	-	26.7	30/20	19.0	-	-	-	ef density low	Yano, 1988
L3+L4	Tomato	-	26.7	30/20	18.6	-	-	-	ef density low	Yano, 1988
L3+L4	Tomato	-	20.0	25/10	35.0	-	-	-	ef density low	Yano, 1988
L3+L4	Tomato	-	26.7	30/20	18.6	-	-	-	ef density medium	Yano, 1988
L3+L4	Tomato	-	26.7	30/20	19.8	-	-	-	ef density high	Yano, 1988
L3+L4	Tomato	-	20.0	25/10	36.0	-	-	-	ef density medium	Yano, 1988
L3+L4	Tomato	-	20.0	25/10	38.2	-	-	-	ef density high	Yano, 1988
PP+PU	Tomato	-	26.7	30/20	20.0	-	-	-	ef density low	Yano, 1988
-	-	-	22.5	24/21	17.5	-	-	-		Agekyan, 1981
-	-	-	-		28	-	-	-		Milliron, 1940
-	Tomato	-	-		>28	-	-	-		Speyer, 1927
-	-	-	-		20	-	-	-		Tonnoir, 1937

Appendix B1. Mortality of the black stage (% of individuals entering the stage) of *E. formosa* in *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(ef), total number of *Encarsia*'s (ef).

Host stage	Host plant	Cultivar	Temp. (°C)		Mortality				Remarks	Reference
			Mean	Range	mean	*cv*(%)	*n*	*n*(ef)		
L1	Bean	'Canadian Wonder'	18.0		7.5	-	40	40		Madueke, 1979
L1	Bean	'Canadian Wonder'	22.5		8.3	-	36	36		Madueke, 1979
L1	Bean	'Canadian Wonder'	27.0		6.3	-	32	32		Madueke, 1979
L2	Bean	'Canadian Wonder'	18.0		3.2	-	31	31		Madueke, 1979
L2	Bean	'Canadian Wonder'	22.5		4.9	-	41	41		Madueke, 1979
L2	Bean	'Canadian Wonder'	27.0		5.9	-	34	34		Madueke, 1979
L2	Bean	-	17.0		0.0	-	92	92		Di Pietro, 1977
L2	Bean	-	22.0		1.0	-	197	197		Di Pietro, 1977
L3	Bean	'Canadian Wonder'	18.0		4.4	-	45	45		Madueke, 1979
L3	Bean	'Canadian Wonder'	22.5		4.9	-	41	41		Madueke, 1979
L3	Bean	'Canadian Wonder'	27.0		5.0	-	40	40		Madueke, 1979
L3	Bean	-	17.0		0.0	-	125	125		Di Pietro, 1977
L3	Bean	-	22.0		2.0	-	152	152		Di Pietro, 1977
L4	Bean	-	17.0		0.0	-	128	128		Di Pietro, 1977
L4	Bean	-	22.0		2.5	-	241	241		Di Pietro, 1977
L4+PP	Bean	'Canadian Wonder'	18.0		8.0	-	50	50		Madueke, 1979
L4+PP	Bean	'Canadian Wonder'	22.5		7.5	-	40	40		Madueke, 1979
L4+PP	Bean	'Canadian Wonder'	27.0		7.9	-	38	38		Madueke, 1979
PU	Bean	'Canadian Wonder'	18.0		8.6	-	35	35		Madueke, 1979
PU	Bean	'Canadian Wonder'	22.5		9.8	-	41	41		Madueke, 1979
PU	Bean	'Canadian Wonder'	27.0		13.5	-	37	37		Madueke, 1979
L3-PU	Tree tobacco	-	17.0		7.7	-	795	795		Vet & van Lenteren, 1981
L2	Tomato	-	26.7	30/20	2.1	-	-	-	ef density low	Yano, 1988
L3+L4	Tomato	-	26.7	30/20	3.5	-	-	-	ef density low	Yano, 1988
L3+L4	Tomato	-	26.7	30/20	5.8	-	-	-	ef density medium	Yano, 1988
L3+L4	Tomato	-	26.7	30/20	20.1	-	-	-	ef density high	Yano, 1988
L3+L4	Tomato	-	20.0	25/10	7.6	-	-	-	ef density low	Yano, 1988
L3+L4	Tomato	-	20.0	25/10	12.4	-	-	-	ef density medium	Yano, 1988
L3+L4	Tomato	-	20.0	25/10	18.4	-	-	-	ef density high	Yano, 1988
PP+PU	Tomato	-	26.7	30/20	14.0	-	-	-	ef density low	Yano, 1988

Appendix B2. Total immature mortality (% of individuals entering the egg stage) of *E. formosa* in *T. vaporariorum*. *cv*, coefficient of variation; *n*, number of replicates; *n*(ef), total number of *Encarsia*'s (ef).

Host stage	Host plant	Cultivar	Temp. (°C)		Mortality				Remarks	Reference
			Mean	Range	Mean	*cv*(%)	*n*	*n*(ef)		
L1	Tobacco	'N.C.2326'	25.0		76	-	-	-	calculated	Nechols & Tauber, 1977a
L1	Tobacco	-	25.0		7.7	-	13	13		Arakawa, 1982
L2	Tobacco	-	25.0		25.0	-	20	20		Arakawa, 1982
L3	Tobacco	'N.C.2326'	25.0		13	-	-	-	calculated	Nechols & Tauber, 1977a
L3	Tobacco	-	25.0		10.5	-	38	38		Arakawa, 1982
L4	Tobacco	'N.C.2326'	25.0		10	-	-	-	calculated	Nechols & Tauber, 1977a
L4	Tobacco	-	25.0		12.1	-	66	66		Arakawa, 1982
PP	Tobacco	'N.C.2326'	25.0		7	-	-	-	calculated	Nechols & Tauber, 1977a
PP	Tobacco	-	25.0		11.1	-	36	36		Arakawa, 1982
PU	Tobacco	'N.C.2326'	25.0		29	-	-	-	calculated	Nechols & Tauber, 1977a
PU	Tobacco	-	25.0		24.0	-	25	25		Arakawa, 1982
-	-	-	22.5	24/21	34.5	-	-	-		Agekyan, 1981

Appendix C. Longevity (days) of *E. formosa*. *cv*, coefficient of variation; *n*, number of replicates; *n*(ef), total number of *Encarsia*'s.

Host stage	Host plant	Cultivar	Temp. (°C)		Longevity				Remarks	Reference
			Mean	Range	Mean	cv(%)	n	n(ef)		
L3	Bean	-	22.0		16.20	40.6	15	15		Di Pietro, 1977
L3+L4	Bean	-	18.0		22.5	43.3	18	18	host during 30 days	Christochowitz & van der Fluit, 1981
										Christochowitz et al., 1981
L4	glass	-	25.0		36.8	18.6	6	6		Arakawa, 1982
L4	Tomato	'Bonnie Best'	12.0		46.0	-	32	32		Burnett, 1949
L4	Tomato	'Bonnie Best'	15.0		31.0	-	31	31		Burnett, 1949
L4	Tomato	'Bonnie Best'	18.0		27.0	-	30	30		Burnett, 1949
L4	Tomato	'Bonnie Best'	21.0		21.5	-	30	30		Burnett, 1949
L4	Tomato	'Bonnie Best'	24.0		15.7	-	30	30		Burnett, 1949
L4	Tomato	'Bonnie Best'	27.0		8.1	-	34	34		Burnett, 1949
L4	Tomato	'Bonnie Best'	30.0		3.9	-	34	34		Burnett, 1949
L4	Tomato	'Bonnie Best'	33.0		2.5	-	32	32		Burnett, 1949
L4	Bean	'Canadian Wonder'	18.0		17.8	52.3	13	13		Madueke, 1979
L4	Bean	'Canadian Wonder'	22.5		14.6	33.8	13	13		Madueke, 1979
L4	Bean	'Canadian Wonder'	27.0		11.4	56.5	14	14		Madueke, 1979
L4	Bean	-	17.0		21.29	53.4	31	31		Di Pietro, 1977
L4	Bean	-	22.0		12.84	54.1	31	31		Di Pietro, 1977
L4	Bean	-	27.0		5.55	32.9	31	31		Di Pietro, 1977
L4	Bean	-	32.0		4.89	42.6	27	27		Di Pietro, 1977
L4-PU	Tobacco	'Bright Yellow'	15.0		47.7	19.9	12	12		Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	20.0		31.9	19.7	12	12		Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	25.0		12.5	32.7	12	12		Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	30.0		6.0	23.6	12	12		Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	35.0		1.8	43.7	12	12		Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	40.0		1.0	0.0	12	12		Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	20.0		28.0	23.4	10	10		Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	25.0		3.0	23.3	10	10	31% RH	Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	25.0		7.0	43.9	10	10	55% RH	Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	25.0		19.0	44.9	10	10	74% RH	Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	25.0		2.2	139.8	10	10	100% RH	Kajita, 1979
PP+PU	Tomato	'Kyoryoku-beiju'	20.0		28.7	23.7	-	-		Kajita, 1989
L1-PU	Bean	-	20.0		51.8	42.4	18	18		Gast & Kortenhoff, 1983
										van Lenteren et al., 1987
L3-PP	Tree tobacco	-	17.0		44.0	-	7	7	host during 20 days	Vet & van Lenteren, 1981
L2	Bean	-	22.0		12.95	50.4	18	18		Di Pietro, 1977
L2+L3	Tomato	'Bonnie Best'	18.0		11.0	-	64	64		Burnett, 1949
L3+L4	Bean	-	11.6	18/7	32.6	62.8	17	17	host during 30 days	Christochowitz & van der Fluit, 1981
										Christochowitz et al., 1981
L3+L4	Tomato	'Moneydor'	11.6	18/7	24.7	73.3	15	15		Burggraaf & van der Laan, 1983
										van der Laan et al., 1982
-	-	-	-		28	-	-	-		Milliron, 1940
No host	Bean	-	25.0		21.6	23.1	216	216	with honeydew	Lopez Avila, 1988
No host	glass	-	15.6		99.3	-	24	24	with honeydew	Vet & van Lenteren, 1981
No host	glass	-	21.1		48.4	-	28	28	with honeydew	Vet & van Lenteren, 1981
No host	glass	-	26.7		35.2	-	20	20	with honeydew	Vet & van Lenteren, 1981
No host	glass	-	13.0		42.9	60.3	30	30	with honeydew	van Vianen & van Lenteren, 1982
										van Lenteren et al., 1987

Appendix C (continued). Longevity (days) of *E. formosa*.

Host stage	Host plant	Cultivar	Temp. (°C)		Longevity				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(ef)		
No host	glass	-	13.0		9.9	30.3	21	21	no food	van Vianen & van Lenteren, 1982 van Lenteren et al., 1987
No host	Tomato	'Bonnie Best'	18.0		5.8	-	50	50	no food	Burnett, 1949
No host	Tomato	'Moneydor'	11.6	18/7	57.6	28.4	13	13	with honeydew	Christochowitz & van der Fluit, 1981
No host	glass	-	20.0		3.2	-	62	62	no food	Gast & Kortenhoff, 1983 van Lenteren et al., 1987
No host	glass	-	20.0		3.4	-	59	59	with water	Gast & Kortenhoff, 1983 van Lenteren et al., 1987
No host	glass	-	20.0		29.1	-	31	31	with honeydew	Gast & Kortenhoff, 1983 van Lenteren et al., 1987
No host	glass	-	20.0		37.4	-	27	27	with honey	Gast & Kortenhoff, 1983 van Lenteren et al., 1987
No host	-	-	22.5	24/21	22.5	-	-	-		Agekyan, 1981
No host	Tomato	-	26.7	30/20	1.5	-	-	-	with water	Yano, 1988
No host	Tomato	-	20.0	25/10	2.5	-	-	-	with water	Yano, 1988

Appendix D. Pre-oviposition period (days) of *E.formosa*. *cv*, coefficient of variation; *n*, number of replicates; *n*(ef), total number of *Encarsia*'s.

Host stage	Host plant	Cultivar	Temp. (°C)		Pre-oviposition period				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(ef)		
L3+L4	Tomato	'Bonnie Best'	18.0		1.60	-	70	70		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	21.0		0.87	-	177	177		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	24.0		0.10	-	69	69		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	30.0		0.06	-	35	35		Burnett, 1949

Appendix E. Fecundity (eggs per female per lifetime) of *E. formosa*. *cv*, coefficient of variation; *n*, number of replicates; *n*(ef), total number of *Encarsia*'s.

Host stage	Host plant	Cultivar	Temp. (°C) Mean	Temp. (°C) Range	Fecundity Mean	Fecundity cv(%)	Fecundity *n*	Fecundity *n*(ef)	Remarks	Reference
L3	Bean	-	22.0		63.13	52.3	15	15		Di Pietro, 1977
L4	Bean	-	17.0		59.59	54.7	31	31		Di Pietro, 1977
L4	Bean	-	22.0		70.45	53.5	31	31		Di Pietro, 1977
L4	Bean	-	27.0		32.13	31.6	31	31		Di Pietro, 1977
L4	Bean	-	32.0		23.15	47.3	27	27		Di Pietro, 1977
L4	glass	-	25.0		442.2	12.1	6	6		Arakawa, 1982
L3+L4	Tomato	'Moneydor'	11.4		0	-	10	10		van der Schaal, 1980
										van Lenteren & van der Schaal, 1981
L3+L4	Bean	-	18.0		223	10.7	30	30		Christochowitz & van der Fluit, 1981
L4+PP	Bean	'Canadian Wonder'	18.0		69.0	69.4	13	13		Madueke, 1979
L4+PP	Bean	'Canadian Wonder'	22.5		160.2	38.5	13	13		Madueke, 1979
L4+PP	Bean	'Canadian Wonder'	27.0		91.1	64.9	14	14		Madueke, 1979
L4-PU	Tobacco	'Bright Yellow'	15.0		75.8	19.9	12	12		Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	20.0		90.3	25.3	12	12		Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	25.0		45.5	41.2	12	12		Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	30.0		23.0	37.6	12	12		Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	35.0		2.6	90.8	12	12		Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	40.0		0.6	209.9	12	12		Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	20.0		91.5	26.0	10	10	74% RH	Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	25.0		7.3	51.7	10	10	31% RH	Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	25.0		21.8	48.7	10	10	55% RH	Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	25.0		59.5	50.5	10	10	74% RH	Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	25.0		2.7	134.6	10	10	100% RH	Kajita, 1979
PP+PU	Tomato	'kyoryoku-beiju'	20.0		96.0	26.4	10	10		Kajita, 1989
L3-PU	Tree tobacco	-	17.0		165.6	19.8	9	9		Vet & van Lenteren, 1981
L1-PU	Bean	-	20.0		259	42.5	18	18		Gast & Kortenhoff, 1983
L1-PU	-	-	25.0		50	-	-	-		Woets, 1972b
-	-	-	25.0		350	-	-	-		Biggerstaff in Parr et al., 1976
-	-	-	20.0		47.3	-	-	-		Ibrahim, 1975
										Madueke, 1979
-	-	-	23.0		127.6	-	-	-		Ibrahim, 1975
										Madueke, 1979
-	-	-	26.0		167.6	-	-	-		Ibrahim, 1975
										Madueke, 1979
-	-	-	-		100	-	-	-		Tonnoir, 1937
-	-	-	-		50	-	-	-		Speyer, 1927
-	-	-	-		135.5	-	-	-		Scheeuwe (pers.comm.)
										Vet et al., 1980
-	-	-	-		50	-	-	-		Milliron, 1940
-	-	-	22.5	24/21	85	-	-	-	between 50-120	Agekyan, 1981
L2	Bean	-	22.0		47.78	66.9	18	18		Di Pietro, 1977
L3+L4	Bean	-	11.6	18/7	99	11.3	24	24		Christochowitz & van der Fluit, 1981
L3+L4	Tomato	'Moneydor'	11.6	18/7	76.7	79.4	15	15	70.8 in publ.	Burggraaf & van der Laan, 1983
										van der Laan et al., 1982
L2	Tomato	'Bonnie Best'	18.0		13.00	53.1	32	32		Burnett, 1949
L3	Tomato	'Bonnie Best'	18.0		12.38	33.2	32	32		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	15.0		15.58	37.7	31	31		Burnett, 1949

Appendix E (continued). Fecundity (eggs per female per lifetime) of *E. formosa*.

Host stage	Host plant	Cultivar	Temp. (°C)		Fecundity				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(ef)		
L3+L4	Tomato	'Bonnie Best'	18.0		28.20	47.2	30	30		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	21.0		28.77	37.2	30	30		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	24.0		32.67	36.7	30	30		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	27.0		30.50	35.4	34	34		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	30.0		9.86	61.4	32	32		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	33.0		2.89	70.6	18	18		Burnett, 1949

Appendix F. Oviposition frequency (eggs per (still living) female per day) of *E. formosa*. *cv*, coefficient of variation; *n*, number of replicates; *n*(ef), total number of *Encarsia*'s.

Host stage	Host plant	Cultivar	Temp. (°C)		Oviposition frequency				Remarks	Reference
			Mean	Range	Mean	*cv*(%)	*n*	*n*(ef)		
L2	Bean	-	22.0		4.45	43.7	18	18		Di Pietro, 1977
L3	Bean	-	22.0		4.25	31.3	15	15		Di Pietro, 1977
L3+L4	Bean	-	18.0		8.0	50.2	30	30		Christochowitz & van der Fluit, 1981 Christochowitz et al., 1981
L4	Bean	-	17.0		3.21	28.1	31	31		Di Pietro, 1977
L4	Bean	-	22.0		6.55	22.9	31	31		Di Pietro, 1977
L4	Bean	-	27.0		7.70	27.6	31	31		Di Pietro, 1977
L4	Bean	-	32.0		5.32	33.4	27	27		Di Pietro, 1977
L4	Glass	-	25.0		20	-	6	6	during 15 days	Arakawa, 1982
L4+PP	Bean	'Canadian Wonder'	18.0		3.3	-	13	13		Madueke, 1979
L4+PP	Bean	'Canadian Wonder'	22.5		11.2	-	13	13		Madueke, 1979
PP+PU	Tomato	'Kyoryoku-beiju'	20.0		2.3	65.2	10	10		Kajita, 1969
L4-PU	Tobacco	'Bright Yellow'	15.0		1.59	-	10	10	fecundity/longevity	Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	20.0		2.83	-	10	10	fecundity/longevity	Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	25.0		3.64	-	10	10	fecundity/longevity	Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	30.0		3.83	-	10	10	fecundity/longevity	Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	35.0		1.44	-	10	10	fecundity/longevity	Kajita, 1979
L4-PU	Tobacco	'Bright Yellow'	40.0		0.6	-	10	10	fecundity/longevity	Kajita, 1979
L3-PU	Tree tobacco	-	17.0		8.3	12.7	9	9		Vet & van Lenteren, 1981
L2-PU	Bean	-	12.5		0	-	-	-		Pravisani, 1981
L1-PU	Bean	-	20.0		4.9	28.6	46	46		Gast & Kortenhoff, 1983
L3+L4	Tomato	-	25.0		4.1	48.2	100	100	during 2 days	Kajita & van Lenteren, 1982
L3+L4	Tomato	'kyoryoku-beiju'	25.0		4.07	48.4	120	120	during 2 days	Kajita, 1983
L3-PP	Cucumber	'IVT 71-240/ 761077Mayak'	24.0		11.5	35.7	10	10	during 3 hours	Hulspas, 1978
L3-PP	Cucumber	'IVT 71-240'	24.0		6.0	60.0	3	3	during 3 hours + honeydew	Hulspas, 1978
L3-PP	Tomato	'Moneymaker'	20.7	23/16	8.75	35.7	12	12	during 1 day	Veerkamp, 1975
L3-PP	Cucumber	'IVT 71-241'	20.7	23/16	8.68	24.1	19	19	during 1 day	Veerkamp, 1975
L1-L4	Bean	'Canadian Wonder'	25.0		15.5	-	47	47	during 1 day	Fransen & van Montfoort, 1987
L1-PU	Tomato	'Moneydor'	11.4		0	0.0	10	10	during 3 hours	van der Schaal, 1980 van Lenteren & van der Schaal, 1981
L1-PU	-	-	25.0		3.5	-	-	-		Woets, 1972b
L1-PU	Bean	-	23.5		0	-	10	10	at night	van Alphen, 1972
L1-PU	Cucumber	-	23.5		0	-	10	10	at night	van Alphen, 1972
-	-	-	-		0	-	30	30	<4200 lux, 16 hours	McDevitt, 1973 Scopes, 1973
-	-	-	-		max.	-	30	30	7300 lux, 16 hours	McDevitt, 1973 Scopes, 1973
L3+L4	Bean	-	11.6	18/7	3.5	59.9	24	24		Christochowitz & van der Fluit, 1981 Christochowitz et al., 1981
L3+L4	Bean	-	11.6	18/7	2.44	-	-	-	bad experiment	Christochowitz & van der Fluit, 1981 Christochowitz et al., 1981
L3+L4	Bean	-	11.6	18/7	2.48	-	-	-	bad experiment	Christochowitz & van der Fluit, 1981 Christochowitz et al., 1981
L3+L4	Tomato	'Moneydor'	11.6	18/7	3.2	31.8	15	15		Burggraaf & van der Laan, 1983 van der Laan et al., 1982

Appendix F (continued). Oviposition frequency (eggs per (still living) female per day) of *E. formosa*.

Host stage	Host plant	Cultivar	Temp. (°C)		Oviposition frequency				Remarks	Reference
			Mean	Range	Mean	cv(%)	*n*	*n*(ef)		
L3+L4	Tomato	'Bonnie Best'	15.0		0.85	26.2	31	31		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	18.0		1.68	45.6	30	30		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	21.0		1.81	27.2	30	30		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	24.0		2.74	36.0	30	30		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	27.0		5.30	36.3	34	34		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	30.0		3.31	47.9	32	32		Burnett, 1949
L3+L4	Tomato	'Bonnie Best'	33.0		2.47	48.1	18	18		Burnett, 1949
L2	Tomato	'Bonnie Best'	18.0		2.13	39.8	32	32		Burnett, 1949
L3	Tomato	'Bonnie Best'	18.0		1.87	30.3	32	32		Burnett, 1949