อิทธิพลของความชื้นอุณหภูมิและแสงที่มีต่อการเจริญเติบโตของหนอนกอข้าวสีชมภู

Effects of Humidity, Temperature, and Light on the Growth and Development of Sesamia inferens (Walker).

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ABSTRACT

Eggs, pupae, and adult moths of *S. inferens* were exposed to constant humidities, ranging from 20—95 percent, constant temperatures, ranging from 20—34 C, and constant continuous light intensities 0 and 10 foot-candles, and the effects on the development, emergence, and life duration of the borer were compared.

Humidity at the test range affected greatly the hatching of eggs and adult longevity. In almost all cases, they showed higher preference in higher humidity. Optimum humidity for hatching eggs and at rearing adult moths were between 90—95, and 70—90 percent RH respectively. Pupae developed well in all humidities eventhough slight effect on the adult emergence was observed at the humidity below 50 percent RH.

Temperature at the test range affected greatly the egg and pupal periods, but very little on hatching percentage and adult emergence. The percent adult emergence was reduced markedly only when pupae were exposed throughout their development at 34 C.

Hatchability of eggs was favored when they were illuminated continuously with 10 foot-candle light as compared to those kept in the darkness under the experimental conditions. It had no effect on the pupal development and emergence.

Eggs and pupae of *S. inferens*, in general, exhibited their higher tolerance to temperature when compared with those of *C. polychrysa* and *T. incertulas* at the same conditions.

Several workers have reported the influence of environmental factors on the growth and development of various species of rice stem borers but none has yet included the pink borer, *Sesamia inferens* (Walker) (1—10). The species is one of the three most important borers of paddy in Thailand. Being a member of the family Noctuidae which is much different from other rice borers of the family Pyralidae, the insect seems to be wider spread, better developed, and well adapted to a wider range of habitat. It is therefore interesting to investigate the effects of humidity, temperature, and light to the growth and development of this species in comparison with other borers. The study will also provide basic information which will be helpful for the future mass rearing program of this species.

Materials and Methods

Eggs, pupae, and adult moths of *S. inferens* were exposed to constant humidities, ranging

from 20 – 95 percent, constant temperatures, ranging from 20 – 34 C and constant continuous light intensities at 0 and 10 foot candles. All procedures used in these experiments were essentially the same as described in the tests with *Chilotraea polychrysa* (Meyrick) and *Tryporyza incertulas* (Walker) (1). The differences which were made with *S. inferens* are as follows: Breeding stock of the insect used for all tests was reared from rice plants of the variety Nang Mol S4. For ovipositing site, the adult moths were allowed to deposit eggs freely between leaf sheaths of rice plants in the jars. Eggs deposited by female moths were collected, mixed and divided in to group for hatchability tests to minimize variable factors such as size and age. Results of the tests with *S. inferens* are shown in Tables 1—5, and they are compared with the results obtained from the tests with *C. polychrysa* and *T. incertulas* (1) in Figures 1—5.

Results and Discussion

Table 1 shows that the hatchability of eggs of *S. inferens* was increased by the increasing of the percentage of relative humidity. This correlationship is significance, positive, and linear. The trend of effect of humidity on hatching eggs of *S. inferens* was the same when compared with those obtained in the tests with *C. polychrysa* and *T. incertulas* (Figures 1 a, and 1 b.). The data show also great diffirence in hatchability under continuous dark and light conditions and hatchability of eggs of *S. inferens* was improved markedly by the latter. Light at 10 foot-candles accelerated the hatching period of eggs of *T. incertulas* (1), and it exerted the same effect to *S. inferens*. This is in constrast to *C. polychrysa* in which longer period of egg hatching was observed when they were exposed to light condition (1).

Eventhough the temperatures, ranging from 20 to 34 C affected the hatching period of eggs of *S. inferens* by delaying it at low temperatures, they had no effect on the percentage of hatch (Table 2). In this case they showed higher degree of their tolerance to the extreme temperatures of the tests, both low and high, when compared with the results obtained from the experiments with *C. polychrysa* and *T. incertulas* (Figure 2).

There were no difference on the numbers of adult moths of *S. inferens* emerged from pupae that were exposed under the humidities ranging from 70—95 percent RH (Table 3). The percentage of emergence was slightly declined as percent RH decreased from 62 to 20. No difference in the influence of light at 10 foot-candles on the adult development was observed when compared with those treated under total darkness. The trend of effect to the pupal development and adult emergence of *S. inferens* and *C. polychrysa*, in general, was the same, and showed much different from *T. incertulas* (Figures 3 a, 3 b).

The percentages of adult emergence were not affected by exposing pupae to the temperatures ranging from 24—32 C (Table 4). However, the temperature at 34 C not only prolonged the average period of pupation but also reduced greatly the number of adult emergence. The same effect of this temperature was obtained in the tests with *C. polychrysa* and *T. incertulas* (Figure 4). No effect of light, incorporated to the temperature, on the development of *S. inferens* could be detected in this experiment.

Results in table 5 showed that adult moths of *S. inferens* lived longer when they were exposed to high humidity. The suitable humidity of rearing adult moths of this species was from 70 to 90 percent RH. This is also true in the case of *T. incertulas* (Figure 5). *C. polychrysa* was the only species that relative humidity higher than 90 percent RH lengthened the adult life.

Table 1. Hatchability of eggs of *S. inferens* as affected by humidity and light at the temperature 27 ± 1 C[1].

%R.H.	Total Darkness (0 ft. candles)				Continuous Light (10 ft.candles)			
	Days	Hatch	Black-Head	Unhatch	Days	Hatch	Black-Head	Unhatch
20	—	0	0	100	—	0	20.25	79.75
32	—	0	0	100	9—14	6.25	66.25	27.50
42	15—20	8.75	65.0	26.25	9—12	17.50	46.25	11.25
50	9—15	23.75	52.50	23.75	6— 8	67.50	26.25	12.50
62	7— 9	28.75	17.50	53.75	6— 8	77.50	18.75	3.75
70	7— 9	55.00	21.25	23.75	6— 7	86.25	8.75	5.00
80	6— 8	85.00	8.75	6.25	6— 7	96.25	1.25	2.50
90	6— 7	97.50	1.25	1.25	5— 6	100	0	0
95	5	100	0	0	5— 6	100	0	0
r		= 0.9807				= 0.9227		

1. Data based on fourty eggs per treatment, and concluded at thirty days of the investigation.
r = correlation coefficient.

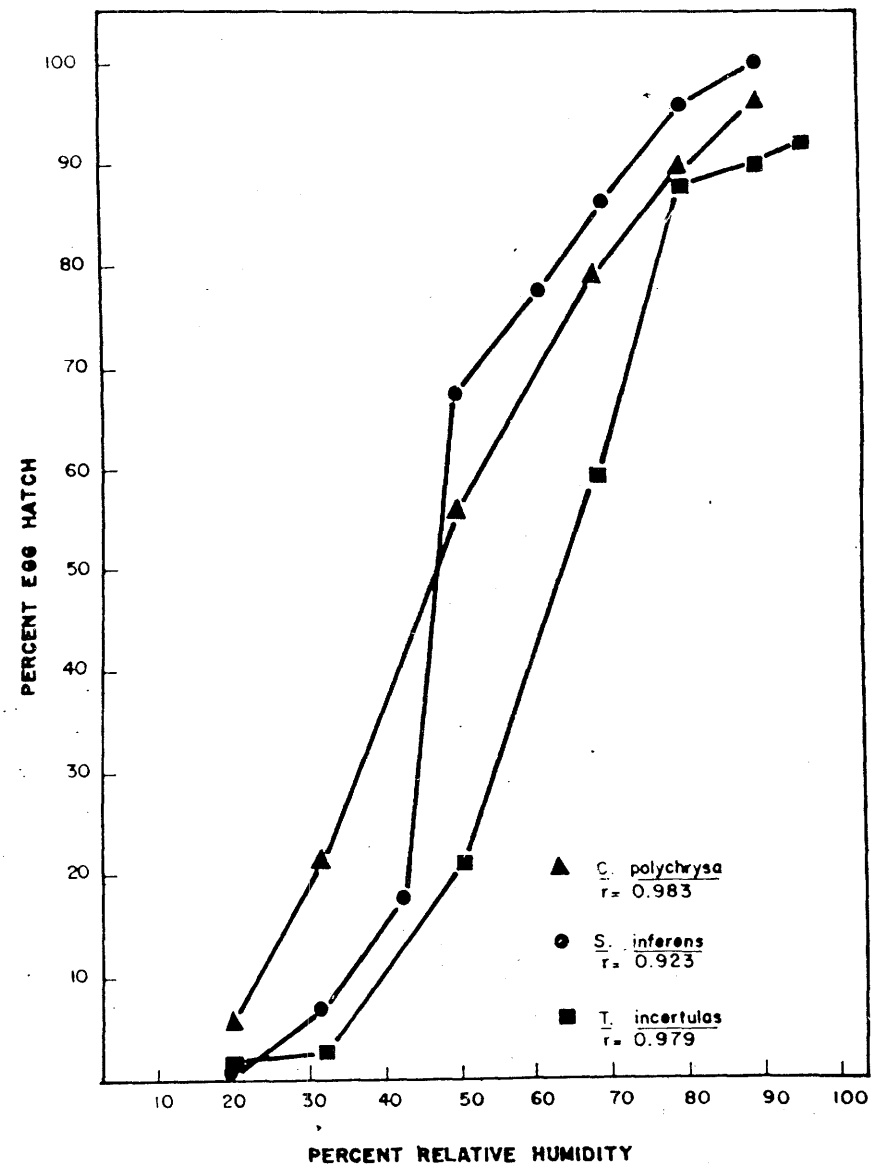

Fig. 1 a. Effect of humidity on the hatchability of eggs of three species of rice stem borers, tested under continuous light at 10 foot-candles.

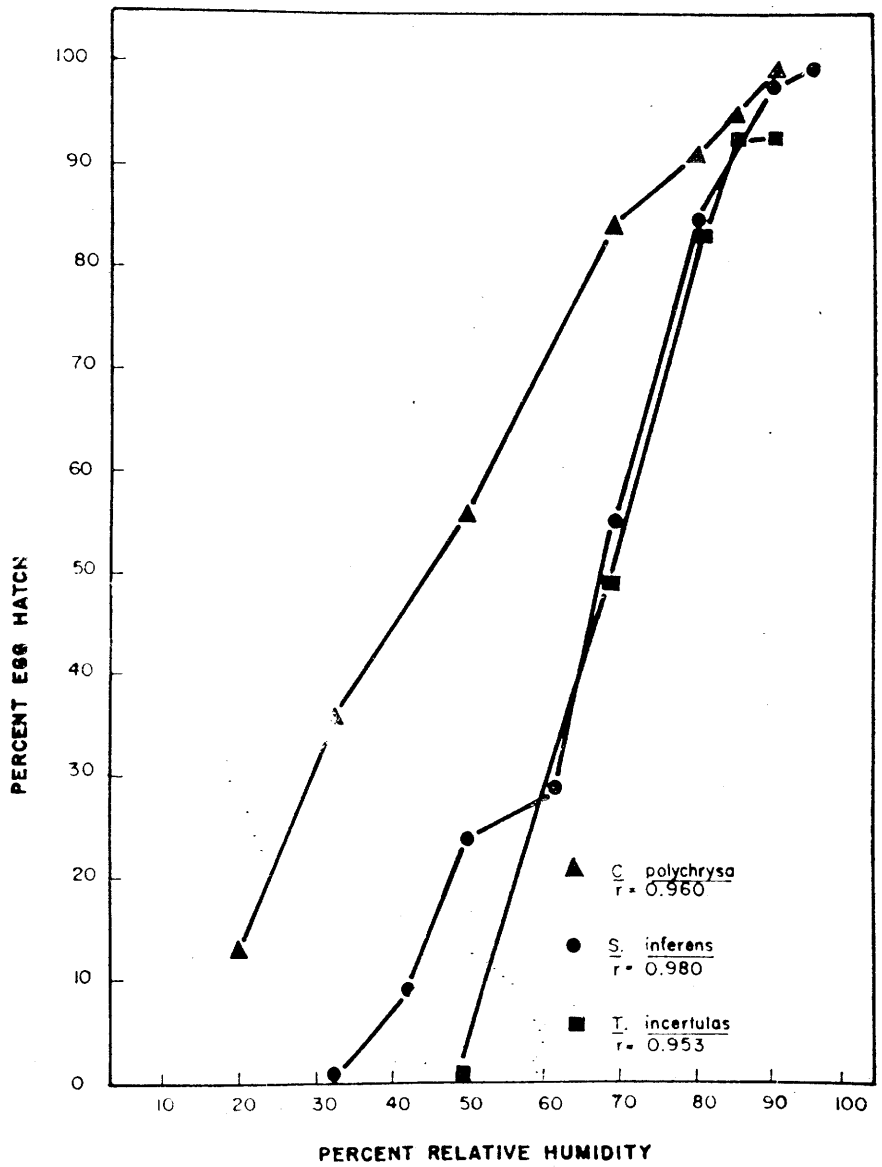

Fig. 1 b. Effect of humidity on the hatchability of eggs of three species of rice stem borers, tested under continuous darkness.

Table 2. Hatchability of eggs of *S. inferens* when exposed to different constant temperatures at 95 percent relative humidity[1].

Temperature (C)	Duration (Days)	Hatchability %
20	8	100
22	6—7	100
24	5—6	100
26	5—6	100
28	5—6	100
30	5	100
32	5	100
34	4—5	100

1. Data based on fourty eggs per treatment, and were concluded at thirty days of the investigation.

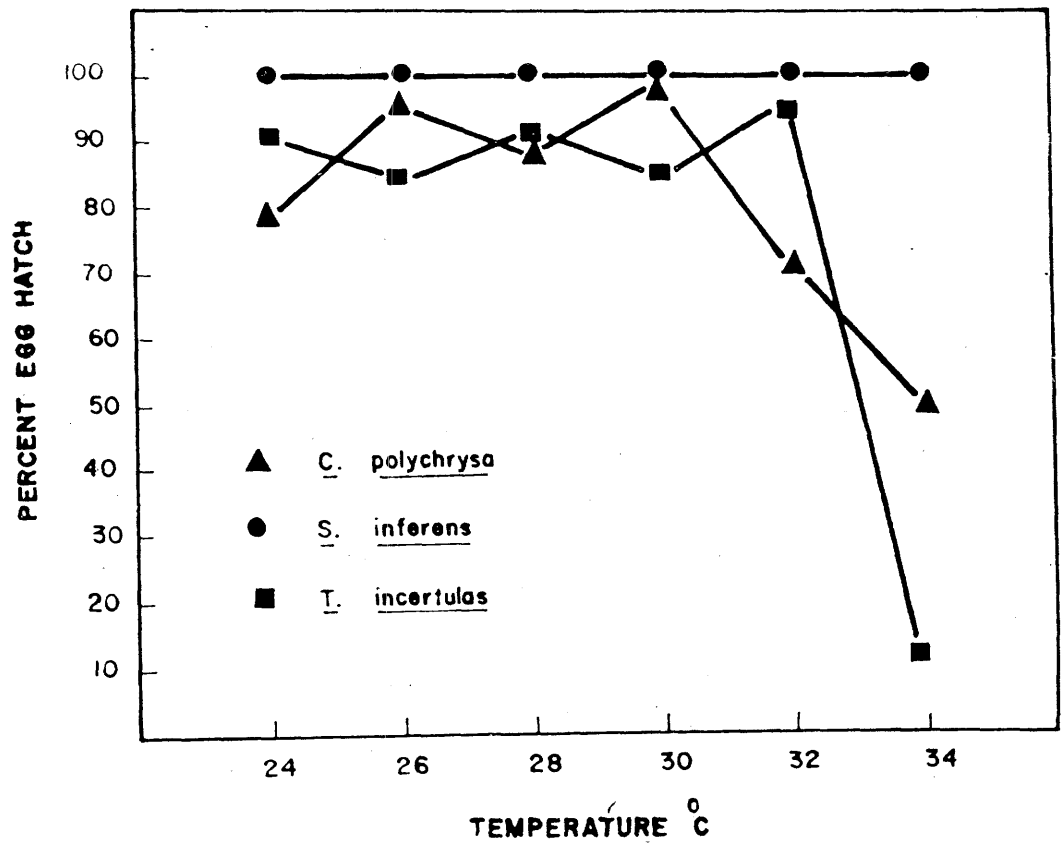

Fig. 2. Effect of temperature on the hatchability of eggs of three species of rice stem borers, tested at 95 percent RH.

Table 3. Emergence of adult moths of *S. inferens* from pupae exposed to different humidities under light and dark conditions at 27 ± 1 C.1

% R.H.	Light (10 ft. candles)			Dark (0 ft. candle)		
	Duration in Days		Emergence of Adult	Duration in Days		Emergence of Adult
	Range	Average	(%)	Range	Average	(%)
20	9—11	10.25	90.0	9—10	9.45	90.0
32	9—11	10.00	90.0	8—11	9.55	90.0
42	9—11	10.00	92.5	9—11	10.23	92.5
50	9—11	9.58	95.0	9—10	9.50	97.5
62	9—10	10.00	97.5	9—10	9.33	95.0
70	9—11	9.60	100	9—11	9.70	100
80	10—11	10.20	100	8—10	9.25	100
90	9—10	9.50	100	9—10	9.50	100
95	9—11	9.75	100	8—10	9.25	100

Data based on fourty pupae per treatment and were concluded at thirty days of the investigation.

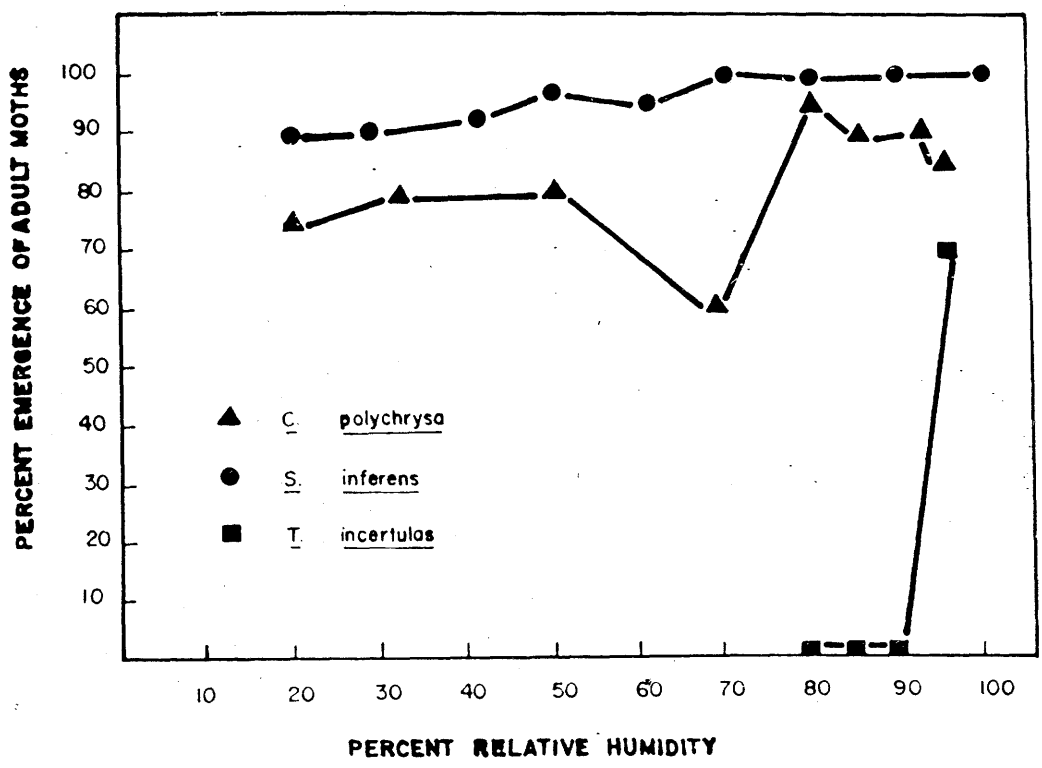

Fig. 3 a. Emergence of adult moths of three species of rice stem borers when pupae were exposed to different humidities, at 0 foot-candles, and 27 ± 1 C.

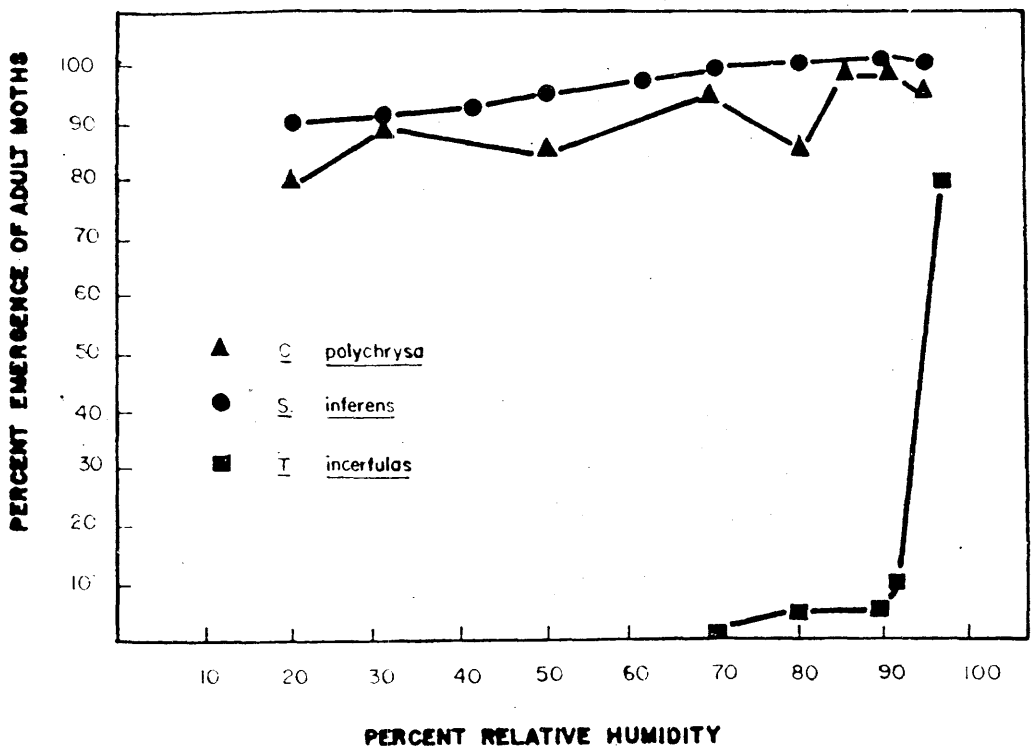

Fig. 3 b. Emergence of adult moths of three species of rice stem borers when pupae were exposed to different humidities, at 10 foot-candles, and 27 ± 1 C.

Table 4. Emergence of adult moths of *S. inferens* from pupae exposed to different temperatures under light and dark conditions.[1]

Temperature C	Light			Dark		
	Duration in Days		Emergence of Adult (%)	Duration in Days		Emergence of Adult (%)
	Range	Average		Range	Average	
24	9—12	10.25	97.50	8—12	10.50	95.00
26	8—10	9.58	100.00	8—10	9.75	97.25
28	8— 9	8.93	100.00	8— 9	9.00	100.00
30	8— 9	8.60	97.25	8— 9	8.73	97.25
32	8— 9	8.33	95.50	8—10	8.65	97.25
34	8—10	9.08	32.50[2]	8—10	8.95	40.00[2]

1 Data based on fourty pupae per treatment, and were concluded at thirty days of the investigation.

2 Adults emerged with wing malformation. Dissecting of the pupae which were exposed for three weeks without adult emergence showed a complete development of adult stage inside.

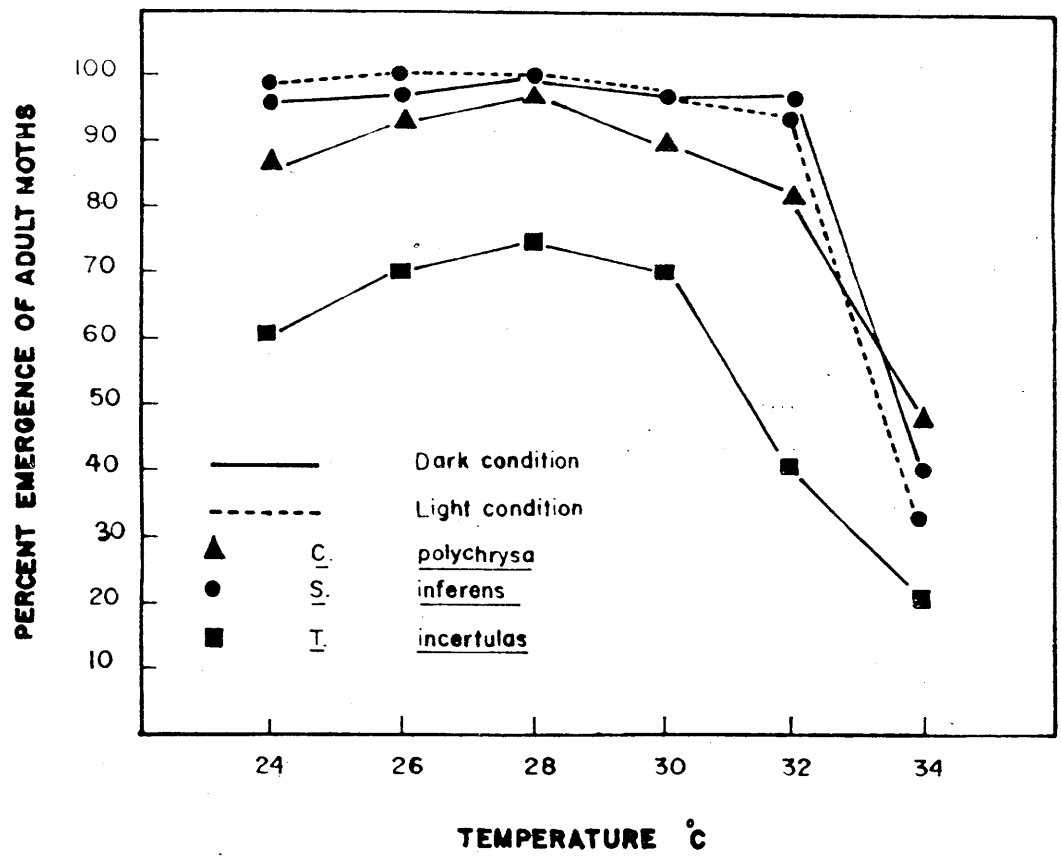

Fig. 4. Emergence of adult moths of three species of rice stem borers from pupae exposed to different temperatures at 90 percent RH.

Table 5. Longevity of adult moths of *S. inferens* reared under different humidities.

% R.H.	Number of Moth	Longevity in Days	
		Range	Average
20	40	2— 9	5.95
32	40	2— 9	6.30
42	40	3—10	6.58
50	40	3—10	6.23
62	40	4—10	7.95
70	40	6—14	9.75
80	40	5—12	9.75
90	40	5—14	10.05
95	40	8—15	8.93

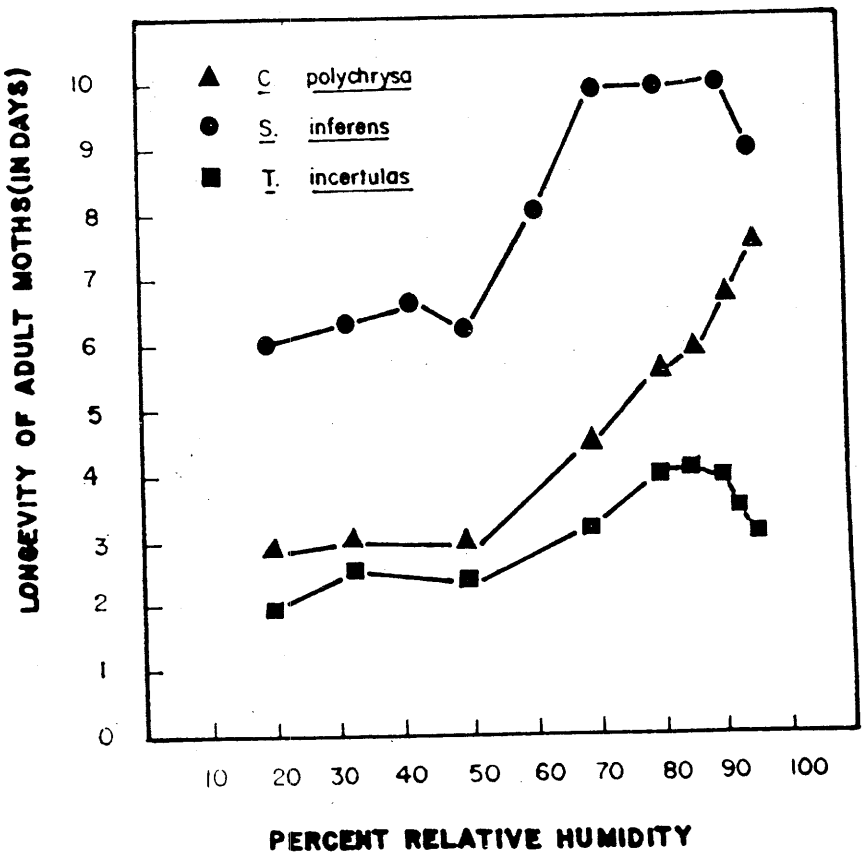

Fig. 5. Longevity of adult moths of three species of rice stem borers, reared under different humidities.

The relationship between the percentage of egg hatching of *S. inferens* and the percentage of relative humidity ranging from 20—95 percent RH was significance, positive and linear. The humidity at this range affected slightly on the pupal development and emergence of adult moths. Longevity of adults extended progressively when the humidity was increased from 50 to 90 percent RH. It dropped slightly when humidity exceeded 90 percent.

Although hatching percentage of eggs was prolonged under cool conditions, the temperatures, ranging from 20 –34 C had no effect on the percentage of hatching. The percentage of adult emergence was reduced greatly when pupae were exposed to 34 C but such phenomenon did not occured in other test temperatures.

Hatchability of eggs was favored by illuminated them consistently with light at 10 foot candles as compared to those kept under total darkness.

Eggs and pupae of *S. inferens*, in general, exhibited their higher tolerance to the test temperatures when compared with those of *C. polychrysa* and *T. incertulas* at the same conditions.

Literature Cited

1. AREEKUL, S., C. BHONUANGPOL, and D. EKAPAT 1971. Effects of humidity, temperature, and light on the growth and development of *Chilotraea polychrysa* (Meyrick) and *Tryporyza incertulas* (Walker). Proceedings of the Symposium on Rice Insects. Trop. Agr. Res. Center, Min. Agr. and Forest., Tokyo. 49—62.
2. DOKE, N. 1936. Effects of temperatures and humidities on the ecology of the stem borer. Japan J. Appl. Zool. 8 : 87—93.
3. HARURAWA, C., R. TAKATO, and S. KUWASHIRO. 1931. Biological studies on the rice stem borer. Effects of constant temperature on growth and development of the borer. Rept. Ohara Inst. Agr. Res. 17 : 168—183.
4. INOUE, H., and S. KAMANO. 1956. The relation between the pupation of the rice stem borer and light. Oyo-Kontyu 12 : 130—132.
5. KOYOMA, T. 1955. Studies on the paddy borer (*Schoenobius incertulas* Walker). Bull. Agr. Imp. Eng., Min. Agr. and Forest, Dep. Agr., Impt. Res. Bran., Wakayama-KenAgr. Res. Sta. 53 : 174.
6. LIN, Y.Z.Q. SHU, J.Q. HU, S.W. PEI, and J.C. YEH, 1959. Studies on the outbreak of the paddy borer, *Schoenobius incertulas* Walker, with effective thermal summation. I. The minimum temperatures of development and effective thermal summations. Acta. Entomol. Sinica 9 : 423—435.
7. PATHAK, M.D. 1968. Ecology of common insect pests of rice. Ann. Rev. Entomol. 13 : 257—294.
8. SUGIYAMA, S. 1960. The influence of temperature on the embryonic development of the rice stem borer moth, *Chilo suppressalis* Walk. Nogaku Kenkyu 47 : 195—204.
9. TSAI, P.H. 1935. Epidemiological experiments with the paddy borer (*Schoenobius bipunctifer* Walk.) I. The influence of temperature and relative humidity on oviposition and hatching. Agr. Sinica 1 : 273—317.
10. TSUCHIYA T. 1939. The effect of alternating temperatures on the pupal development of rice borer, *Chilo simplex* Butl. Nogaku- Kenkyu 31 : 307—317.