

Difference of Developmental Time, Survival Rate and Sex Ratio of *Dichocrocis punctiferalis* (Lepidoptera: Pyralidae) on Three Hosts

Kwang Sik Choi^{1*}, Kyung Sik Han², Il Kwan Park¹, Jeong Im Hong¹,
Chul Soo Kim¹, Yeong Jin Chung¹ and Sang Chul Shin¹

¹Division of Forest insect and disease pests, Korea Forest Research Institute, Seoul 130-712, Korea

²Department of Urban horticulture, Shingu College, Sunghnam 462-743, Korea

Abstract : The experiments were conducted by supplying hosts with natural food(chestnut, peach, Quince). The developmental difference of peach pyralid moth, *Dichocrocis punctiferalis* was examined in the laboratory under three different natural food regime. The periods of egg, larva and pupa were 6.01 ± 0.07 , 12.23 ± 0.03 and 13.32 ± 0.01 days on the chestnut fruit, 6.21 ± 0.01 , 18.69 ± 0.02 and 13.38 ± 0.03 days on the peach fruit and 7.02 ± 0.04 , 22.62 ± 0.04 and 13.44 ± 0.14 days on the quince fruit, respectively. The growth of *D. punctiferalis* larva was better chestnut fruit than other tested fruits. The rates(%) of hatching, pupation and emergence were 94.0, 57.0 and 63.3 on the chestnut fruit, 89.2, 77.8 and 85.7 on the peach fruit and 79.6, 52.6 and 70.7 on the quince fruit, respectively. The survival rate(%) of *D. punctiferalis* from hatching to emergence were 31.0 on the chestnut fruit, 4.8 on the peach fruit and 14.3 on the quince fruit, respectively. The sex ratio (female : male) of all pupae obtained on the tested natural food fruits were 52.7 : 47.3. The sex ratio of *D. punctiferalis* reared on three difference food fruits were no significantly. It can be used a as the basic research for the study of *D. punctiferalis*.

Key words : peach pyralid moth, *dichocrocis punctiferalis*, developmental difference, survival rate, sex ratio

Introduction

Insects and plants have been coevolving from Cretaceous to today. Current diet adaption of a given insect species is the consequence of a long evolutionary process molded by the genetic and physiological endowments of the species (Mahani *et al.*, 2003). A herbivorous's various host species will exhibit inter-and intraspecific differences in a number of ecologically important parameters, such as nutrient content, defensive chemistry, and phenology. As a result, an individual's choice of host plant will affect its development and reproductive success (Chew, 1977). The ambient many hosts in polyphagous insects are known to have influence on the activity and life history traits of insects.

The peach pyralid moth, *Dichocrocis punctiferalis* Guenee is polyphagous insects which refers to insects feeding on a relatively large number of plants from different families. Shinkaji (1969) and Choi (1998) reported

that the fruit, seed and corn of Pinaceae, Fagaceae and Rosaceae may serve as host plants of the peach pyralid moth. Particularly, it is one of the most important pests of the chestnut tree, *Castanea crenate* in Korea (Choi, 1998; Choi *et al.*, 2004). The adult moths migrate to many host fruits in field. This insect was known to have the 44 species of the host trees with fruit, seed and corn (Konno *et al.*, 1981; Neelay *et al.*, 1983; Hossain *et al.*, 1995; Choi, 1998). Therefore, the wild host plants act as a reservoir for the chestnut borers that later migrate to neighbouring chestnut orchards. At present stage, there are many points which are uncertain in a host of *D. punctiferalis*. The damage on chestnut fruits varied in accordance with the period of fruit ripening. Early and middle ripening varieties were attacked by the second generation larvae (Shinkaji, 1969) and was bi-or trivoltine in Korea (Choi *et al.* 2004). The present method of control recommended by Forest Administration in Korea is aerial spraying and to introduce insecticide(pyrethroids and organophosphorous compounds) (Korea Forest Service, 2002). This practice, however, is not satisfactory because only larvae direct contact with the insecticide are killed. In Korea, the aerial control by administration convenience and a scarcity of Helicopter

*Corresponding author

E-mail: choiks99@foa.go.kr

*This study was financially supported by grants from Agricultural R & D Promotion Center.

didn't have been succeeded a proper control timing according to the real condition of province. However, the rate of damaged by the peach pyralid moth is 20~30% of total production, and its price is about 17 millions dollars (Choi, 1998).

Reduction and/or solution of this damage from *D. punctiferalis* in chestnut orchards is one of the most challenging problem.

So, we studied the developmental time, survival rate and sex ratio of *D. punctiferalis* in 3 different hosts, and was undertaken to find out its control strategy in chestnut orchards.

Materials and Methods

D. punctiferalis has been maintain on natural food fruits at the insectary, since the insects were collected from the damaged chestnut fruits by *D. Punctiferalis* in Jinju, Kyungnam province in late-August to mid-September, 2002. The obtained larvae in field were individually reared in the insectary. Adult moth emerged from field-collected larvae were housed the 250 mesh soft net covered apples in polystyrene cages (20×20×30 cm) for mating and oviposition. The eggs laid on the 250 mesh soft net covered apples by mated females. The 250 eggs of *D. punctiferalis* inoculated on the fruits of *Prunus persica*, the 100 eggs on the burr tissue of fruits which is hanging on *Castanea crenata* 7~8 years old tree and 49 eggs on the fruits of *Pseudocystodonia sinensis*. It was carried out to investigate the developmental period of larva, survival rate and sex ratio on the 3 different food fruits. Classification of female and male in *D. punctiferalis* observed terminal abdominal segments(sternum 11+telson) of the pupa with anatomy microscope (×40) after pupation. All experiments were conducted at 25±1°C, 60±10%RH and a photoperiod of 15L:9D in insect rearing room.

Results and Discussion

The pyralid peach moth, *Dichocrocis punctiferalis* is a major economic pest of many of Korean's most important orchard commodities, including chestnut, peach, apricot, persimmon, apple, pear etc. (Choi, 1998). This moth is herbivorous polyphagous insect pests, which is probably native to the most of orchards in Korea.

Table 1 showed that development of *D. punctiferalis* larvae is better chestnut than other fruits. The aim in table 1 is to examine the good development by which certain *D. punctiferalis* prefer chestnut. In other words, a chestnut is the best of the 3 different hosts. The difference of developmental degree of *D. punctiferalis* larva in 3 different hosts were 12.23±0.03 days on the chestnut

Table 1. Developmental period (day ±SE) of *D. punctiferalis* when reared on 3 different host fruits at 25 ±1°C, L15/D9 and 60 ±10%RH.

Stage	Chestnut	Peach	Quince
Egg	6.01 ± 0.07 ^a	6.21 ± 0.01 ^a	7.02 ± 0.04 ^a
Larva	12.23 ± 0.03 ^a	18.69 ± 0.02 ^b	22.62 ± 0.04 ^c
Pupa	13.32 ± 0.01 ^a	13.38 ± 0.03 ^a	13.44 ± 0.14 ^a
Adult (♂)	5.92 ± 0.08 ^a	5.01 ± 0.05 ^a	5.98 ± 0.03 ^a
(♀)	7.61 ± 0.07 ^a	8.08 ± 0.05 ^a	8.27 ± 0.57 ^a

*Figures followed by same letters for the same stage are not significantly different by Duncan's multiple range test (p<0.05).

Table 2. Survival rate(%) of *D. punctiferalis* when reared on 3 different host fruits at 25 ±1°C, L15/D9 and 60 ±10%RH.

Stage	Chestnut	Peach	Quince
Larva	86.0	7.2	38.8
Pupa	49.0	5.6	22.4
Adult	31.0	4.8	14.3

*The initial number of eggs was 100 in chest, 250 in peach and 49 in quince for this test, respectively.

fruit, 18.69±0.02 days on the peach fruit and 22.62±0.04 days on the quince fruit, respectively. Larval developmental time was significantly longer on Quince fruit compared with the others. Larvae developed in the fewest days on chestnut fruit. In 3 different hosts, significant differences were not observed for the egg, pupa and adult longevity (Table 1). Choi (2004) reported that the peak of seasonal occurrence of *D. punctiferalis* in chestnut orchards showed two generations a year in Gongju and Suncheon province, and three generations a year in Jinju and Sancheong province. In the result of the table 1, the total developmental periods until egg to emergence were 32.56 days on the chestnut fruit, 38.26 days on the peach fruit and 43.08 days on the quince fruit, respectively. The growth of *D. punctiferalis* larva was better chestnut fruit than other tested fruits. At this point, we can give a clear biological interpretation for seasonal occurrence. Therefore, if the 2nd generation of *D. punctiferalis* adults last for offspring at the chestnut orchards, they will be the occurrence of the 3rd generation at a temperature area of southern province in Korea.

The death rate (%) of *D. punctiferalis* larvae on peach fruit were higher than other host fruits (Table 2). Pubescence composition of a peach surface couldn't be the limiting factors for *D. punctiferalis* larva with chewing mouth type. The property of the flesh of a peach is very different from that of the usual ones. It showed the low survival rate(%) of *D. punctiferalis* on a peach in the table 2. It thought their territory decayed quickly because of restricted like in the mud. If there were reared on hard peach such as chundo race, it is more

Table 3. Newly Hatching, pupation and emergence rate (%) of *D. punctiferalis* when reared on 3 different host fruits at 25±1°C, L15/D9 and 60±10%RH.

Stage of Molting	Rate(%)		
	Chestnut	Peach	Quince
Newly Hatching	94.0	89.2	79.6
Pupation	57.0	77.8	52.6
Emergence	63.3	85.7	70.0

*The initial number of eggs was 100 in chest, 250 in peach and 49 in quince for this test, respectively.

Table 4. Sex ratio of *D. punctiferalis* pupae when reared on 3 different host fruits at 25±1°C, L15/D9 and 60±10%RH.

Host	No. female	No. male	Sex ratio
Chestnut	26	23	53.1 : 46.9
Peach	7	7	50.0 : 50.0
Quince	6	5	54.5 : 45.5
Total	39	35	52.7 : 47.3

likely low death rates less than result in the table 2. Experimentally, the preferred host, *C. crenate* was found to be the most suitable host for *D. punctiferalis*.

There was significant difference in larval developmental period among 3 different host (Table 1). In the laboratory, larval developmental period of *D. punctiferalis* was approximately 2 times longer on quince fruit than chestnut fruit. This is in agreement with the results obtained by Mahani *et al.* 2003 that found differences of developmental period in *Xanthogaleruca luteola* within elms species.

Newly hatching rate(%) of *D. punctiferalis* egg in the table 3 showed a similar tendency that was 94.0% on the chestnut, 89.2% on the peach and 79.6% on the quince, respectively.

Pupation rate(%) of the tested insects were about or greater than 50% *D. punctiferalis* larvae fed on 3 natural food fruits (Table 3). And Emergence rate(%) were greater than 60% from all pupae reared on 3 natural food fruits (Table 3).

In the table 4, the sex ratio(female : male) of all pupae obtained on the tested natural food fruits were 52.7 : 47.3. The sex ratio of *D. punctiferalis* reared on three difference food fruits were no significantly.

Natural host fruits of diet affected the immature developmental periods of *D. punctiferalis*. Adult eclosion occurred at 25 on the chestnut fruit, 30 on the peach fruit, and 52 days on the quince fruit for males, and 27 on the chestnut fruit, 33 on the peach fruit, and 55 days on the quince fruit for females with three kinds of diet, respectively. The quantity and quality of the food sources provided by the host have an impact on both

immature stages of development and occurrent time of adults. Therefore, we know that the result of this study related to the effect of host diet on the generation of *D. punctiferalis* in Korea.

Acknowledgement

This study was financially supported by grants from ARPC(Agriculture R & D Promotion Center) of Ministry of Agriculture and Forestry.

Literature Cited

1. Chew, F.S. 1977. Coevolution of pierid butterflies and their cruciferous food plants. II. The distribution of potential food plants. *Evolution* 31:568-579.
2. Choi, K.S., K.S. Han, M.J. Jeon, Y.J. Chung, C.S. Kim, S.C. Shin, J.D. Park and K.S. Boo. 2004. Seasonal occurrence of the peach pyralid moth, *Dichocrocis punctiferalis* at chestnut orchards in some provinces of Korea. *Jour. Korean For. Soc.* 93: 134-139.
3. Choi, K.S. 1998. The peach pyralid moth, *Dichocrocis punctiferalis* Guenee (Lepidoptera : Pyralidae), adults : Circadian rhythms in activity and seasonal occurrence at chestnut orchards. ph D. thesis. 102pp. Seoul national University, Korea. (in Korean with an English abstract).
4. Hossian, M.M., S.H. Ali and A. Rahim, 1995. Some lepidopteran and homopteran pests and parasites of castor (*Ricinus communis* L.) Bangladesh J. Sci. Industrial. Res. 30: 265-269.
5. Konno, Y., H. Honda and Y. Matsumoto. 1981. Mechanisms of reproductive isolation between the fruit-feeding and the Pinaceae feeding types of the yellow peach moth, *Dichocrocis punctiferalis* Guenee(Lepidoptera : Pyralidae). *Appl. Entomol. Zool.* 25: 253-258.
6. Korea Forest Service. 2002. Statistical Yearbook of Forestry 32. 407pp. (In Korean).
7. Mahani, M.K., B. Hatami and H. Seyedoleslami. 2003. Host preference of three elms and hackberry for elm leaf beetle, *Xanthogaleruca(=pyrrhalta) luteola* (Coleoptera: Chrysomelidae). *Forest Ecology and Management.* 186: 207-212.
8. Neelay. V.R., R.S. Bhandari and K.S. Negi. 1981. Effect of insecticidal and hormonal spray on the production of fruits in teak seed orchard. *Indian For.* 109: 829-839.
9. Shinkaji, N. 1969. Studies on the peach pyralid moth, *Dichocrocis punctiferalis* Guenee (Lepidoptera : Pyralidae). II. Seasonal development with special reference to the difference between the fruit tree type and the conifer type. *Hiratsuka Agr. Eng. Res. Sta. Bull.* (In Japanese with an English abstract).