Effects of pyriproxyfen on *Aedes albopictus*

การศึกษาผลของ pyriproxyfen ต่อยุง *Aedes albopictus*

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จากการศึกษาผลของ pyriproxyfen ซึ่งเป็นสารที่มีคุณสมบัติเหมือน juvenile hormone ต่อลูกน้ำยุง Aedes albopictus ในห้องปฏิบัติการ และภาคสนาม เพื่อศึกษาประสิทธิภาพ และความเข้มข้นต่ำสุดของสาร pyriproxyfen ที่จะใช้ในการยับยั้งการเจริญจากตัวโม่ง (pupae) เป็นตัวเต็มวัย ผลจากการวิจัยพบว่าความเข้มข้นของ pyriproxyfen 1 - 10 ppm สามารถยับยั้งการเจริญเป็นตัวเต็มวัยของตัวโม่ง Aedes albopictus นานเกินกว่า 2 เดือน และผลจากการทดสอบในห้องปฏิบัติการ พบว่า ตัวเต็มวัยของยุง Aedes albopictus ที่ได้รับการทดสอบด้วย pyriproxyfen ที่ sublethal concentration $1X10^{-6}$ ppm มีความสามารถในการสืบพันธุ์ (จำนวน ไข่/ตัว, อัตราการฟักไข่) ไม่ต่างจากกลุ่มเปรียบเทียบและพบความแตกต่างในเรื่องความไวต่อการเปลี่ยนเป็นตัวเต็มวัยของลูกน้ำเพศผู้และเพศเมียเมื่อทดสอบด้วย pyriproxyfen ขนาด $1X10^{-4}$ ppm

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Abstract *: Pungasem Paeporn, Yoshio Tsuda, Masahiro Takagi, Yoshito Wada. 1997. Effects of pyriproxyfen on Aedes albopictus. Thai J Hlth Resch 11(1) : 55-61.*

Pyriproxyfen, a juvenile hormone mimic was used in field and laboratory studies. In field study, concentrations of 0.1, 1.0 and 10 ppm were tested in water containers to determine the minimum effective concentration and evaluate length of effective period. The concentration of pyriproxyfen between 1.0 to 10 ppm showed emergence inhibition of Ae. albopictus for more than 2 months. In laboratory experiments, no significant difference in reproduction was found between control and adults emerging from larvae treated with sublethal concentration of pyriproxyfen at $1X10^{-6}$ ppm. A difference in sensitivity between sex were found when larvae were treated with pyriproxyfen at $1X10^{-4}$ ppm.

Key words *: pyriproxyfen, Aedes albopictus*

Introduction

Pyriproxyfen, 2 - { 1- methyl -2 - (4 -Phenoxyphenoxy) ethoxy} pyrideine, also known as s-31183 and tradenames as Nylar® and Sumilarv® is a juvenile hormone mimic. This compound does not produce direct larvae toxicity except at very high treatment levels (Schaefer *et al.*, 1991). It disrupts the normal process of insect development, resulting in pupal mortality or production of abnormal adults. It is highly active against a variety of public health importance insects including cockroaches, fleas, tsetse fly and mosquitoes (Schaefer and Mulligan, 1991).

The objective of this research was to evaluate the effectiveness of this insect growth regulator against the mosquito *Aedes albopictus*, an important vector of dengue virus in Asia (Simmons *et al.*, 1931)

Materials and Methods

Technical standard of pyriproxyfen 0.5 % was used in the field and laboratory experiments.

Field experiment : pyriproxyfen was applied in water containers of 14.7 cm diameter, 17.5 cm high with water volume of 1 litre at concentrations of 0.1, 1.0 and 10 ppm. Six replicates per concentration were set in 6 separate areas. Each area is approximately 1 metre distance setting up around a building near Nagasaki University School of Medicine campus. Waiting for mosquito to lay egg. Day of treatment was 28 April, 1994.

The effect of pyriproxyfen was evaluated by collecting pupae from water containers then transfering them to 30 cc vial with 15 cc of water. Vials were then placed in a cage and kept in the laboratory (temperature 27 $^{\circ}$C, 80 % humidity) to observe mortality and adult emergence.

The days of pupal collection were Monday, Wednesday, and Friday each week. The temperature and level of water in cm. were recorded everytime of collection.

Laboratory experiment : First of all sublethal concentration of pyriproxyfen was determined using larvae in beakers. Adult emerging from larvae treated with sublethal concentration were kept in cage and maintained on 3 % sucrose, at the age of 3 - 5 day a mice was offered for a blood meal. Feeding response, egg production and egg hatching were recorded.

The sensitivity of pupal sex for adult emergence were tested at different concentrations of pyriproxyfen.

Results and Discussion

The first day of pupal collection was May 30, 1994. Data of temperature and amount of water in treated water containers are shown in Table 1 and numbers of pupae collected per water container are shown in Table 2. The number of pupae per container was expected to be minimum with highest concentration in the field experiment because pyriproxyfen at higher dose have a lethal effect on *Ae. albopictus* larvae in the field experiment (Takagi *et al.*, 1995).

Because the water containers were dried up due to hot weather and the effect of pyriproxyfen was wanted to be examine further more after dry up period so water was added up to maintain the volume of 1 litre in each container. Water was added the first time on August 16 and second time on August 29, 1994. Twenty fourth instar larvae of *Ae. albopictus* were added in each water container 1 day after water addition (on August 17 and August 30 respectively). Pupae were collected until September 9, 1994.

Table 1 Temperature and water volume in treated water containers

	Temperature (°C)		No. of container		Average
(Month. day)	Max	Min	A	B	Depth (cm.)
530-603	29.5	12.7	18	0	5.87
606-610	28.8	18.2	18	0	4.48
613-617	26.3	17.3	18	0	5.92
620-624	26.0	13.0	18	0	6.38
627-701	30.7	19.7	18	0	6.29
704-708	34.2	24.3	17	1	5.18
711-715	35.7	23.0	10	8	3.75
718-722	37.5	25.8	10	8	2.64
725-729	34.7	24.8	6	12	1.71
801-805	37.5	25.5	6	12	1.60
808-812	37.5	24.5	5	13	1.15
815	37.5	24.5	3	15	0.71

Average length of dry up period = 37.07 ± 17.21
(in days) (Min 4, Max 53)

Total number of treated water container was 18 (3 concentration in 1 area and 6 replicates per concentration)

A : Number of treated water container with water

B : Number of treated water container without water

Percentage of emergence inhibition were calculated compared with control by using Abbott's formula (Abbott, 1925), data is shown in Table 3.

The nearly complete inhibition of adult emergence was observed for more than 2 months at 1.0 and 10 ppm which complied with the report of Takagi *et al.* (1995) stating that the complete inhibition of adult emergence was observed continuously for 6 and 4 weeks at 0.1 ppm in the laboratory and in the field, respectively. The effective period of pyriproxyfen was longer in the laboratory than in the field at all concentrations. The change in water amount in containers was considered to be the main reason for the shorter effective period in the field.

Table 2 Average numbers of pupae collected per water container

			Treatment		
		Control	0.1 ppm	1.0 ppm	10 ppm
June	early	20.5	26.2	27.3	2.3
	late	21.0	30.7	21.7	12.7
July	early	24.5	16.0	25.5	8.3
	late	2.0	5.2	3.7	1.3
August	early	0	1.7	4.7	3.3
Total		68.0	79.8	82.9	27.9

Control was container filled with 1 litre of untreated water setting together with treated container in each area.

Treatment was container filled with 1 litre of treated water with pyriproxyfen at concentration of 0.1 , 1.0 and 10 ppm.

Table 3 Percentage of emergence inhibition

		Control	0.1 ppm	1.0 ppm	10 ppm
June	early		70.25	100.00	100.00
	late		63.99	100.00	100.00
July	early		29.61	95.03	100.00
	late		36.84	100.00	100.00
August	early		61.29	100.00	100.00
Add Water 8/16					
August 19-29			68.97	97.60	93.38
Add water 8/29					
August 31 - September 9			71.24	95.70	98.79

In the laboratory experiment, fourth instar larvae of *Ae. albopictus* were exposed to sublethal concentration of pyriproxyfen at 1 X 10^{-6} ppm. Pupae were isolated for emergence in cages. Two male and ten female mosquitoes were kept in a cage with sugar and blood meal provided. No significant difference of feeding response, egg production and egg hatching was found compared with control, neither with control that have ten males and ten females. There was a difference in sensitivity between male and female mosquitoes when treated with pyriproxyfen at 1 X 10^{-4} ppm as fourth stage larvae, resulting in different percentages of adult emergence between males and females. Males were more sensitive than females as shown in Table 4.

Table 4 Difference in effect of pyriproxyfen between sexes of mosquitoes representing in percentage of adult emergence

	Control	Treatment ($1X10^{-4}$ ppm)
Male	10 (41/41)	16.2 (6/37)
Female	99.1(113/114)	32.9 (48/146)
Total	99.4 (154/155)	29.5 (54/183)

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