CHAPTER FOUR

Results

4.1 Laboratory Experiment

4.1.1 Stock Culture of *Ostrinia furnacalis* (Guenee)

Mass culture of the Asian corn borer, *Ostrinia furnacalis* (Guenee), was greatly facilitated by using artificial diet by Zhou et al. (1980). The overwintering larvae collected from field were reared under the optimum conditions, 25 ± 0.5°C, relative humidity 70 ± 0.4%, and photophase of light with dark 16 : 8 hours. The mean number of eggs laid per female was 224.9 ± 9.8 eggs. The time required at 25 ± 0.5°C were 5 ± 0.6 days for egg stage. The length for the larval stages was 23 ± 0.8 days. After the fifth molt larvae entered the pupal stage and completed this phase within 10 ± 0.8 days. After copulation one fertilized females carried 224.9 ± 9.8 eggs and being laid over a period of about 7 days. The hatching rate of eggs at 25 ± 0.5°C, 70 ± 0.4% RH and photophase 16 hours was 80%; the rate of pupation was 75%; and the rate of adult emergence was 60%.

4.1.2 The Effect of Temperature on the Duration of Development of *Ostrinia furnacalis* (Guenee)

The results obtained from this experiment revealed that as the temperature increased, the developmental time of egg stage decreased in the range of temperature from

12 to 26°C (Table 1). When the reciprocals of these duration were plotted against the temperature, the points formed a relatively straight line, the velocity line,between the temperatures 12°C and 26°C. Since 30°C and 34°C were out of the linear part, so they were not used in the calculation of the minimum developmental threshold in egg stage. The minimum developmental threshold temperature by simple linear regression of developmental rate as a function of temperature taken from the linear part (12, 14, 16, 18, 22, and 26°C) of the developmental rate curve, and then extrapolating to zero so that the minimum developmental threshold temperature of egg stage was determined as 10.34 ± 0.02°C (Figure 1). The data suggested averaging all degree-days associated with all treatment temperatures acquired the degree-days for egg stage was: 79.15 ± 5.18.

According to the method suggested by Stinner et al. (1974), the values of C, k_1, and k_2 were determined by SYSTAT Pro (SYSTAT Inc. 1990), then, the topt was determined visually from developmental rates versus constant temperature. From Figure 1 the upper limit temperature (topt) for this species at egg stage would be near 28°C. However, no estimates of the variability of model predictions were provided by SYSTAT program.

The developmental time of egg stage was decreased at each rise temperature treatments up to 28°C. The developmental time of egg stage was significantly by different constant temperature treatments (F = 7.84; DF = 7, 24; P < 0.0001). The comparisons of mean of developmental time in egg stage were determined by Least Significant Difference method (LSD) (Statistix 1985) (Table 1).

No eggs hatched at 10°C but very few eggs hatched at 12°C. The hatching rates out of 50 in egg stage also were significantly different by various constant temperature treatments. F = 39.46 ; DF = 7, 21; P < 0.0001. The comparisons of mean of survival rate were taken by LSD presented in Table 2. Mortality was significantly great at extreme

Table 1. The developmental time (days) of Asian corn borer, *Ostrinia furnacalis*, from egg to adult emergence at different temperatures and 70% RH with 16 hours photophase.

Temp (°C)	Stage and duration of development (Mean + S.E)[1, 2]							
	Egg	1st instar	2nd instar	3rd instar	4th instar	5th instar	Pupa	Egg to Adult
10	no hatch	-	-	-	-	-	-	-
12	$36.8^{a} \pm 5.12$	$21.5^{a}\pm0.65$	$15.5^{a}\pm3.23$	$14.8^{a}\pm3.48$	no maturity	-	-	-
14	$28.5^{ab}\pm1.19$	$18.3^{b}\pm0.86$	$13.3^{a}\pm1.11$	$12.0^{a}\pm0.92$	$15.8^{a}\pm0.48$	$36.8^{a}\pm1.03$	$43.5^{a} \pm 2.85$	$168.44^{a} \pm1.87$
16	$16.3^{bc}\pm1.25$	$10.8^{c}\pm0.86$	$7.8^{b}\pm0.48$	$7.3^{b}\pm0.63$	$9.5^{b}\pm0.92$	$23.5^{b}\pm1.26$	$25.3^{b} \pm 2.29$	$100.50^{b} \pm1.80$
18	$10.8^{c}\pm0.75$	$7.3^{d}\pm0.48$	$5.5^{bc}\pm0.65$	$4.5^{bc}\pm0.63$	$6.3^{bc}\pm0.75$	$16.5^{c}\pm0.75$	$17.8^{c} \pm 0.86$	$68.70^{c} \pm1.37$
22	$6.5^{c}\pm0.95$	$4.8^{e}\pm0.48$	$3.8^{c}\pm0.48$	$4.0^{bc}\pm0.71$	$4.3^{cd}\pm0.75$	$9.8^{d}\pm0.75$	$12.0^{d} \pm 0.41$	$45.20^{d} \pm1.33$
26	$4.3^{c}\pm0.85$	$3.5^{ef}\pm0.29$	$2.8^{c}\pm0.63$	$2.8^{c}\pm0.85$	$3.0^{cd}\pm0.41$	$8.3^{de}\pm0.41$	$9.5^{de} \pm 0.65$	$34.20^{de} \pm1.28$
30	$4.5^{c}\pm1.50$	$2.8^{f}\pm0.25$	$2.5^{c}\pm0.65$	$2.0^{c}\pm0.75$	$2.5^{d}\pm0.65$	$6.8^{e}\pm0.65$	$6.5^{e} \pm 0.65$	$27.60^{e} \pm1.46$
34	$4.8^{c}\pm2.50$	$3.5^{ef}\pm0.65$	1.8 ± 0.48	$2.7^{c}\pm0.65$	$2.8^{cd}\pm0.48$	$6.3^{e}\pm0.48$	$7.3^{e} \pm 0.48$	$29.20^{e} \pm1.68$

[1] Mean of four replicates. Initial numbers of egg at each replicate = 50.

[2] Data were analyzed by analysis of variance and LSD test; all treatments F-values were highly significant ($P << 0.01$); treatment means within a column not followed by the same letter are significantly different ($P < 0.05$).

S.E. = The standard error associated with the means.

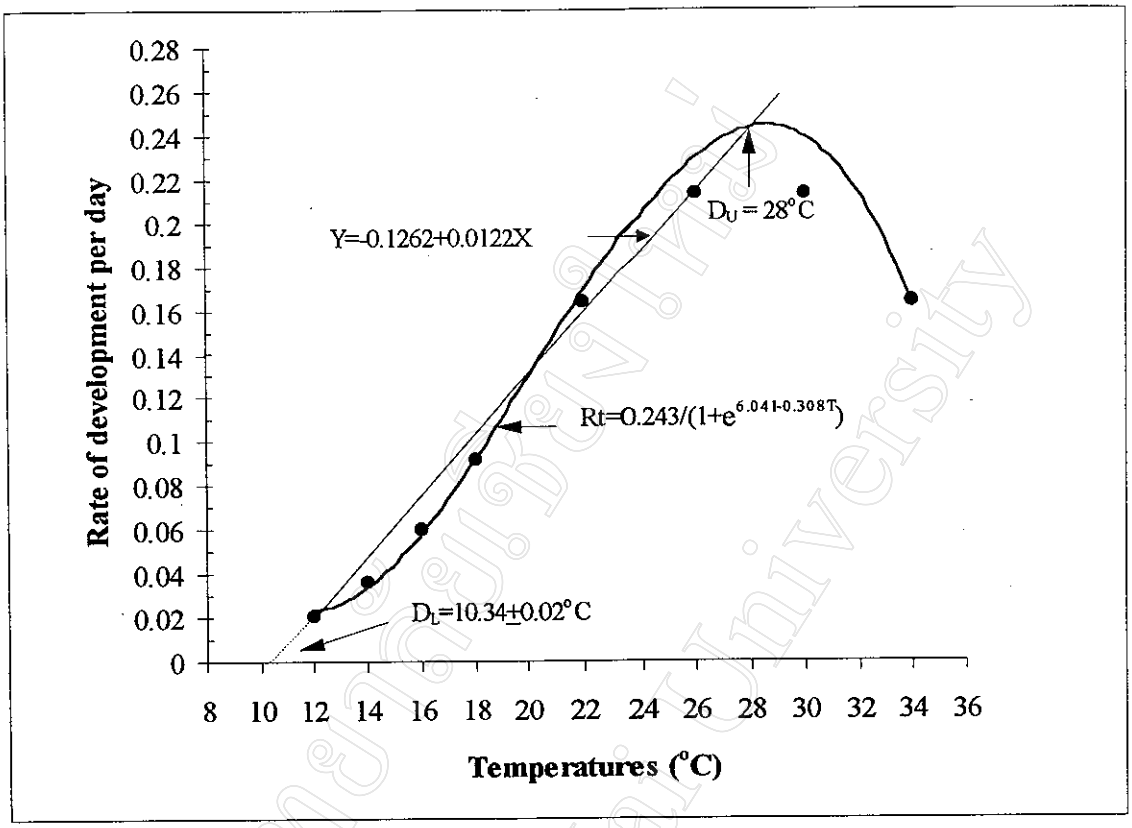

Figure 1. Estimated relationship between daily developmental rate and constant temperatures for *Ostrinia furnacalis* for the period from newly deposited egg to egg hatching.

Table 2. The survival rate of Asian corn borer, *Ostrinia furnacalis*, from the egg to adult at different constant temperatures and 70 RH with 16 hours photophase.

Temp (°C)	Stage and duration of development (Mean + S.E)						
	Egg	1st instar	2nd instar	3rd instar	4th instar	5th instar	Pupa
10	no hatch	-	-	-	-	-	-
12	$3.8^{e} \pm 1.03$	$3.8^{e} \pm 0.86$	$2.8^{e} \pm 1.40$	$2.5^{e} \pm 1.18$	no maturity	-	-
14	$18.0^{d} \pm 2.97$	$18.0^{d} \pm 3.82$	$16.3^{d} \pm 1.85$	$15.5^{cd} \pm 3.23$	$14.5^{d} \pm 2.10$	$10.1^{de} \pm 3.12$	$4.0^{de} \pm 0.92$
16	$25.3^{d} \pm 0.75$	$25.3^{cd} \pm 1.25$	$23.0^{cd} \pm 0.91$	$21.5^{bc} \pm 2.85$	$16.0^{cd} \pm 1.47$	$15.0^{cd} \pm 1.83$	$8.0^{d} \pm 2.20$
18	$31.3^{c} \pm 1.65$	$31.3^{bc} \pm 2.78$	$28.3^{bc} \pm 1.82$	$26.3^{b} \pm 0.86$	$21.3^{c} \pm 2.02$	$19.5^{c} \pm 2.33$	$14.0^{c} \pm 1.83$
22	$37.0^{ab} \pm 0.92$	$37.0^{ab} \pm 1.47$	$35.0^{ab} \pm 1.81$	$33.0^{a} \pm 2.20$	$30.0^{a} \pm 2.04$	$27.8^{b} \pm 1.65$	$21.0^{b} \pm 1.29$
26	$39.0^{a} \pm 0.92$	$39.0^{a} \pm 1.47$	$37.0^{a} \pm 1.25$	$34.0^{a} \pm 2.20$	$32.0^{ab} \pm 2.58$	$31.0^{ab} \pm 0.82$	$26.0^{a} \pm 1.29$
30	$41.8^{a} \pm 1.29$	$41.8^{a} \pm 1.65$	$38.5^{a} \pm 1.20$	$37.5^{a} \pm 1.04$	$36.0^{a} \pm 1.83$	$35.0^{a} \pm 0.92$	$29.0^{a} \pm 1.69$
34	$22.0^{d} \pm 2.11$	$22.0^{d} \pm 2.2$	$16.0^{d} \pm 1.00$	$14.8^{d} \pm 3.2$	$8.3^{e} \pm 0.86$	$6.8^{e} \pm 1.85$	$3.3^{e} \pm 0.75$

[1] Mean of four replicates. Initial numbers of larval stage at each replicate = 50.

[2] Data were analyzed by analysis of variance and LSD test; all treatments F-values were highly significant ($P < 0.01$); treatment means within a row not followed by the same letter are significantly different ($P < 0.05$).

S.E. = The standard error associated with the means.

temperatures for eggs than eggs at moderate temperatures.

The influence of temperature to the developmental rate (1/days) of Asian Corn Borer larvae were showed in Table 1. The developmental rate increased as temperature increased except 34°C. The results of F test revealed that the developmental time was significantly differ by constant temperature treatments.

For first instar $F = 144.27$; $DF = 7, 24$; $P < 0.00001$. For second instar $F = 15.95$; $DF = 7, 24$; $P < 0.00001$. For third instar $F = 11.56$; $DF = 7, 24$; $P < 0.00001$. For fourth instar $F = 59.93$; $DF = 6, 21$; $P < 0.00001$. For fifth instar $F = 188.84$; $DF = 6, 21$; $P < 0.00001$. The developmental time of total combined larval stage was also significantly different by temperature treatments. $F = 192.6$; $DF = 6, 21$; $P < 0.00001$. The comparisons of mean of developmental rate with each instar and the total combined stages affected by various temperature were taken with LSD method (Statistix 1985) (Table 1).

In larval stage, the linear part (14, 16, 18, 22, 26, and 30°C) of the developmental rate (1/days) relating to various constant temperatures was employed for each instar and the total combined instars of larva to construct linear regression equations. Because each instar and the total combined instars of larva were similarly responded to this linear part and development of them at 12°C did not through third instar and 34°C outside the linear segment of growth curve therefore they were not included in the linear equations. Series of simple linear equations for each instar and the combined total instars of Asian corn borer larvae were developed according to the data in Table 1. For each instar and the total combined instars of larvae, the minimum threshold temperatures ranged from a low of 9.70 ± 0.02°C at second instar to a high of 10.92 ± 0.008°C at fourth instar. The other minimum threshold temperatures were: 10.88 ± 0.003°C for first instar; 10.33 ± 0.03°C for third instar; 10.03 ± 0.006°C for fifth instar; and 10.06 ± 0.01°C for total combined instars. Degree-days for each instar was calculated according to their individual minimum threshold temperature with developmental time. First instar and fifth instar required relatively more degree-days which was 51.90 ± 4.32 and 136.37 ± 4.16, respectively. They were in concert with their longer developmental times. Other instars had some less degree-days, that is, second instar was 46.81 ± 2.18; third instar was 42.31 ± 3.94; fourth instar was 49.53 ± 2.41; and the total combined instars, the degree-days was 336.73 ± 12.71.

In the same way, sigmoid growth models developed by Stinner et al. (1974) in each instar and the total combined instars of larvae were used to estimate the upper threshold temperatures for each of them. The results showed that sigmoid developmental equations were consistent with these data, as indicated by R^2 values > 0.90 with the exception of 0.835 at third instar. Upper threshold temperature values for larval stage were 32, 35, 31, 30, 35 and 31°C for first, second, third, fourth, fifth instar, and the total combined instars, respectively. The variability of model in each stage of larva was not available in SYSTAT Pro.. The developmental rate curve of the total combined larval instars of Asian corn borer was presented in Figure 2.

The data from Table 2 suggested that the survival rate increased as temperature increased continuously with each higher temperature in larval stage. From temperatures between 14 and 18°C survival rates out of 50 were 10.1 at the 14°C, 15.0 at the 16°C, and 19.5 at the 18°C, respectively. Between temperature 22 and 30°C, the survival rate was obviously increased. The survival rates out of 50 at 22°C were 27.8 and 31.0 at 26° C, respectively. Up to 30°C, the survival rate arrived to the maximum, 35.0. However, at 12°C, larvae could survive through the third instar, but could not survive through fourth instar. At 34°C, only about 7 individuals out of 50 initial individuals survived. In larval stage, extreme temperatures at lower and higher were obviously decreased the survival rates. The statistical analysis revealed that the survival rates of total larval stage was also

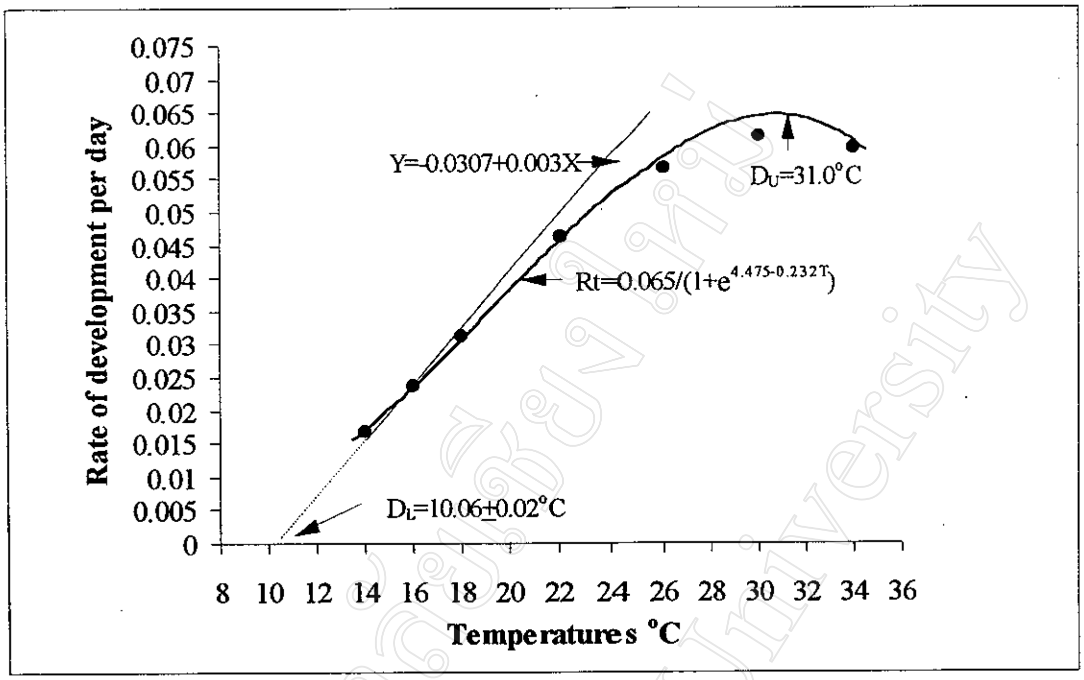

Figure 2. **Estimated relationship between daily developmental rate and constant temperatures for *Ostrinia furnacalis* for period from first instar larva to the pupation.**

significantly differ by temperature treatments. F = 88; DF = 7, 24; P < 0.0001. The comparisons of mean of survival rate affected by various temperature to each instar were taken with Least Significant Difference method (LSD) (Statistix 1985) (Table 2).

When the temperature-duration data (Table 1) were plotted for the pupal stage the developmental curve was formed (Figure 3). This velocity line was straight between 14°C and 30°C. The minimum threshold temperature and degree-days of pupal stage were determined by linear equation. The linear equation did not include 34°C .

The developmental time decreased as the treatment temperatures increased at the pupal stage. The minimum time of development occurred at 30°C, averaging 6.5 days. The growth rate reached to maximum at this temperature. The developmental time was significantly by temperature treatments. F = 56.2; DF = 6, 21; P < 0.00001. The comparisons of the means of developmental rate in pupal stage by various constant temperature treatments were taken with Least Significant Difference method (LSD) (Statistix 1985) (Table 1).

From the estimation, minimum threshold temperature of pupal stage was determined to be 11.07 ± 0.008°C using linear part (14, 16, 18, 22, 26, and 30°C), the degree-days was 128.02 ± 3.99. Upper limited threshold temperature was estimated by Stinner's et al. (1974) equation. Upper threshold was near 31.0°C.

From 14°C to 30°C, the number of Asian corn borer from newly pupation to adult emergence was gradually increased. Up to 30°C the emergence adults arrived to maximum survival rate. However, the numbers of adult emergence drastically decreased when temperature was over 30°C. Only was 3.3 emergence adults out of 50 at 34°C, which was the one tenth of that at 30°C. The survival rate of pupal stage was significantly different by temperature treatments . F = 49.11; DF = 6, 21; P < 0.00001. Mortality was significantly greater at temperature extremes 14 and 34°C for pupa. The comparisons the

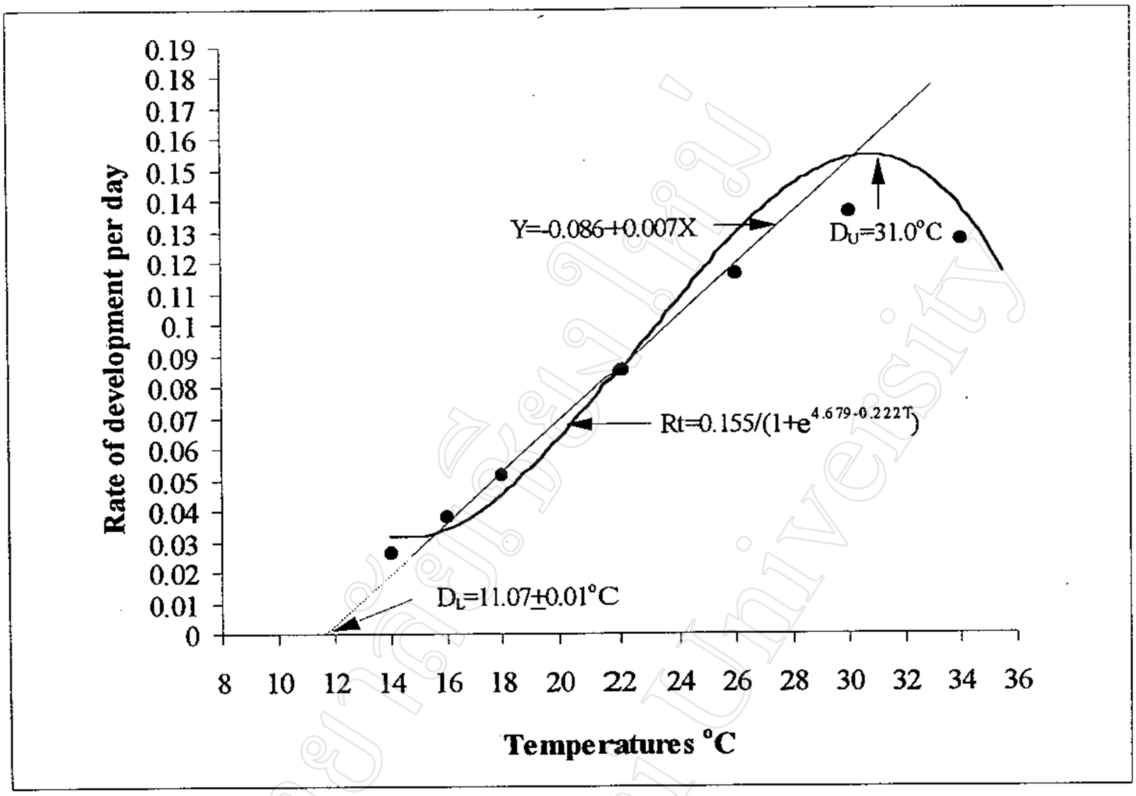

Figure 3. Estimated the relationship between daily developmental rate and constant temperatures for Asian corn borer during the period from newly pupation to adult emergence.

means of survival rate in pupal stage by constant temperature treatments were also taken with LSD method (Statistix 1985) (Table 2).

The data from laboratory experiments involving the effects of different constant temperatures on the duration of egg, larval, and pupal stages were combined so that these effects could be correlated with the combined developmental stages of Asian corn borer.

It should be noted that approximately 17% of the total duration of the immature stage was spent in the egg stage, about 57% in the larval stage, and about 25% in the pupal stage. The elapsed time from deposition of eggs to adult emergence of Asian corn borer varied from about 28 days at 30°C to about 168 days at 14°C. The minimum developmental threshold of combined immature stages from egg to adult was captured by the linear part of velocity line within 14, 16, 18, 22, 26, and 30°C. When they extrapolated to zero, the lower developmental threshold was determined at 10.35 ±0.02° C. In like manner, the degree-day required for combined immature stage was estimated as the individual immature stages. The degree-day was 539.51 ± 8.62. Upper limited threshold also determined by Stinner's equation and calculated the value as near 32.0°C (Figure 4).

Table 3 presented a series of developmental linear equations, sigmoid developmental equations, and R^2 values. The minimum and maximum threshold temperatures for each stage or event of Asian corn borer were presented in this table. The degree-days required for each developmental stage were also included in this table.

4.1.3 Life Table Study of *Ostrinia furnacalis* (Guenee)

The calculation of age-specific mortality for each developmental stage of Asian corn borer in laboratory were derived. To achieve standardization, eggs less than 24 hour

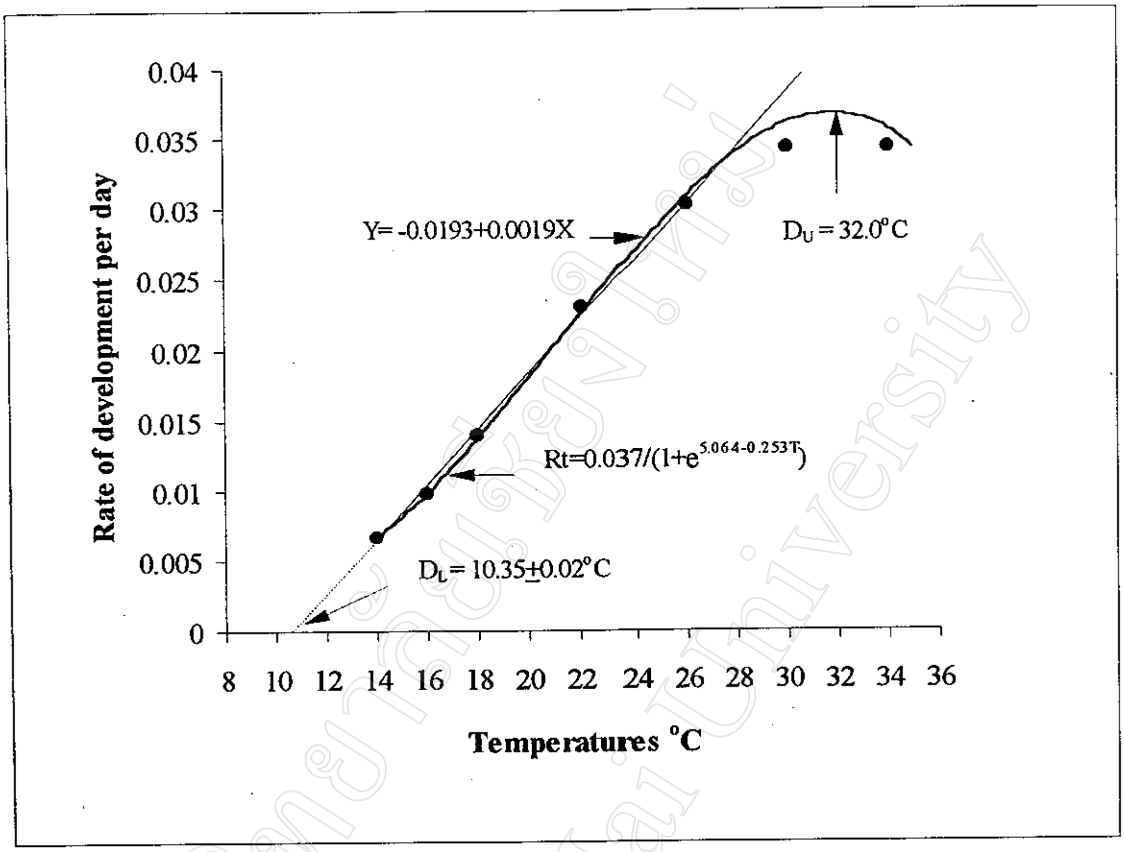

Figure 4. **The relationship between daily developmental rate and constant temperatures for Asian corn borer during the immature stages from newly deposited egg to adult emergence.**

Table 3. Equations correlating rate of development with constant temperature, and theoretical thresholds of development for *Ostrinia furnacalis*, at various constant temperatures and 70% RH with 16 hours photophase.

Stage	Theoretical thresholds			Equation[d]	R^2
	D_L[a]	D_U[b]	Degree-days[c]		
Egg	10.38±0.02	28.0	79.15±5.18	$Y = -0.170857+0.015072X$	0.978
				$R_t = 0.226/(1+e^{6.499-0.343T})$	0.956
1st instar	10.88±0.003	32.0	51.90±4.32	$Y = -0.205 + 0.019X$	0.999
				$R_t = 0.337/(1+e^{5.503-0.280T})$	0.922
2nd instar	9.70±0.02	35.0	46.81±2.18	$Y = -0.201 + 0.021X$	0.986
				$R_t = 0.755/(1+e^{3.720-0.136T})$	0.986
3rd instar	10.33±0.03	31.0	42.31±3.94	$Y = -0.250 + 0.024X$	0.970
				$R_t = 0.465/(1+e^{4.523-0.228T})$	0.835
4th instar	10.92±0.008	30.0	49.53±2.41	$Y = -0.233 + 0.021X$	0.997
				$R_t = 0.391/(1+e^{5.391-0.272T})$	0.930
5th instar	10.03±0.006	35.0	136.37±4.16	$Y = -0.076 + 0.008X$	0.985
				$R_t = 0.174/(1+e^{4.434-0.209T})$	0.973
Combined instar	10.06±0.01	31.0	336.73±12.71	$Y = -0.031 + 0.003X$	0.997
				$R_t = 0.065/(1+e^{4.475-0.232T})$	0.997
Pupa	11.07±0.007	31	128.82±3.99	$Y = -0.086+0.007X$	0.975
				$R_t =0.155/(1+e^{4.679-0.222T})$	0.945
Egg to adult	10.35±0.02	32.0	539.91±8.62	$Y = -0.01925+0.00186X$	0.998
				$R_t =0.037/(1+ e^{5.064-0.253T})$	0.989

[a] Minimum threshold temperature determined from the linear equation

[b] Upper threshold temperature determined from the sigmoid equation

[c] Degree-days for each developmental stage.

[d] Y is developmental rate (1/day) of linear equation in Stinner's et al (1974) equation; X is constant temperature. R_t is developmental rate (1/day) of Stinner's et al (1974) equation; T is constant temperature.

old were used to investigate the cohort life tables. Sequential examination of development of individuals showed that the mortality of Asian corn borer occurred sequentially in the successive developmental stages. Stages at which death occurred were recorded. The results suggested that the influence of temperature on the mortality of Asian corn borer differed during various life stages and larval instars.

Within temperature regime of 26, and 30°C, either mortality or K values were obviously lower in the whole generation of Asian corn borer than those treated by other temperatures in this experiment. The data in Table 4-5 showed that 26°C and 30°C were suitable temperature regime for the development of Asian corn borer. Results from Table 4 revealed that total K value was 0.284 at 26°C. The mortality and k-value in egg stage were 0.220 and 0.108, respectively. In larval stage, the k-values from first instar to fifth instar were 0.023, 0.036, 0.027, 0.014, and 0.029 respectively. In 30°C, the total K value arrived to the least value which was only 0.237 within whole temperature treatments. The k-values treated by 30°C at egg stage was 0.078 and at pupal stage was 0.070. The k-values at larval stage from first to fifth instar were 0.036, 0.011, 0.018, 0.012, and 0.012 respectively. The mortality was lower in larval stage at either 26°C or 30°C when compared to the egg and pupal mortalities. More than 50 percent of Asian corn borer became adult insects at 26°C and 30°C respectively (Table 4-5). Compared to the mortality in the temperature 26°C and 30°C, however, the temperature 30°C might be the optimum temperature to the development of Asian corn borer.

At the temperature 10°C no any eggs could hatching and at temperature 12°C the Asian corn borer could only survive through third instar but could not survive through the late stages of larvae. When Asian corn borer reared under 34°C condition, all of the mortality and k-values and K were very high, particularly compared with those in moderate temperature.

Table 4. Life table for the Asian corn borer, *Ostrinia furnacalis*, reared under laboratory conditions at 26°C and 70% RH with a 16 hour photophase.

x	l_x[a]	d_x	q_x	k_x
Egg	1000	220	0.220	0.108
Larva				
1st instar	780	40	0.051	0.023
2nd instar	740	60	0.081	0.036
3rd instar	680	40	0.059	0.027
4th instar	640	20	0.031	0.014
5th instar	620	40	0.065	0.029
Pupa	580	60	0.103	0.047
Adult	520	-	K =	0.284

[a] 200 eggs at start and 104 adults at completion.

Table 5. Life table for the Asian corn borer, *Ostrinia furnacalis*, reared under laboratory conditions at 30°C and 70% RH with a 16 hour photophase.

x	l_x[a]	d_x	q_x	k_x
Egg	1000	165	0.165	0.078
Larva				
1st instar	835	65	0.078	0.036
2nd instar	770	20	0.026	0.011
3rd instar	750	30	0.040	0.018
4th instar	720	20	0.028	0.012
5th instar	700	20	0.029	0.012
Pupa	680	100	0.147	0.070
Adult	580	-	K =	0.357

[a] 200 eggs at start and 116 adults at completion.

The mortalities on the extreme temperatures (10, 12, 14, and 34°C) were obviously high within overall immature stages. Similar trends of the k-values also were reflected on the extreme temperatures. The total K value was 1.10 at 14°C and 1.15 at 34°C, respectively. Otherwise, the K values were relatively lower at those moderate temperatures. During the range of temperatures from 16°C to 18°C, the K values had the tendency to become lower.

The k-values of egg stage within overall temperature treatments were higher than those of other life stages. Evident instances were on the extreme temperatures, the k-value was 0.443 at 14°C and 0.356 at 34°C, respectively. The k-values in egg stages including the series of moderate temperatures were somehow higher than those of larval, and pupal stages. This might explain that egg stage was more sensitive to the influence of temperatures or the rearing conditions in laboratory were not suitable to the development of Asian corn borer eggs.

Within the range of 16°C to 30°C, the mortalities were lower on each instar of larval stage; these mortalities were somewhat similar to each other. The k-values also showed that there were not evident changes in larval stages within this range of temperatures, which the k-values could not over 0.1 at each stadium. However, the extreme temperatures (14°C and 34°C) resulted in higher mortality and higher k-values in larval stages. These phenomena revealed that extreme temperatures led to high mortality in larval stage, especially during third stadium. And the extreme higher temperature caused a higher k-value than that in extreme lower temperature.

During pupal stage, the mortality and k-values within all temperature treatments were relatively higher than those of larval instars. However, the mortality should be relatively lower in the pupal stage because pupae of insects stopped eating and any activities and achieved certain abilities of resistance (Pedigo 1989). Data from this experiment showed that the higher mortality and higher k-values of pupal stage happened on at extreme lower temperatures than those on extreme higher temperature. The appearance of k-values during combined all immature stages was a similar trend with individual immature stage, i.e. higher K values always happened on extreme temperatures. Otherwise, lower K values presented within the moderate temperatures.

4.2 Field Experiments

The time required for a moth generation under field conditions was estimated as the duration of time between the start of a flight and the start of the subsequent flight. Moths emerging from the overwintering brood constituted the overwintering flight.

The start of the flight was signaled by first moth capture whichever the pheromone or light trap in early spring. The start of the next flight was assumed to be when moth capture began to rise consistently following a period of few or no moth captures, indicating the previous flight had finished. These moths resulted from eggs laid by overwintering females and represent the first generation. The duration of time between the start of the overwintering flight and the first-generation flight was assumed to estimate the developmental time of the first generation. In like manner, the developmental time of the second generation was estimated as the duration between the start of the first flight and the start of the second flight. Likewise, the third generation was the period with the start of second flight beginning and the start the third flight.

4.2.1 Response of *Ostrinia furnacalis* to the Light Trap

The first moth flights were detected about May 17 (Figure 5). The abundance peak of first generation moth flight was reached on June 3. Moth numbers then declined but overlapped the second generations in early July. The second generation flight was captured on 13 July and continued 6 weeks with a peak flight on July 29. The last capture was on 22 August. The third generation flights was captured on 30 August and they continued 6 weeks with peak flight on 15 September. The greatest number of third generation moths per trap was caught during late-September. This flight continued at declining levels throughout October.

4.2.2 Response of *Ostrinia furnacalis* (Guenee) to the Synthetic Sex Pheromone

At Yongde, the pheromone traps were plased in the corn field on the same day as for the light trap. The number of trapped moths was presented in Figure 5. Flights of overwintered moths started during mid-May. The flight continued for 6 weeks with the greatest seasonal numbers of moths being trapped about June 3. The second generation flight began on 13 July and continued for 5 weeks with a peak on 29 July. On 14 August, no flight activity was detected. In late August the third generation moth flight started and continued for 6 weeks with a peak on 23 September. No moths were caught on 8 October. The total number of trapped moths during the study periods revealed that the first generation level was much higher than both of the second and third generation levels.

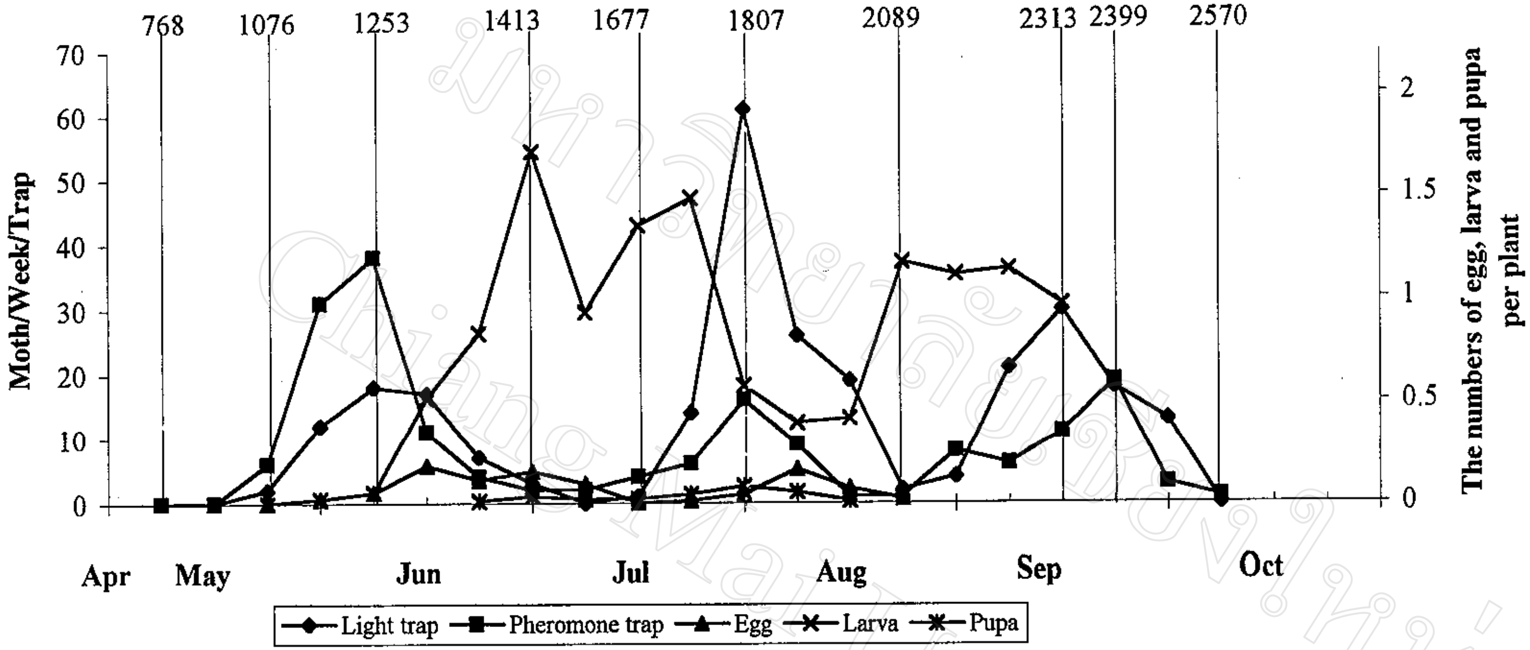

Figure 5. Seasonal flight collected using a blacklight trap and two pheromone traps and seasonal immature stages of Ostrinia furnacalis at Yongde corn field. The vertical lines indicate cumulative degree days above 10.35 C after 1 January 1995.

4.2.3 Sampling for Immature Populations of *Ostrinia furnacalis* (Guenee)

The egg masses of first generation was initially noticed after ca. 5 days of first moth capture on 27 May. The abundance of peak of egg masses were observed on 11 June while was one week after the sharp peak of first generation flight captured by either pheromone or light traps. First generation egg masses had been observed from 27 May to 5 July, continued 6 weeks. Second generation egg masses were noticed on 21 July which was delayed one week after second flight was observed. Second generation egg masses continued 5 weeks and the quantity of peak of second generation egg masses was on 6 August which was also one week later than the second flight peak. The small (first and second instars) larvae of first generation were collected on 3 June at first and stopped on 27 June, which continued 4 weeks with a peak abundance on 19 June after one week later than the abundance peak of first generation egg masses. Those small larvae of second generation were similar to the first small ones which continued 4 weeks from 29 July to 7 September. Small larvae of second generation with a peak on 14 August was one week later than second generation egg masses peak. Medium larvae (third and fourth instars) of first generation were noticed at the same time as the small ones on 11 June, and their abundance peak was on 27 June and they continued 6 weeks stopped on 13 July. Second generation medium ones appeared a peak on 22 August which was one week delayed than the small larval's peak of second generation. They continued 5 weeks and terminated on 7 September. Large larvae (fifth instar) of first generation had a obviously abundance on 13 July which was two weeks later than the abundance peak of first generation medium larvae. The large larvae continued seven weeks from 11 June to 29 July. Second large larvae continued 4 weeks with a peak around 7 September which was two weeks later than that of second medium larval's abundance peak. The first generation pupae were noticed on 19 June and stopped on 14 August. The pupae of first generation continued 8 weeks with a peak around 29 July which was two weeks later than first large larval's abundance. Parts of second larger larvae began to diapause after their peak abundance so that it was not available to notice the pupae of second generation in the corn fields (Figure 5).

Poisson, Negative binomial distribution models, and Taylor's power law yielded the spatial patterns of Asian corn borer in various life stages when data were combined over sampling dates.

The results suggested that the spatial distribution patterns of egg masses, larvae and pupae were similar to the first and second generations each other (Table 6). The analyses of data collected in this experiment indicated that this species was distributed at random in most events except small larvae in both generations. The initial step in pattern detection of each live event of Asian corn borer in corn fields of Yongde involved testing the hypothesis that the distribution of the number of individuals per corn plant was random. If hypothesis was rejected, then the distribution might be in the direction of contagious distribution but not uniform distribution (Chiang and Hodson 1959). In entomology the most frequently used contagious distribution is the negative binomial (Ruesimk 1980).

The observed numbers of corn plants receiving various numbers of egg masses, each category of larval instars, and pupae for their combined sampling dates during available periods were compared with the expected numbers according to the Poisson series. The means and the variance of the combined samples for sampling dates were calculated by using the formulae suggested by Sachs (1984). Egg masses, medium larvae (3rd and 4th instars) and large larvae (5th instar), and pupae of both generations tended to

Table 6. A Chi-square good-of-fit test for fitting a Poisson distribution for the egg masses, small larvae (1st and 2nd instars), medium larvae (3rd and 4th instars), large larvae (5th instars), and pupae of Ostrinia furnacalis in Yongde, 1995.

Stage	Combined sampling[a]	N[b]	Mean/plant[c]	s^2	Poisson series	
					d.f.	$(O-E)^2/E$
			First generation			
Egg masses	6	1800	0.101	0.105	2	0.52
Larva						
Small	4	1200	0.315	0.673	3	93.70[d]
Medium	6	1800	0.410	0.420	3	0.88
Large	7	2100	0.471	0.492	3	1.96
Pupae	8	2400	0.031	0.031	1	0.06
			Second generation			
Egg masses	5	1500	0.062	0.064	1	0.08
Larvae						
Small	4	1200	0.251	0.584	2	77.58[d]
Medium	5	1500	0.413	0.432	2	1.18
Large	4	1200	0.513	0.524	3	1.88

a The number of continuous sampling times.

b Sample size based on 300 plants per sample.

c Sampling units with whole plant.

d Rejection of the null hypothesis at $P < 0.05$.

be randomly distributed between plants in the fields (Table 6). For first generation egg masses, df = 2, the Chi-square was 0.518, which value was below the critical value of 5.99 for Chi-square at the 0.05 probability level. Similarly, the medium larvae of first generation the Chi-square value was 0.88, df = 3, P > 0.05; the large larvae of first generation with Chi-square value 1.96, df = 3, P > 0.05; and the pupae of first generation with Chi-square value 0.06, df = 1, P > 0.05. So small, medium, large larvae, and pupae of first generation Asian corn borer belonged to the Poisson distribution. Whereas, the Chi-square value in the small larvae of the first generation was 93.70 which was evidently higher than the critical value of 7.81 with df = 3, P < 0.05. For the first generation small larvae, the agreement of Poisson distribution was rejected. The small larvae tended to be the contagious distribution.

Similarly, the spatial distribution patterns on egg masses, medium and large larvae of second generation Asian corn borer were incline to the Poisson distribution and small larvae were tending to the contagious distribution. The Chi-square value of second generation egg masses was only 0.08 which was less to reach the critical value 3.84 at 0.05 level of Poisson probability (df = 1). The medium and large larvae of the second generation showed the tendency of Poisson distribution. The Chi-square value of the second generation medium larvae was 1.18 which was less than the critical table value of 5.99 with df = 4. The large larvae of second generation achieved 1.88 of Chi-square value so that it was less the critical value 5.99 at 0.05 level with df = 3. However, the small larvae of second generation appeared a obviously character of contagious distribution. The Chi-square was 77.58 df = 2, which value was far bigger than the critical value 5.99 at 0.05 level. Combined over sampling dates suggested that the spatial distribution did not change in spite of the different life stage and density of Asian corn borer varied per plant.

Since the small larvae of both generations rejected to the null hypothesis of Poisson distribution, so they were tested by the agreement of Negative binomial distribution. Table 7 showed that the small larvae of first generation was well fitted to the Negative binomial distribution. In this case, Chi-square value was 0.57, df = 2, P > 0.05. Table 8 showed that the small larvae of second generation also well fitted to the Negative binomial distribution, the Chi-square value was 2.74, df = 3, P > 0.05.

Parameters of Taylor's power law were estimated for egg masses, small, medium, large larvae, and pupae also using the combined over sampling dates data. The Taylor's power law parameters of first and second generations were presented in Table 9. Point estimates of these parameters for the first and second generation egg mass models were both close to 1 (a = 1.12, b = 1.01 for the first generation; a = 1.15, b = 1.06 for the second generation), which indicated that the egg masses, for the ranges of combined sampling dates, were distributed as a Poisson distribution. Medium and large larvae of both generations were less aggregated than their small larvae. The b values of medium and large larvae of first generation were 1.13 and 1.18, respectively; b values in the second generation, the medium was 1.14 and the large was 1.19, respectively. In contrast, the b values in Taylor's power law were significantly bigger than 1 of small larvae in both generations (b = 1.32 in the first generation; b = 1.33 in the second generation), which indicated that an contagious distribution on sample units. A criterion for the Poisson series to be a good model of data described by Taylor's power law is that the confidence intervals for a and b contain 1 (Taylor 1961).

Table 7. **A Chi-square good-of-fit test for fitting a Poisson and Negative binomial distributions for the first generations small larvae (1st and 2nd instars) of *Ostrinia furnacalis*.**

Numbers of larvae/plant	**Observed[a] frequency**	**Poisson**			**Negative binomial**		
		Probability	Expected frequency	χ^2	Probability	Expected frequency	χ^2
0	969	0.7298	875.75	9.94	0.8073	894.12	0.00
1	149	0.2299	275.86	58.34	0.1228	246.12	0.02
2	48	0.0362	43.45	0.48	0.0410	49.44	0.18
3	21	0.0041	4.94	24.95	0.0162	8.76	0.22
4^+	10	-	-		0.0069	1.56	0.12
N = 1200				93.70			0.57
mean = 0.315				$P < 0.0001$			$P > 0.05$
variance = 0.673				(df=2)			(df=2)
k = 0.294							

[a] The first generation small larvae of *Ostrinia furnacalis* existed within continuos sampling dates.

Table 8. **A Chi-square good-of-fit test for fitting a Poisson and Negative binomial distributions for the second generation small larvae (1st and 2nd instars) of *Ostrinia furnacalis*.**

Numbers of larvae/plant	Observed frequency	Poisson			Negative binomial		
		Probability	Expected frequency	χ^2	Probability	Expected frequency	χ^2
0	1000	0.7188	934.56	4.58	0.8426	1011.12	0.12
1	135	0.1947	233.64	41.64	0.1032	123.84	1.01
2	42	0.00243	29.21	26.47	0.0326	39.12	0.21
3	11	0.0022	2.64	24.95	0.0124	14.89	1.01
4	7	-	-	-	0.0051	6.12	0.13
5^+	4	-	-	-	0.0043	5.16	0.26
N = 1200				93.70			2.74
mean = 0.25				$P < 0.001$			$P > 0.05$
variance = 0.58				(df=2)			(df=3)
k = 0.24							

a The second generation small larvae of *Ostrinia furnacalis* existed within continuos sampling dates.

Table 9. Parameter estimates derived from Taylor's power law to compare distribution patterns of life stages of first and second generation Asian corn borer in field corn, Yongde, 1995.

Stages	n[a]	Range of means[b]	a	b	R^2
		First generation			
Egg masses	6	0.01-0.18	1.12	1.01	0.93
Larvae					
Small	4	0.11-0.64	3.39	1.32[c]	0.95
Medium	6	0.10-0.6	1.32	1.13	0.96
Larger	7	0.2-1.1	1.38	1.18	0.98
Pupae	8	0.01-0.08	0.91	0.98	0.82
		Second generation			
Egg masses	5	0.02-0.16	1.15	1.06	0.92
Larvae					
Small	4	0.10-0.41	3.02	1.33[c]	0.92
Medium	5	0.1-0.62	1.29	1.14	0.94
Larger	4	0.11-0.81	1.35	1.19	0.98

[a] Number of mean-variance pairs used in the linear regression

[b] Mean number of egg masses, larvae, or pupae per plant based on 300 plants sampled.

[c] Rejection of the null hypothesis ($H_0 : b = 1$) at $P < 0.05$.

4.2.4 Arthropod Population Density Assessment

A total of 2959 individuals representing 20 arthropod taxa were collected during three various growth periods of corn in this study. A list of the taxa and their abundance at which growth period of corn they were collected from corn fields is shown in Table 10. In the seedling stage of corn (20 days after planting), 113 individuals representing 8 taxa collected from corn fields; 1,599 individuals representing 19 taxa in the tasseling stage of corn (50 days after planting) and 1,247 individuals representing 16 taxa in the physiological mature stage of corn (100 days after planting) were collected from the same experimental corn fields.

In the seedling stage of corn, the taxa and individuals of arthropods found in corn fields were relatively less. Underground insects, however, were dominant within these arthropods. Individuals of *Gryllotapla unispina* Saussure, *Brachytrupes portentosus* Lichtenstein, *Pedinus femoralis* L., *Holotricha oblita* Faldermann, and *Agrotis ypsilon* Rottemberg were 6, 19, 11, 51, and 12, respectively. Among the underground insects, *H. oblita* was obviously dominant in abundance, whereas *P. femoralis* was least. In general, *P. femoralis* was treated as nonpest in corn field.

Other arthropods in this period were less including pests and nonpests, *Locusta migratoria* L. was 6 individuals and *Tetranychus desertorum* Zehntner were 5 only, respectively.

In tasseling stage of corn, the taxa and individuals of arthropods increased as the season progressed. Underground insects had decreased in abundance, meanwhile other feeding leaf, stem, and ear insects became dominant. *Mythimma separata* (Walker), *Sesamia inferens* Walker, and *Ostrinia furnacalis* Guenee populations were increased

Table 10. **The abundance of arthropod taxa in the 3 growth periods of corn, Yongde, 1995**

Order	Family	Species	Growth periods[a] SE	TA	PM
Acari	Tetranychidae	*Tetranychus desertorum* Zehntner	5	31	15
Arachnida	Oxyopidae	*Oxyopes salticus* Henth	0	92	38
Orthoptera	Gryllotalpidae	*Gryllotapla unispina* Saussure	6	3	0
	Gryllidae	*Brachytrupes portentosus* Lichtenstein	19	1	0
	Acrididae	*Locusta migratoria* Linn.	6	22	37
Homoptera	Aphididae	*Rhopalosiphum maidis* (Fitch)	0	558	349
Hemiptera	Anthocoridae	*Orius tantillus* (Motsch)	0	6	15
Coleoptera	Coccinellidae	*Coccinella seplempunctata* Linn.	0	76	58
	Carabidae	*Pedinus femoralis* Linnean.	11	22	1
	Chrysomelidae	*Dactylispa selifera* Chapusis	3	12	0
	Scarabaeidae	*Holotricha oblita* Faldermann	51	45	7
Lepidoptera	Noctuidae	*Mythimma separata* (Walker)	0	79	28
		Agrotis ypsilon Rottemberg	12	3	0
	Pyralididae	*Sesamia inferens* Walker	0	248	137
		Ostrinia furnacalis Guenee	0	228	429
Hymenoptera[b]	Chalcididae	*Trichogramma ostrinia* Pang et Chen	0	7	12
	Formicidae	*Lasius alienus* (Forster)	0	142	94
	Tenthredinidae	*Holocampa minuta* (Christ)	0	0	5
Diptera[b]	Tachinidae	*Lydella grisescens* Reuter	0	18	3
		Macrocentrus sp.	0	6	19
		Total number of individuals N=	113	1,599	1,247
		Total number of of species S=	8	19	16

[a] SE, seedling stage (20 days after planting); TA, tasseling stage (50 days after planting); PM, physiological mature stage (100 days after planting).

[b] Data collected from parasitized insects of sampling specimens reared in the laboratory

rapidly to impact the leaf , stem, and ear of corn. The adults of *Holotricha oblita* Faldermann fed in foliage of corn arrived to 45 in abundance. They were treated as main pests within this period in corn fields. Among these insects *O. furnacalis* were most abundant, which individuals arrived to 228. Other Lepidoptera insects also much higher in abundance compared with they being in seedling stage. *M. separata* and *S. inferens* were 79 and 137, respectively. In the same time, natural enemy insects seemed to be a increase in abundance. Predators, *Orius tantillus* (Motsch) and *Coccinella seplempunctata* L., appeared to corn plants and their individuals were 6 and 76, respectively. The pridates collected from the priated insects in laboratory, *Trichogramma ostrinia* Pang et Chen, *Lydella grisescens* Reuter, and *Macrocentrus sp.* were 142, 18, and 6 in the individuals, respectively. *Locusta migratoria* L., *Pedinus femoralis* L., and *Lasius alienus* (Forster) gradually became higher to certain extent in abundance. The individuals of them were 22, 22, and 142, respectively. The popularly believed nonpests, *Tetranychus desertorum* Zehntner and *Oxyopes salticus* Henth, were 31 and 92.

By physiological mature period of corn, the taxa and abundance of arthropods had decreased with exception of a few species in abundance. *O. furnacalis* not only still dominated in this period but dominated within whole growth period of corn. The individuals of *O. furnacalis* were 429 which arrived to the maximum compared with them in previous growth periods of corn, whereas the individuals of other insects had decreased. The main pests of corn, *Mythimma separata* and *Sesamia inferens* , obviously decreased in their individuals down to 28 and 137, respectively. Another main pest, *Holotricha oblita*, also decreased from 45 to 7 in abundance. In contrast, the individuals of natural enemy insects, *Orius tantillus*, *Coccinella seplempunctata*, *Trichogramma ostrinia*, *Holocampa minuta* , and *Macrocentrus sp.* were increased with a exception of *Lydella grisescens* . (Table 10).

Table 11 presented the diversity indices based on the data in the Table 10. The species richness indicate Margalef index increases from 1.481 in seedling stage to 2.440 in tasseling stage, then decrease from 2.440 in tasseling stage to 2.104 in physiological mature stage. This reflected that the dynamic of the number of species and individuals. From seedling stage to tasseling stage, the number of species increased (from S = 8 to S = 19) even though the large increased in the total number of individuals found in corn fields. Margalef index decreased from tasseling stage to physiological mature stage suggested that both the number of species decreased (from S = 19 to S = 16) and decreased in the number of total individuals (from 1,599 to 1,247).

The evenness index , Modified Hill's ratio, decreased from seedling stage (*E*=0.681) to tasseling stage (*E* = 0.635), but in this case, the evenness index was identical in both tasseling stage and physiological stage which evenness index was 0.635. There was a increase of rare species in tasseling stage and physiological mature stage of corn. Examination showed that Modified Hill's ratio was not evidently different in these three developmental stages of corn.

4.2.5 Degree-Day Accumulations under Field Conditions

Using a minimum threshold 10.35°C and a upper developmental threshold 32.0°C for the entire developmental periods including all developmental stages were adopted (Higley et al. 1986). The Asian corn borer adult emergence pattern in relation to accumulated degree-days by blacklight and pheromone traps was given in Figure 5.

Data from black light trap indicated that the first emergence of adults (17 May) was noticed which thermal units accumulation was 1,076 degree-days. The flight peak of the first generation occurred on 3 June with 1,253 degree-days and the flight peak of the

Table 11. Species diversity indices for three arthropod species sampling periods in Youngde, 1995

Index	Sampling periods[a]		
	SE	TA	PM
Richness			
S	8	19	16
Margalef index	1.481	2.440	2.104
Diversity			
Shannon index	1.670	2.083	1.890
Evenness			
λ	0.254	0.183	0.219
Modified Hill's ratio	0.681	0.635	0.635
Sample size	300	300	300

[a] SE, seedling stage (20 days after planting); TA, tasseling stage (50 days after planting); PM, physiological mature stage (100 days after planting).

second generation occurred on 29 July with 1807 degree-days. So the degree-days accumulation between first peak flight and second peak flight was 554. The peak of third generation was on 23 September with 2,399 degree-days, between second peak flight and third peak flight was 506. The average heat unit accumulation between peak flight as 530 degree-days at the blacklight trap. The first emergence of adults from overwintering larvae started at 1,076 degree-day on 17 May and the first generation adult flight which were no moth captures on 5 July, which was 1585 degree-days, was almost over by 509 degree-days. Thus, a total of about 509 degree-days required between first and last emergence at first generation. The second generation adult moths were noticed at about 1660 degree-days on 13 July and the last moths of the second generation were trapped on 22 August with 2,089 degree-days. That means that the degree-days required for second generation was 429. Likely, the third generation adults were initially captured on 30 August with 2,138 degree-days and the last moths of third generation terminated on 7 October with 2570 degree-days. The number of degree-days required for completion of third generation was 432 degree-days. The averaging degree-days of three generations captured by light trap according to the first and last capture was 457.

Data from pheromone trap showed that first emergence on late May (19 May) (Figure 5) which was two days later than the first capture by blacklight trap. The beginning of degree-days accumulation in pheromone trap was 1,092. The first peak flight and second peak flight monitored by pheromone trap were identical with those monitored by black light trap. That is, first peak flight on 3 June was 1,253 degree-days and second peak flight on 29 July was 1,807 degree-days, respectively. But in third peak flight, there was one week later in pheromone trap than that in black light trap. Third peak flight monitored by pheromone trap on 23 September had 2,399 degree-days, but in black light trap was 2,313 The first peak flight and second peak flight monitored by pheromone trap were identical with those monitored by black light trap. Degree-days accumulation between first peak flight and second peak flight was 554, and was 588 degree-days accumulation between second peak flight and third peak flight, respectively. The average degree-days accumulation between peak flight with pheromone trap was 571. First emergence of moth was initially noticed on 19 May with 1,092 degree-day and no moth captures on 27 June with 1,514 degree-days accumulation. It was over by 422 degree-days. Second generation moths were captured on 5 July at first which degree-days accumulation was 1,585 and last second generation moths stopped on 14 August with 1,995 degree-days which degree-days in this period was 410. The beginning capture of third generation moth was monitored on 30 August with 2138 degree-days and last capture of third generation moth was trapped on 8 October which was 2,570 degree-days. Thus, in first generation between first and last emergence had 422 degree-days accumulation; 410 degree-days accumulation in second generation; and 432 degree-days accumulation in third generation. The average degree-days accumulation according to between first and last capture for each generation was 421.

Using the dates on which peak numbers of each event were observed in the field, the degree-days above 10.35°C (D_L = 10.35°C, D_U = 32.0°C) accumulated during development of each life stage were calculated and the relation of each life event with degree-days accumulation were showed in Figure 6. These field observed data were compared with the thermal requirement which were previously acquired from the laboratory experiment and tested by Chi-square test in Table 12. The results showed that the observed degree-days accumulated between stages of two generation did not differ significantly from those expected. Chi-square value was 5.47; df = 4; for all events of first generation which was not significantly differ at 0.05 level. And Chi-square was 6.59; df = 4; was also not significantly differ at 0.05 level.

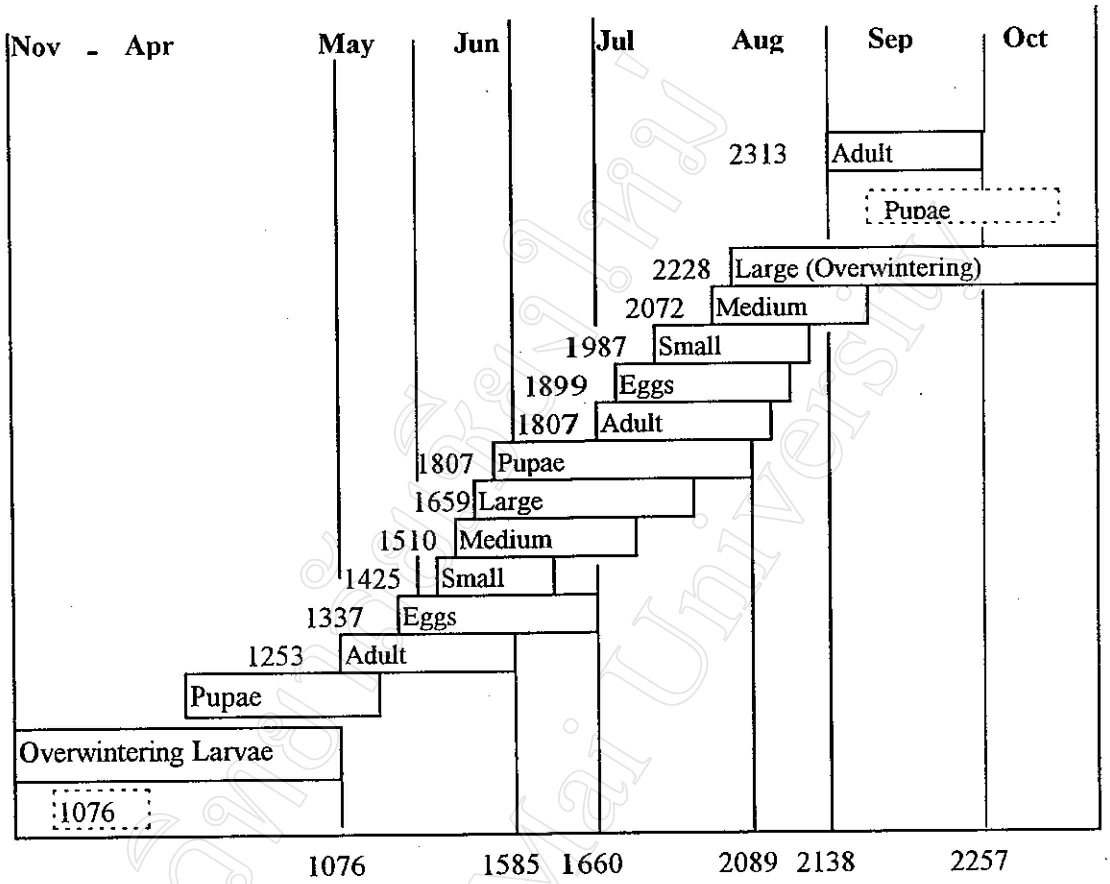

Figure 6. The field life stages of Ostrinia furnacalis at Yongde corn fields, 1995. The vertical lines represent the cumulative degree above 10.35°C (D_L = 10.35°C, D_U = 32.0°C).

Table 12. Comparison between observed and expected degree-days required for development of the Asian corn borer at Yongde, 1995.

Stage[a]	Date of peak numbers	Degree-days(°C) from one peak to the next		Chi-square
		Observed	Expected[b]	
Overwinter adult	June 3			
Egg	June 11	83	79.15	0.19
Larvae				
Small instars	June 19	88	98.71	1.16
Medium instars	June 27	89	91.84	0.09
Larger instars	July 13	149	136.37	1.17
Pupa	July 29	148	128.82	2.86
				5.47[c]
New adult	July 29			
Egg	Aug 6	92	79.15	2.09
Larvae				
Small instars	Aug 14	88	98.71	1.16
Medium instars	Aug 22	85	91.84	0.51
Larger instars	7 Sep.	156	136.37	2.83
				6.59[c]

[a] Small instar includes 1st and 2nd instars; medium instar includes 3rd and 4th instars; large instar includes 5th instar.

[b] Expected degree-days determined in laboratory.

[c] Not differ significantly at 0.05 level.

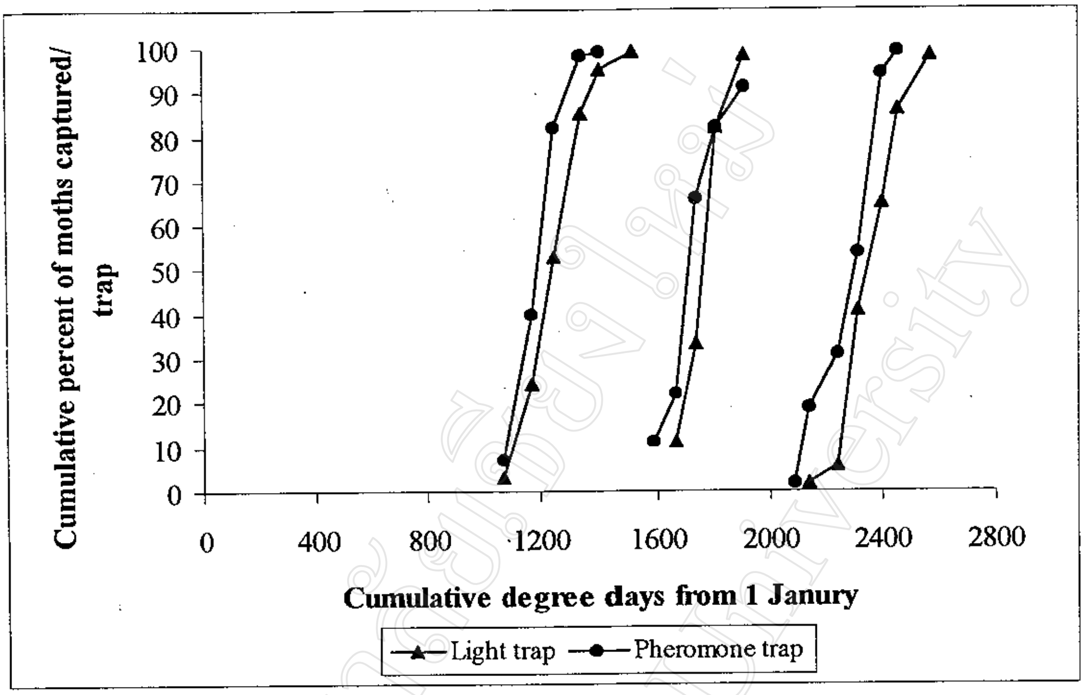

Figure 7. **Cumulative percent moths captured in relation to accumulative degree-days.**

When the cumulated percentages of first, second, and third generation moth flights captured by light and pheromone traps were plotted against degree-days accumulation on a scatter diagram, the relationship between these two variables followed a sigmoid curve (Figure 7). To make this relationship linear, the percentage values of moths accumulation were transformed to probits and the degree-days accumulation transformed to logarithms (Despins and Robert 1984). Using the transformed data, regression equations, R squares of the regression coefficients were presented in Table 13. The equations were of the form Y = a + bX, where Y is the probit of the percent to be estimated, a is the intercept of the regression coefficient, and X is the logarithm of any desired number of degree days. To estimate the number of degree days necessary for a given percent of Asian corn borer development, the regression equations must be rearranged to the form X = (Y-a)/b. By using the cumulative percentage of moth flights in the field data with the degree days accumulation in Yongde, the predicting equations of each generation moth flight were formed. The logarithm of an expected number of degree days could be estimated for any desired cumulative percentage of any generation moth flight of Asian corn borer. By determining the antilogarithm, the expected number of degree days could also be estimated, and a predicted date could be obtained by comparing the expected number of degree days with the actual number.

The captured moth flights cumulated percentages of first, second and third generations were cumulated for blacklight and pheromone trap data, along with the expected number of degree-days necessary to reach cumulative percentage. Table 13 contains the regression equations relating to probits of the cumulating percentage of adult of Asian corn borer moth flight to the logarithm of cumulative degree-days for each generation. Table 14 showed the expected number of degree-days necessary to 1, 25, 50,, 75 and 95% of first, second and third generation moth flights.

Since the degree-days accumulation for moth flight captured by either light trap or pheromone under field conditions just was one year data, the analyses of accuracy of prediction and the improvements of predicting models were not available. The estimations, however, occurred in the somehow good fit in the R squares for each estimate. These equations can be used to estimate the number of degree-days for any given cumulative percentage of adult Asian corn borer moth flight using any kind of traps.

Table 13. Regression of probits of cumulative percentage of captures of Asian corn borer adults (y) in blacklight and pheromone traps on the log(10) of degree days (x).

Generation	Equations[a]			
	Blacklight	R^2	Pheromone	R^2
1st	$Y = -83.22 + 28.50X$	0.99	$Y = -97.28 + 33.27X$	0.93
2nd	$Y = -163.31 + 51.85X$	0.96	$Y = -99.41 + 32.25X$	0.96
3rd	$Y = -173.82 + 53.05X$	0.99	$Y = -189.10 + 57.88X$	0.95

[a] Y is the probit of the percent to be estimated; X is the logarithm of any desired number of degree days.

Table 14. The expected cumulative degree days in for 1, 25, 50, 75, and 95 percent of the first , second, and third generations of moths captured by the blacklight trap and pheromone traps, Yonde 1995.

Trap	Percentage				
	1	25	50	75	95
			First generation		
Blacklight	1032.01	1180.13	1245.77	1315.07	1422.27
Pheromone	1009.74	1132.67	1186.43	1242.74	1329.03
			Second generation		
Blacklight	1589.12	1710.70	1762.36	1815.58	1895.50
Pheromone	1463.09	1647.19	1727.90	1812.57	1942.55
			Third generation		
Blacklight	2122.57	2281.14	2348.46	2417.75	2521.72
Pheromone	2057.00	2197.43	2256.78	2317.75	2408.93