Kor. J. Pl. Prot. Vol. 12, No. 1, p. 41~46, 1973 한국식물보호학회지 제12권 제 1 호

Study on Stable Fly Eradication by Sterile-Male Technique.

1) Mass Rearing of the Stable Fly, *Stomoxys calcitrans* L.

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웅성불임기술을 이용한 쇠파리 구제에 관한 연구

1) 쇠파리의 인공대량사육에 관하여

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(접수일자 1973. 1.30)

적 요

1) 쇠파리의 누대 실내사육을 위한 온도는 약 26°C가 좋으며, 이때 유충기간은 약 6.8일, 용기간은 5.3일, 산란전기간은 10.4일, 성충의 수명은 약 30일이었다.

2) 인공사육에 있어서 용화율은 80.7% 우화율은 84.3%였으며 성비는 1 : 1이었다.

3) 용의 체중량은 약 14.5 mg이었으며, Wheat bran medium 보다 Standard medium이 사육성적이 좋았다.

4) medium 125 gr에 대한 난의 접종수는 약 310개가 가장 적합하였다.

5) rectangular cage를 사용할 경우, 성충의 resting place는 2 inch²/adult가 적합할 것으로 본다.

Acknowledgement

This project was granted partially by I.A.E.A.

Authors also express sincere thanks to Dr. Lindquist, Dr. Ouye and Dr. Moore for their helpful suggestion and valuable comments on the study.

Introduction

The first artificial diet for rearing of flies (*Musca domestica* L.) was reported by Lodge[13], and it has remarkably been developed in during last 40 years. Rearing of house fly appears to be easy as compared with the stable fly reared in the laboratory, because stable fly adult requires blood feeding to complete their life cycle. The first attempt to maintain colonies of *Stomoxys* was made by Glaser[8] and he succeeded in development of first artificial diets in 1940. Pospisil[14] reported that female stable fly was not able to lay eggs satisfactorily when it was fed with bloods of sheep, mouse and guinia-pig. Whereas Glaser[8], Bruce and Eagleson[2], and Eagleson[7] obtained satisfactory results by feeding difibrinated whole blood. By 1943, many investigators thought that the blood should be warmed to 25°C to 40°C before it was offered to the flies. However, Eagleson[7] declared that defibrinated or acidulated blood may be stored in a refrigerators and need not to be warmed to feed the flies. Also

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Woodbury[15] stated that flies feed as readily on ice-cold blood as when it had been at room temperature, but that the flies could not detect its presence except by contact with their tarsi. Appleby and Fisk[1] found that *Stomoxys* could be reared with fresh animal blood prevented coagulation by adding sodium citrate at the rate of 2 to 3.5g per liter of blood and it could be stored at the temperature of 0° to 7°C for 2 weeks or kept for longer period if frozen.

A screw-worm eradication project by using sterile male technique was launched by Knipling[11], Lindquist[12] and Bushland[3] in the southwestern United States. To carry out the sterile male technique, large number of laboratory reared insects are necessary and the efficient and economical rearing methods have been developed in the several species of insects, such as screw-worm, tobacco bud worm, and cotton weevil etc.

Stable fly damage is not serious like in the case of screw-worm, but blood sucking, transmits disease organisms, causes sucking wounds from which secondary infection of various diseases on cattle can occur. Consequently, production of milk and meat are reduced as compared with that of healthy cattles. Damage loss on cattle caused by blood sucking stable flies are hardly underestimated. Moreover, it is difficult to expect complete eradication by insecticides because of resistance to chemicals and residue problems. On this regards, it feels that there is an urgent need to expand research on the use of the sterile-male technique for stable fly control, especially in the suitable situation of Che-Ju Island. Hence, the preliminary results concerning laboratory rearing and life cycle of stable fly studied in 1972 are presented.

Che-Ju Island, experimental area of this program, is 183,485 ha. and situated at Pacific ocean 140 km away from the utmost southern parts of main-land of Korea. According to the 3rd Five Year Development Plan of Korean Government, the Che-Ju Island was designated as a cattle-raising province due to its historical background, suitable climate, and geographical status for raising cattles. At present, the island possesses about 45,000 heads of beef cattle, 10,672 heads of horse, and 2,244 heads of sheep and a huge government runing model ranch. The provincial government has established a plan to increase the number of beef cattle up to 84,000 heads by 1975.

Materials and Method

1) Rearing conditions

Stable flies were reared in a room maintained 16°C-28°C in temp. and 50% in relative humidity.

2) Adult cage

Stable fly adults were raised in rectangular screen nylon cages (40cm×50cm×40cm) (Photo. 1) and rectangular screen wire cages (15cm×15cm×60cm) (Photo. 2). Optimum number of adults per cage and type of cages were determined in this experiment. The front of the cage consists of a cloth sleeve which gives access to the interior. Petri dish (9cm in diameter) containing cotton soaked with citrated beef blood and they were replaced daily. A wet and black colored cloth was placed under the cage to oviposit on it. For the contineous feeding, citrated blood is stored at 2°C—5°C for 3 weeks.

3) Eggs

Female flies begin to deposit eggs from 8th day after emergence. The eggs are washed out or brushed off from black cloth (Photo. 3).

4) Larvae

The larvae rearing medium used by Champlain *et al*[6] Goodhue and Cantrel[9] was composed of 27% alfalfa meal, 33% of soft wheat bran, 40% of brewer's dried grain, and 25% of sawdust. The author used another medium consisting of wheat bran mixed with sawdust (3 : 1 ratio) to compare it with CSMA medium[6] For rearing the larvae, plastic containers (23cm×12cm×10cm) were employed and optimum number of pupae cultured on 125 grams of standard medium were also determined (Photo. 4).

5) Pupae

Complete pupation was found 10 days after seeding in the top layer of the rearing medium. Pupae were seperated from the larval medium by washing method developed by Goodhue and Linnard[10] To obtain

clean pupae, a 10 mesh sieve was used and the pupae were spread on filter paper for drying before being transfered to adult cages (Photo. 5).

Results and Discussion

The results obtained from these preliminary studied so far were as follows:

1) Developing stage due to different temperature.

Table 1. shows days of larvae, pupae, preoviposition, and adult stage at different room temperature from August to October.

Table 1. Days of larvae, pupae, preoviposition and adults stages at different temperature condition.

Month	Min. Temp. (C)	Max. Temp. (C)	Ave. Temp. (C)	Larvae	Pupae	Preoviposition	Days for adult stage
August	24.74	27.62	25.68	6.84	5.33	10.43	30.40
September	20.92	24.35	22.64	7.36	6.91	13.00	31.50
October	16.10	18.83	17.47	9.17	10.09	17.67	26.80

Number of days required for each stage of development at a room temperature (ave. temp.: 25.68°C) of August were 7 days from egg to pupae, 6 bays from pupae to adult, and 11 days from pupae to preovipositional period, respectively. On the other hand, at a room temperature (ave. temp.: 22.64°C) of September, 8 days from egg to pupae, 7 days from pupae to adult, and 11 days for preovipositional period were required. But, the room temperature (ave. temp.: 17.47°C) of October was significantly lowered than those of August and September. The number of days required for each stage of development in October was significantly prolonged, that is, they were 10 days from egg to pupae, 11 days from pupae to adult, and 18 days for preoviposition. These results were similar to that of Calvin[4], and the actual number of days for the development in this study was longer than the days reported by Calvin. This may be due to the constant rearing temperature of 15.5°C, 21.1°C, and 26.6°C in the Calvin's study, but this experiment was carried out under various room temperatures. Ratio of pupation and emerging was 80.7% and 84.32%, respectively and sex ratio was 1 : 1 at adult stage in this experiment.

Table 2. Ratio of pupation, emerging and sex appeared in the artificial culture.

% of pupation	% of emergence	Sex Ratio (%) Female	Male
30.72	84.32	50.68	49.32

2) Life cycle following different media

The results obtained from rearing stable flies by two kinds of artificial diets were shown in Table 3.

Table 3. Development of stable flies reared on standard medium and wheat bran medium.

	Culture temp.	Larvae	Pupae	Weight pupae (mg/pupae)
Standard medium	21.4°C	7	8	14.52±0.76
Wheat bran medium	22.7°C	6	7	13.86±0.53

(1) Standard medium (C.S.M.A.'s method, 1963)

Alfalfa meal	26.67 g
Soft wheat bran	33.33 g
Brewer's dried grain	40.00 g
Sawdust	25.00 g

(2) Wheat bran medium

Wheat bran	100 g
Sawdust	30g

Weight of pupae grown on standard medium was 14.52±0.76mg, which is heavier than ones grown on wheat bran medium. The number of days required for development each stage of on wheat bran medium was decreased as compared with standard medium.

Table 4. Effect of population size on the pupal weight of stable fly(grown on the 125 grms of standard medium)

Number of pupae	Weight of pupae (mg)	Number of pupae	Weight of pupae (mg)
0—50	13.365	200—250	14.148
50—100	14.288	250—300	12.582
100—150	14.396	300—350	
150—200	14.297	350—400	12.533

3) Determination of optimum number of eggs for inoculation on 125 gr. of standard medium.

As shown in Table 4, different number of eggs were inoculated on 125 g. of standard media provided and optimum number of egg size which produce maximum number of healthy matured pupae was determined. Significant reduction in body weight was observed in case of pupae matured over 250 per flask containing 125gr of standard medium. Since the pupation rate was 80 per cent, inoculation of 310 eggs per 125g of medium would be most efficient and economical in the stable fly rearing.

4) Determination of adult population in the different types of cage.

Maximum number of eggs were collected with 400 adults raised in a wire cage and 600 adults in a nylon cage. This result indicates that at least two square inches per adult should be provided for resting place. Many investigators reported that optimum resting place is one square inch per fly with cylinderlical cage, but it seems to need more resting area in the rectangular cages which have been employed in this experiment.

Table 5. Determination of optimum number of adults grown in the different types of cages.

No. of adults:	0—200	200—400	400—600	600—800	800—1,000
Iron Cage;*					
No. of eggs	1,565	2,570	1,563	1,474	1,305
No. of eggs/F.	24.8	16.8	6.5	4.0	3.0
Nylon Cage;**					
No. of eggs	240	2,403	4,566	2,772	1,829
No. of eggs/F.	2.2	6.9	18.9	7.1	4.3

*The size of Iron Cage: 15×15×60 cm.
**The size of Nylon Cage: 40×40×50 cm.

Abstract

1) The optimum temperature for mass rearing of stable fly was 26° centigrade. Number of days required for stage of development at 26°C were 6.8 days for larval stage, 5.3 days for pupla stage, 10.4 days for preovipositionla stage, and 30 days for adult stage respectively.

2) The pupation rate, emergence rate and sex ratio were 80.7%, 84.3% and 1 : 1, respectively.

3) The average weight of pupae was 14.5mg, and the standard medium showed better result in larvae rearing than wheat bran medium.

4) The optimum number of eggs for inoculation on 125gr medium was approximately 310.

5) Optimum size of resting place was determined as 2 inch²/adult when it reared in a rectangular cage.

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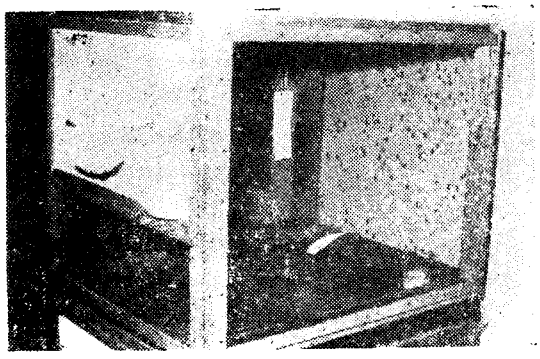

Photo. 1 Rectangular nylon screened cage for adults.

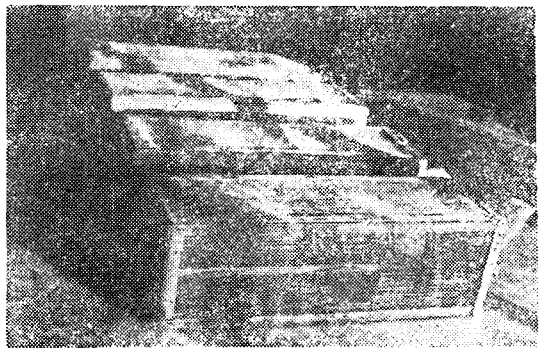

Photo. 2 Rectangular wire screened cage for adults.

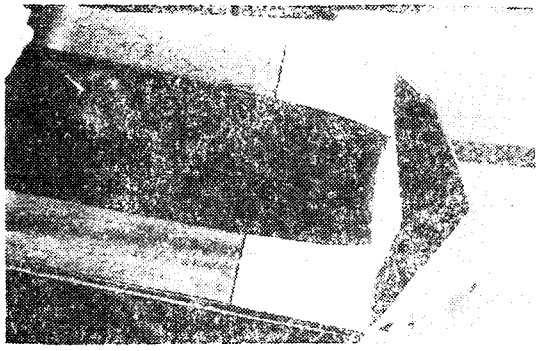

Photo. 3 Collection of eggs.

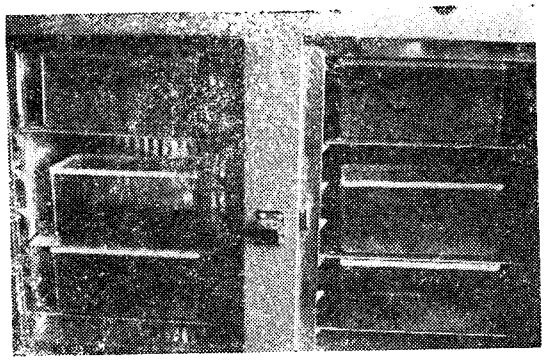

Photo. 4 Plastic box for rearing of larvae.

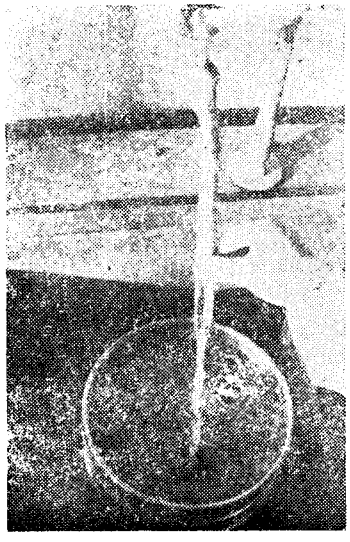

Photo. 5 Separation of pupae.