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Report

Life Table Parameters for Tarnished Plant Bug Models

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Abstract: The tarnished plant bug, *Lygus lineolaris* (Palisot De Beauvois) (TPB), is a highly polyphagous insect that feeds on numerous wild and cultivated host plants. Previous papers have reported the survival and developmental times of immature stages of TPB and the fecundity and longevity of adults on various host plants, but the majority of these studies have used the common green bean as the food source. The life history information reported in these previous studies can be used as parameter estimates in the construction of realistic models depicting the population dynamics of this important insect pest.

Keywords: Tarnished plan bug, life tables, models

Introduction

Tarnished plant bug (TPB), *Lygus lineolaris* (Palisot De Beauvois) feeds on a multitude of crop and wild host plants and is distributed throughout the United States, Canada, and many of the states of Mexico (Kelton 1975, Young 1986). Young (1986) tabulated 328 plants classified to species or subspecies and an additional 57 plants classified to genus that were hosts of the TPB and of these 130 have been classified as economically important. The breadth of research associated with this insect is due, in part, to its economic damage inflicted on agricultural crops that are important in various regions of the United States. In the Delta of Arkansas, Louisiana, and Mississippi, TPB were collected from 169 host species in 36 plant families (Snodgrass et al. 1984), but the importance of these host plants to the population dynamics of TPB varies from location to location and varies at different times of the year.

Models used to examine an insect species' population dynamics are constructed, to a large extent, by incorporation of various life table parameters. Some of the most important life history information includes: survival rate, developmental time of the various life stages, and fecundity and longevity of female adults. Among other factors, these parameters are affected by the host plant and the temperature at the time of development. Although numerous (potentially hundreds) of host plants may have an impact on the ultimate population dynamics of highly polyphagous insects such as TPB (depending on time and area aspects of a model), functional models may be developed using only the most important host plant habitats within an area.

Most studies that have examined the development and survival of TPB on various host plants have been conducted under laboratory conditions. This is understandable due to the difficulties associated with documenting survival and development of specific cohorts of insects under field conditions. Mortality factors associated with development in the "wild" are not accounted for in these laboratory-based studies. Also, the results of these studies are dependent upon the adequate replacement of the plant tissues that were used and may not be indicative of the survival of TPB on a particular host when it has the choice of feeding on multiple structures on a plant host. They have been conducted within a range of temperatures and results reported in various segments of the TPB life cycle. The majority of these studies have examined development of TPB utilizing green beans as the food source. Relatively few studies have examined the development of TPB on row crops.

A compilation of the available life history information from studied host plants is the first step in building realistic life table parameters that may be used in computer models depicting the population dynamics of TPB. The aims of this paper are to compile available references that report at least some life history information on at least one of the many host of TPB and which may be useful in the construction of realistic simulation models of TPB. Some of the information in this paper is reported as survival within a life stage instead of the original reporting of mortality in order to standardize the tables. Also, cumulative survival across multiple instars is broken down into survival within particular an instar when the data was available.

The eggs of TPB are laid directly in parts of the host plant tissue. Since no feeding occurs in this insect stage, the developmental rate should depend mostly on the temperature that is experienced by an egg from the time of oviposition until eclosion. It is possible that environmental conditions associated with the host plant, such as moisture, could impact survival and developmental rates of TPB eggs. Only a few studies have examined the developmental times and survival of TPB eggs, with the majority of these using green beans as the substrate for oviposition (Table 1). The developmental times of eggs from these studies ranges from 42.1 days at 15°C to 5.2 days at 32°C. Other plant substrates are reported by Khattat and Stewart (1977) (Table 2).

Table 1. Proportional emergence and developmental times (days) of TPB eggs laid on green bean.

n	Temp. (C°)	Mean duration	Emergence	Ref.
25	15	42.1	.	2
136	16	17.5	0.62	3
100	16	18.4	0.62	4
33	17	13.6	.	5
33	18	13.6	.	5
64	20	14.7	.	2
100	20	12.5	0.79	4
195	21	11.5	0.78	3
400	22	.	0.79	4
100	24	8.4	0.73	4
36	25	7.2	.	5
66	25	7.6	.	2
.	25	7.5	.	1
.	27	6.9	.	5
175	27	7.2	0.82	3
100	28	6.1	0.56	4
.	30	6.4	.	5
37	30	6.7	.	2
.	32	6.0	.	5
115	32	5.2	0.38	3
84	35	6.0	.	2
100	20-16[a]	12.8	0.74	4
100	24-20[a]	8.7	0.81	4
100	28-24[a]	6.5	0.69	4

[a] Temperatures fluctuated during daylight and dark hours.
Ref. [1]Waters (1943); [2]Ridgway and Gyrisco (1960); [3]Bariola (1969); [4]Khattat and Stewart (1977); [5]Ugine (2012)

Table 2. Proportional emergence of eggs laid on various hosts. Data from Khattat and Stewart (1977).

Host	Host part	n	Temp. C°	Emergence
potato	shoots	400	22	0.8253
wax beans	.	400	22	0.745
peas	sprouts	400	22	0.7405
beans	sprouts	400	22	0.7255
celery	stalks	400	22	0.5515
turnip	stalks	400	22	0.5695
broccoli	.	400	22	0.4098

The most detailed examination of TPB nymph survival and development were conducted using green beans as the host. Ugine (2012) reported survival and developmental time by instar, while Bariola (1969) and Ridgway and Gyrisco (1960) reported only developmental times by instar (Table 3). Other authors reported survival or developmental times by 1st - 3rd and 4th - 5th instars (Table 4). References which report the total developmental times and survival of TPB nymphs on green beans are reported in Table 5 and developmental times from these studies ranged from 12.3 days at 32°C to 37.6 days at 16°C. Development of TPB nymphs on other hosts are reported within various time intervals (Table 6). Only a few studies report survival and developmental times of TPB on row crops and these include cotton (Bariola 1969, and Fleischer and Gaylor 1988) (Table 7), corn (Abel et al. 2010) (Table 8), and soybean (Snodgrass et al. 2010) (Table 9).

Several studies report life history information regarding female TPB adults including: preovipostion period, total female fecundity, daily fecundity, and longevity (Table 10). Again, most of these studies utilized green bean as a food source of both nymphs and adults. The ovipostional period and life-span of female adults generally decreased as rearing temperatures increased. The greatest number of eggs oviposited per female were either overwintering or 1st generation adults collected in Canada and reared on canola (Gerber 1995). These numbers only reflect the numbers of nymphs that emerged and don't take into consideration egg mortality. Overall, reported longevity of males was less than that of females in studies that reported this information (Table 11).

TPB is a serious pest of cotton in the mid-South and understanding the population dynamics of this insect may aid in the implementation of novel insect control tactics. The construction of realistic models depicting this information would be useful for understanding and examining the impact of these potential insect control tactics. The foundation of these models depends on the input of realistic life-history parameters. This compilation of the existing literature should aid in the development and construction of these models.

Table 3. Developmental times (days) and proportional survival of TPB nymphs (by instar) reared on green beans in the laboratory at various temperatures.

1st instar					2nd instar				
n	C°	Mean duration	Survival	Ref.	n	C°	Mean duration	Survival	Ref.
39	16	5.5	.	2	38	16	5.6	.	2
26	17	8.5	0.79	3	23	17	6.0	0.88	3
31	18	6.5	0.94	3	29	18	4.9	0.94	3
26	20	7.0	.	1	19	20	4.8	.	1
48	21	3.5	.	2	45	21	3.0	.	2
8	25	2.9	.	2	8	25	3.2	.	2
48	25	4.8	.	1	26	25	3.1	.	1
36	25	3.9	1.00	3	34	25	3.0	0.94	3
45	27	2.8	.	2	43	27	2.1	.	2
31	27	3.0	0.91	3	29	27	2.6	0.94	3
36	30	3.1	.	1	22	30	2.4	.	1
34	30	3.1	0.97	3	34	30	2.4	1.00	3
48	32	2.6	.	2	47	32	2.0	.	2
30	32	2.9	0.97	3	29	32	2.6	0.97	3
3rd instar					**4th instar**				
n	**C°**	**Mean duration**	**Survival**	**Ref.**	**n**	**C°**	**Mean duration**	**Survival**	**Ref.**
37	16	5.0	.	2	34	16	7.1	.	2
23	17	6.1	1.00	3	21	17	6.9	0.91	3
27	18	5.1	0.93	3	27	18	5.5	1.00	3
18	20	5.5	.	1	17	20	6.0	.	1
42	21	3.5	.	2	42	21	4.0	.	2
7	25	2.6	.	2	7	25	2.0	.	2
18	25	3.3	.	1	18	25	3.3	.	1
34	25	2.8	1.00	3	34	25	3.2	1.00	3
37	27	2.4	.	2	35	27	2.6	.	2
29	27	2.6	1.00	3	29	27	3.0	1.00	3
21	30	2.6	.	1	21	30	2.8	.	1
33	30	2.4	0.97	3	32	30	2.6	0.97	3
45	32	1.9	.	2	42	32	2.4	.	2
29	32	2.3	1.00	3	28	32	2.8	0.97	3

5th instar				
n	C°	Mean duration	Survival	Ref.
33	16	11.7	.	2
21	17	9.9	1.00	3
25	18	8.1	0.89	3
17	20	7.9	.	1
38	21	5.9	.	2
7	25	4.7	.	2
18	25	5.2	.	1
34	25	4.7	1.00	3
34	27	4.2	.	2
29	27	4.3	1.00	3
19	30	4.1	.	1
31	30	3.9	0.97	3
37	32	3.4	.	2
27	32	3.7	0.96	3

Ref. [1]Ridgway and Gyrisco (1960); [2]Bariola (1969); [3]Ugine (2011)

Table 4. Developmental times (days) and proportional survival of TPB nymphs grouped within two age classes (1-3 and 4-5 instars) reared on green beans in the laboratory at various temperatures.

1st - 3rd instars					4th - 5th instars				
n	Temp. (C°)	Mean duration	Survival	source	no.	Temp. (C°)	Mean duration	Survival	Ref.
400	22	.	0.65	8	200	22	.	0.91	3
45	32	6.5	.	1	37	32	5.8	.	2
37	27	7.3	.	1	34	27	6.8	.	2
42	21	10.0	.	1	38	21	9.9	.	2
37	16	16.1	.	1	33	16	18.8	.	2
7	25	8.7	.	1	7	25	6.7	.	2
18	.	.	0.44	2	18	.	.	0.89	4
18	20	17.3	.	6	17	20	13.9	.	1
18	25	11.1	.	6	18	25	8.6	.	1
21	30	8.1	.	6	19	30	6.8	.	1
200	28	6.6	0.48	8	200	28	7.0	0.62	3
200	24	8.0	0.65	8	200	24	8.3	0.75	3
200	20	11.4	0.72	8	200	20	13.8	0.81	3
200	16	18.1	0.76	8	200	16	19.5	0.82	3

Ref. [1]Ridgway and Gyrisco (1960); [2]Bariola (1969); [3]Khattat and Stewart (1977); [4]Fleischer and Gaylor (1988).

Table 5. Total developmental times (days) and proportional survival of TPB nymphs (1st-5th instars) reared on green beans in the laboratory at various temperatures.

n	Temp. (C°)	Mean duration	Survival	Ref.
33	16	34.2	0.73	3
200	16	37.6	0.62	4
33	17	34.8	0.64	6
33	18	28.0	0.73	6
17	20	31.5	.	2
200	20	25.2	0.58	4
38	21	19.7	0.79	3
200	22	.	0.59	4
200	24	16.3	0.49	4
7	25	15.4	.	3
18	25	19.7	.	2
.	25	16.5	.	1
36	25	15.6	0.94	6
7	26.5	14.9	.	5
34	27	13.8	0.76	3
34	27	13.4	0.85	6
200	28	13.6	0.29	4
19	30	14.9	.	2
35	30	12.4	0.89	6
37	32	12.4	0.84	3
31	32	12.3	0.87	6

Ref. [1]Waters (1943); [2]Ridgway and Gyrisco (1960); [3]Bariola (1969); [4]Khattat and Stewart (1977); [5]Fleischer and Gaylor (1988); [6]Ugine (2012).

Table 6. Developmental times (days) and proportional survival of TPB nymphs within indicated age-class reared on various hosts in the laboratory.

Scientific name	Common name	Host part	n	Instar	Temp. (C°)	Mean duration	Survival	Ref.
.	peas	sprouts	400	1-3	22	.	0.67	2
.	peas	sprouts	200	4-5	22	.	0.91	2
.	wax beans	.	400	1-3	22	.	0.63	2
.	wax beans	.	200	4-5	22	.	0.86	2
Apium graveolens	celery	stalks	400	1-3	22	.	0.56	2
Apium graveolens	celery	stalks	200	4-5	22	.	0.76	2
Apium graveolens	celery	stalks	.	all			0.03	1
Brassica oleracea	broccoli	.	400	1-3	22	.	0.46	2
Brassica oleracea	broccoli	.	200	4-5	22	.	0.64	2
Brassica oleracea	broccoli	.	50	all	30	11.66	0.78	5
Brassica oleracea	broccoli	.	50	3-5	30	5.34	0.96	5
Brassica oleracea	broccoli	.	.	all	.	11.5	0.90	6
Brassica septiceps	turnip	stalks	400	1-3	22	.	0.55	2
Brassica septiceps	turnip	stalks	200	4+5	22	.	0.70	2
Daucus carota	carrot	terminal	10	all	18	26.5	.	3
Daucus carota	carrot	terminal	9	all	22	19.89	.	3
Daucus carota	carrot	terminal	13	all	26.5	15.62	.	3
Daucus carota	carrot	terminal	15	all	30	11.33	.	3
Daucus carota	carrot	terminal	79	1-2	18-30	.	0.71	3
Daucus carota	carrot	terminal	79	3	.	.	1.00	3
Daucus carota	carrot	terminal	79	4	.	.	0.94	3
Daucus carota	carrot	terminal	79	5	.	.	0.88	3
Daucus carota	carrot	roots	125	all		.	0.01	1
Erigeron annus	daisy fleabane	terminal	16	all	19	24.88	.	3
Erigeron annus	daisy fleabane	terminal	11	all	22	17.45	.	3
Erigeron annus	daisy fleabane	terminal	16	all	26.5	14.5	.	3
Erigeron annus	daisy fleabane	flowers	50	all	30	13.12	0.76	5
Erigeron annus	daisy fleabane	terminal	22	all	30	10.91	.	3
Erigeron annus	daisy fleabane	terminal	92	1-2	.	.	0.74	3
Erigeron annus	daisy fleabane	terminal	92	3	.	.	1.00	3
Erigeron annus	daisy fleabane	terminal	92	4	.	.	0.99	3
Erigeron annus	daisy fleabane	terminal	92	5	.	.	0.97	3

Scientific name	Common name	Host part	n	Instar	Temp. (C°)	Mean duration	Survival	Ref.
E. annuus + larva	fleabane + larva	terminal	17	all	26.5	13.76	.	3
E. annuus + larva	fleabane + larva	terminal	20	1-2	.	.	0.90	3
E. annuus + larva	fleabane + larva	terminal	20	3	.	.	0.94	3
E. annuus + larva	fleabane + larva	terminal	20	4	.	.	1.00	3
E. annuus + larva	fleabane + larva	terminal	20	5	.	.	1.00	3
E. philadelphicus	Philadelphia fleabane	terminal	24	all	26.5	13.75	.	3
E. philadelphicus	Philadelphia fleabane	terminal	38	1-2	.	.	0.68	3
E. philadelphicus	Philadelphia fleabane	terminal	38	3	.	.	1.00	3
E. philadelphicus	Philadelphia fleabane	terminal	38	4	.	.	0.97	3
E. philadelphicus	Philadelphia fleabane	terminal	38	5	.	.	0.95	3
Lamium amplexicaule	henbit	whole plant	50	all	variable	41.4	0.68	4
Lolium multiflorum	Italian ryegrass	floral spikelets	50	all	30	14.21	0.56	5
Lolium multiflorum	Italian ryegrass	floral spikelets	50	3-5	30	5.3	0.92	5
Onenothera laciniata	evening primrose	terminal	15	all	18	32.27	.	3
Onenothera laciniata	evening primrose	terminal	7	all	22	22.57	.	3
Onenothera laciniata	evening primrose	terminal	14	all	26.5	13.64	.	3
Onenothera laciniata	evening primrose	terminal	12	all	30	12	.	3
Onenothera laciniata	evening primrose	terminal	95	1-2	.	.	0.60	3
Onenothera laciniata	evening primrose	terminal	95	3	.	.	0.93	3
Onenothera laciniata	evening primrose	terminal	95	4	.	.	0.96	3
Onenothera laciniata	evening primrose	terminal	95	5	.	.	0.94	3
Rumex crispus	curly dock	terminal	11	all	18	28	.	3
Rumex crispus	curly dock	terminal	10	all	22	17.1	.	3
Rumex crispus	curly dock	terminal	17	all	26.5	11.29	.	3
Rumex crispus	curly dock	terminal	6	all	30	11.33	.	3
Rumex crispus	curly dock	terminal	78	1-2	.	.	0.62	3
Rumex crispus	curly dock	terminal	78	3	.	.	0.97	3
Rumex crispus	curly dock	terminal	78	4	.	.	0.98	3
Rumex crispus	curly dock	terminal	78	5	.	.	0.95	3

Scientific name	Common name	Host part	n	Instar	Temp. (C°)	Mean duration	Survival	Ref.
R. hastatulus	heartwing sorrel	terminal	16	all	26.5	13.38	.	3
R. hastatulus	heartwing sorrel	terminal	20	1-2	.	.	0.85	3
R. hastatulus	heartwing sorrel	terminal	20	3	.	.	1.00	3
R. hastatulus	heartwing sorrel	terminal	20	4	.	.	0.94	3
R. hastatulus	heartwing sorrel	terminal	20	5	.	.	1.00	3
Solanum tuberosum	potato	shoots	400	1-3	22	.	0.78	2
Solanum tuberosum	potato	shoots	200	4-5	22	.	0.92	2
Trifolium incarnatum	crimson clover	terminal	12	all	18	25.5	.	3
Trifolium incarnatum	crimson clover	terminal	13	all	22	17.69	.	3
Trifolium incarnatum	crimson clover	terminal	14	all	26.5	12.21	.	3
Trifolium incarnatum	crimson clover	terminal	8	all	30	10.75	.	3
Trifolium incarnatum	crimson clover	terminal	72	1-2	.	.	0.67	3
Trifolium incarnatum	crimson clover	terminal	72	3	.	.	1.00	3
Trifolium incarnatum	crimson clover	terminal	72	4	.	.	1.00	3
Trifolium incarnatum	crimson clover	terminal	72	5	.	.	0.97	3
Verbena spp.	vervain	terminal	8	all	18	30.75	.	3
Verbena spp.	vervain	terminal	8	all	22	19	.	3
Verbena spp.	vervain	terminal	7	all	26.5	15.43	.	3
Verbena spp.	vervain	terminal	13	all	30	10.38	.	3
Verbena spp.	vervain	terminal	71	1-2	.	.	0.73	3
Verbena spp.	vervain	terminal	71	3	.	.	1.00	3
Verbena spp.	vervain	terminal	71	4	.	.	0.96	3
Verbena spp.	vervain	terminal	71	5	.	.	0.73	3
Vicia grandiflora	large yello vetch	terminal	13	all	18	33.15	.	3
Vicia grandiflora	large yello vetch	terminal	17	all	22	16.24	.	3
Vicia grandiflora	large yello vetch	terminal	17	all	26.5	12.82	.	3
Vicia grandiflora	large yello vetch	terminal	14	all	30	10.64	.	3
Vicia grandiflora	large yello vetch	terminal	76	1-2	.	.	0.91	3
Vicia grandiflora	large yello vetch	terminal	76	3	.	.	0.95	3
Vicia grandiflora	large yello vetch	terminal	76	4	.	.	0.97	3
Vicia grandiflora	large yello vetch	terminal	76	5	.	.	0.96	3

Ref. [1]Curtis and McCoy (1964); [2]Khattat and Stewart (1977); [3]Fleischer and Gaylor (1988); [4]Snodgrass (2003); [5]Snodgrass et al. (2005); [6]Abel (2010).

Table 7. Developmental times (days) and proportional survival of TPB nymphs within indicated age-structure reared on cotton in the laboratory.

Host part	n	Instar	Temp. (C°)	Mean duration	Survival	Ref.
terminal	10	1	25	2.6	.	1
terminal	9	2	25	3.6	.	1
terminal	9	3	25	3.3	.	1
terminal	9	4	25	3.2	.	1
terminal	8	5	25	4.4	.	1
whole plant	4	all	20	32.75	.	2
terminal	4	all	24	21.3	0.33	1
terminal	8	all	25	17.1	0.53	1
whole plant	7	all	25.5	18.14	.	2
terminal	3	all	26	14.7	0.43	1
whole plant	8	all	27	17.1	0.27	1
whole plant	6	all	30	14.5	.	2
whole plant	54	all	.	.	0.33	2

Ref. [1]Bariola (1969); [2]Fleischer and Gaylor (1988).

Table 8. Total developmental times (days) and proportional survival of TPB nymphs (1st-5th instars) reared on corn in the laboratory at 25° C. Data from Abel et al. (2010).

host part	n	Mean duration	Survival
R3 kernels	30	11.6	0.77
R2-R3 cob tips	30	13.0	0.77
R1 silks	30	17.4	0.50
R1 leaves	30	.	0.00
R1 tassels for 6d and then r2 tassels with no pollen	40	16.6	0.45
R1 tassels for 6d and then r1 silks	40	14.2	0.65
R1 tassels for 6d and then r1 primary ear leaf	40	14.8	0.53

Table 9. Total developmental times (days) and proportional survival of TPB nymphs (1st-5th instars) reared on soybean in the laboratory at 25° C. Data from Snodgrass et al. (2010).

Maturity group	Plant stage	n	Temp. (C°)	Mean duration	Survival
V	pre-bloom	150	25	.	0.00
III	blooming	50	25	19.6	0.18
IV	blooming	200	25	22.67	0.02
V	blooming	450	25	23.67	0.01
VI	blooming	100	25	24	0.02

Table 10. Mean preoviposition periods (days), fecundity, and longevity (days) of TPB female adults reared on various hosts and at varying temperatures.

Nymph host	Adult host	n	Temp. (C°)	Pre-oviposition period	Ovi-position period	Total fecundity	Daily fecundity	Long-evity	Ref.
.	green bean	.	16-29	8.5	.	123.2	2.8	51.9	1
.	celery	.	16-29	12.5	.	30.2	0.9	45	1
.	green bean	.	16-29	11.2	.	6.75	0.5	24.7	1
.	carrot	.	16-29	22.0	.	7.5	0.3	47	1
.	green bean	.	16-29	15.3	.	4.7	0.3	31	1
.	celery +	.	16-29	16.0	.	12.5	0.4	47.2	1
broccoli	green bean	30	25	.	.	49.5	.	.	5
canola	canola	18	22	.	.	239	.	.	4
canola	canola	21	22	.	.	303	.	.	4
canola	canola	18	22	.	.	334	.	.	4
canola	canola	23	22	.	.	250	.	.	4
green bean	potato	20	22	.	.	89.45	.	51.53	3
green bean	green	20	22	.	.	88.4	.	49.9	3
green bean	wax beans	20	22	.	.	86.65	.	49.98	3
green bean	peas	20	22	.	.	88.38	.	48.03	3
green bean	beans	20	22	.	.	84.9	.	43.65	3
green bean	celery	20	22	.	.	83.12	.	36.25	3
green bean	turnip	20	22	.	.	82.73	.	33.05	3
green bean	broccoli	20	22	.	.	70.1	.	25.05	3
green bean	green bean	40	16	25.4	29.0	23.32	0.8	58.1	3
green bean	green bean	7	17	16.5	22.9	111.3	4.4	39.4	6
green bean	green bean	33	18	13.2	21.5	73.6	3.7	34.7	6
green bean	green bean	40	20	12.2	23.5	96.25	4.1	52.35	3
green bean	green bean	.	21	11.5	.	99.4	2.4	54.8	2
green bean	green bean	26	21	9.0	15.5	72.8	5.0	24.5	6
green bean	green bean	40	24	9.5	17.1	82.25	4.8	44.95	3
green bean	green bean	54	25	6.6	19.7	125.7	6.4	26.3	6
green bean	green bean	.	27	8.0	.	77.5	5.8	23.2	2
green bean	green bean	10	27	6.4	21.4	174.7	8.8	27.8	6
green bean	green bean	40	28	7.0	10.8	57.38	5.3	36.98	3
green bean	green bean	36	30	4.9	12.7	110.8	9.5	17.6	6
green bean	green bean	.	32	6.8	.	45.2	4.1	21.6	2
green bean	green bean	39	32	6.2	11.5	77.3	7.0	17.7	6
green bean	green bean	40	20-16	12.9	33.1	78.32	2.4	57.4	3
green bean	green bean	40	24-20	10.0	20.9	89.52	4.3	50.2	3
green bean	green bean	40	28-24	7.4	15.9	82.15	5.2	44.8	3
green	cotton	5	26	8.4	.	53.2	2.7	27.8	2
green	cotton	6	26	13.8	.	32	3.5	29.5	2
R1 corn	green bean	30	25	.	.	12.8	.	.	5
R2-R3 corn	green bean	30	25	.	.	41.7	.	.	5
R3 corn	green bean	30	25	.	.	32	.	.	5

Ref. [1]Curtis and McCoy (1964); [2]Bariola (1969); [3]Khattat and Stewart (1977); [4]Gerber (1995); [5]Abel et al. (2010); [6]Ugine (2012).

Table 11. Mean longevity (days) of TPB male adults reared on various hosts and at varying temperatures.

Nymph host	Adult host	n	Temp. (C)	Longevity	Ref.
.	green bean	.	16.7-	40.7	1
.	celery	.	16.7-	21.5	1
.	green bean +	.	16.7-	19.3	1
.	carrot	.	16.7-	33	1
.	green bean +	.	16.7-	20	1
.	celery and carrot	.	16.7-	33.7	1
green bean	potato	20	22	37.78	3
green bean	green bean	20	22	35.98	3
green bean	wax beans	20	22	32.98	3
green bean	peas	20	22	33.85	3
green bean	beans	20	22	31.5	3
green bean	celery	20	22	27.75	3
green bean	turnip	20	22	25.48	3
green bean	broccoli	20	22	20.25	3
green bean	green bean	40	16	41.2	3
green bean	green bean	7	17	38.7	4
green bean	green bean	33	18	32.6	4
green bean	green bean	40	20	32.9	3
green bean	green bean	.	21	20.9	2
green bean	green bean	26	21	.	4
green bean	green bean	40	24	26.52	3
green bean	green bean	54	25	29.2	4
green bean	green bean	.	27	17.5	2
green bean	green bean	10	27	26.1	4
green bean	green bean	40	28	17.3	3
green bean	green bean	36	30	18.9	4
green bean	green bean	.	32	11.1	2
green bean	green bean	39	32	19.7	4
green bean	green bean	40	20-16	40.1	3
green bean	green bean	40	24-20	31.4	3
green bean	green bean	40	28-24	25.4	3
green bean/cotton	cotton terminal	2	26	16	2
green bean/cotton	cotton terminal	4	26	21.3	2

Ref. [1]Curtis and McCoy (1964); [2]Bariola (1969); [3]Khattat and Stewart (1977); [4]Ugine (2012).

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