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Biology of Dengue Vectors and Their Control in Thailand

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Abstract : The vectors of dengue, dengue haemorrhagic fever, and dengue shock syndrome are *Aedes aegypti* in the urban and rural areas and *Aedes albopictus* in the rural area. *Aedes albopictus* a species member in *Aedes niveus* subgroup is highly susceptible to dengue 2 virus in laboratory. This species breeds in the forest in bamboo stump and tree hole and may be a source of sylvatic transmission. The anthropophilic, diurnal and domestic habit of *Aedes aegypti* in the increasing population of the world sustain *aegypti* population. In South East Asia *aegypti* is now invading *albopictus* the original species. Some evidences in biology morphotaxonomy, biochemistry indicate the plasticity of the species. The control strategy mainly for *Aedes aegypti* are (a) emergency control to interrupt transmission (b) larvicide (c) environmental management. Integrated control would be emphasized. Primary health care aims at extending health services to all the population and participation of each section of the community is essential and under the supervision of vector control professional, making use of the extensive research on vectors and their control.

Key words : Integrated Control, Eradication, *Aedes aegypti*, *Aedes albopictus*, *Aedes niveus* subgroup. Community participation

INTRODUCTION

The vectors of dengue, dengue haemorrhagic fever and dengue shock syndrome are *Aedes aegypti* and *Aedes albopictus*. *Aedes aegypti* is responsible for the transmission in urban and rural communities whereas *Aedes albopictus* in the rural. The other two vectors, *Aedes scutellalis* and *Aedes polynesiensis* in South Pacific, do not present in Thailand. A global threat of this disease is from South East Asia the primary focus West ward to India and Africa and East ward to South Pacific and Central and South Americas especially where there is prevalence of *Aedes aegypti* and *Aedes albopictus* and where dengue viruses of more than one type circulate. Increasing air transportation enhances possibility of involvement of a large number of dengue viremic travellers from one place to another. Eradication of *Aedes aegypti* is possible in America but it has not been possible to sustain in the face of constant reintroduction from the countries still infected. A real

need to study the biology of dengue vector and their control is inevitable so that the control is possible. Moreover transmissions in forest cycle of dengue virus are also possible.

MATERIALS AND METHODS

All the materials and methods were from the Department of Medical Entomology, Faculty of Tropical Medicine, Mahidol University, Bangkok 10400, Thailand. Additional Research were from the Department of Medical Science, Ministry of Public Health, Thailand.

RESULTS

Aedes aegypti: *Aedes aegypti* distributed around the world but rarely occurred beyond latitudes of 45°N and 35°S, where January and July isotherm are 10°C. Altitude is a further modifying circumstance, as also some other factors, notably distance from the sea, desert condition and isolation from human intercourse (Christophers, 1960).

Ae. aegypti has the characteristics on the adult, the lyre shape of white scales and bristles on the dorsum of thorax, maxillary palps covered with white scales. *Aedes aegypti* mutants, the adult female mutant "dorsum of abdomen almost pale" was recorded in our museum. The mosquitoes were studied for 7 enzymes: aldehyde oxidase, esterase, leucine aminopeptidase, lactate dehydrogenase, malate dehydrogenase, malic enzyme, xanthine dehydrogenase (Aldox, Est, Lap, Ldh, Mdh, Me and Xdh) accordingly to Ayala et al., (1972), Steiner et al., (1979), and Tsukamoto, (1984) with modifications in the buffer system and staining for enzyme detection. Isoenzyme patterns were found different from the others in Esterase and Me. The larvae has 8-12 comb scales arranged in one row at the 8th abdominal segment and the spine like thorn posterior to pleural hairs are diagnostic. The egg can be differentiated from *Ae. albopictus* in electron micrograph (Linley, 1989) at micropylar collar, large tubercle, small tubercles, reticulum, ridge and recently ordinary microscope and photographic technique could reveal nearly the same as SEM. The breeding habitats are jars, ant traps, flower pot plate, vase, small jar, and used tire. The adult is anthropophilic and endophagic. Blood feeding study indicated that apart from biting human *aegypti* also bite pig, cow, chick and there was evidence of repeated feeding. The biting cycle is diurnally periodic with the peaks at 10.00 and 15.00 hours. The resting cycle is diurnally subperiodic with the peak at 10.00 hours. Adult do not rest on the wall but on the hanging object. Competition with *Aedes albopictus* larvae was found in laboratory that in the situation where larval food is insufficient *Aedes aegypti* grew better than *albopictus* and the more the percentages of *aegypti* larvae the less the percentages of *albopictus* survived (Sucharit et al., 1978). This evidence explains why *aegypti* is now invading and wiping out *albopictus* the original species *Aedes albopictus* "the Asian Tiger mosquito".

Aedes albopictus: The common name of this species is the Asian Tiger mosquito. Prevalence in oriental region, Australia, Bonin islands, Chagos Islands, French Somaliland, Hawaiian Islands, Japan, Korea, La Reunion, Madagascar, Nepal, New Guinea, Ryukyu Island, Seychelles, West Irain. Now *Aedes albopictus* is invading USA and I come across with the specimens from Albania.

Aedes albopictus, adult with one longitudinal white band on the dorsum of thorax, V shape from group of white scales at mesepimeral are diagnostic. Fringed comb scales and no spine at the 8th abdominal segment and thorax respectively are diagnostic in larvae. It breeds outside the house in bamboo, flower pot plate, coconut shell, can, tire, cup, and leave axil. The biting cycle is diurnally crepuscular periodic with two peaks at 06.00-10.00 hours and 18.00-20.00 hours and is vicious day biter. A single peak of oviposition activity occurs between 08.00-10.00 hours may be as late as 20.00 hours. It is common in Tropical Asia and very common throughout Japan including the Ryukyu Archipelago, especially northern districts.

Aedes niveus subgroup: *Aedes niveus* subgroup is believed to be responsible for the jungle cycle transmission and one of many species, *Aedes albolateralis*, is highly susceptible to dengue 2 virus as *aegypti* in laboratory. Virus could replicate in salivary gland, cervical cell of brain and fat body cells but not in gut and ovary.

Aedes niveus subgroup distributed in Indonesia, Malaysia, Thailand, Andaman Islands, China, India, Sri Lanka, Borneo and Singapore.

Control: Even though *aegypti* is endophilic the adult do not rest on the wall but prefers to rest on hanging object. The residual effects of DDT sprayed on the wall have little effect on the reduction of adult population. Moreover *aegypti* was found to resist to DDT which was not recommended for use in health related control program. *Aedes aegypti* is resistant to DDT and HCH in most countries, but the impact of this resistance has not been evaluated. DDT resistance conferred cross-resistance to bioresmethrin and some other pyrethroids but it was not a problem for trial of the third generation synthetic pyrethroid lambdacyhalothrin. The control strategy are: - (a) Emergency control to interrupt transmission by infected and infective adult mosquitoes by space spraying by ULV (Ultra low volume) or by fogging (Fenthion, Fenitrothion, Naled, Propoxur, Malathion). (b) Larvicide by Abate or Larvicos with extremely low toxicity to fish and mammals or biological agents. Larvicide applied to drinking water containers must have an extremely low mammalian toxicity and must be tasteless, colorless and odorless to be accepted by the people. The only larvicide then available with these characteristics was Temephos (Abate), with an acute oral LC50 toxicity for rat of 8600 mg/kg. Cycle treatment of all habitat at 3-month intervals followed by individual treatment of those habitat found positive during routine inspection. Two cyclical treatments were effectiveness required 34 weeks for Abate and 20 weeks for periodic water enough to abate adult. (c) Environmental management.

Eradication of *Ae. aegypti* is possible in America but it has not been possible to sustain in the face of constant reintroduction from the countries still infested. After a

major epidemic of DHF/DSS, some countries succeeded in virtually eradicating *Ae. aegypti* but in most other countries, vector control programs are frequently ineffective because they lack public cooperation or adequate funding.

Integrated control would be emphasized on environmental management as the principal tool for vector control, integrated with judicious use of insecticide only when physical methods are impractical and with biological control methods where appropriate. The agents are spider for adult, *Toxorhynchitis*, naiad, nematodes, cyclops (*Mesocyclops leukarti* complex), fish, etc. for larvae. Other methods are going on in research phase.

A new sound trap to attract male mosquitoes and sterilize them with chemosterilant treated on the screen surface could brought down 80.9% female and 75.6% male *Aedes albopictus*.

Complete control of larvae of *Aedes* mosquitoes with larvicides is quite difficult, because their larval habits distribute at every aquatic places as a left tire and tree hole. IGR (pyriproxyfen) treated blood fed female of *Aedes aegypti* when laid eggs, a little amount of IGR were left to aquatic spot, causing high inhibition of emergence of adults. Thus, a new method of *Aedes* mosquito control was suggested by Kawada, Itoh and Abe, (1992).

Ikeshoji, (1992) developed an autocidal control method in laboratory by a laser (He/Ca CUV, 13m W/M²), He/Ne (red, 5m w/m²) or argon (blue, 43 w/m² and green, 40 mw/m²). The mortality increased and egg hatches decreased. Some chromosomal aberration of the progenies were observed. The application of less irradiation to the field population may be significant as an autocidal control method.

Primary health care (PHC) aims at extending health services to all the population and, participation of each section of the community is essential component of its health delivery. Whatever the degree of participation by community, there is a need for efficient, professionally direction, vector control groups to carry out vector and disease surveillance, supervise or implement vector control operations and evaluate the efficacy.

Law enforcement for vector control by the community are one means but are generally unpopular and even counter-productive.

Dengue vector control in Thailand must integrate the use of insecticides, environmental management, legislation and community participation under the supervision of vector control professional, making use of the extensive research on vectors and their control carried out in Thailand.

DISCUSSION

The rising trend of DHF inspite of control measures were put in. The vectors are now prevalent in all area infested with DHF. *Aedes aegypti* is the most important one in transmission of DHF because of its domestic and anthropophilic nature. Eradication of both vectors *Aedes aegypti* and *Aedes albopictus* is impossible. Eradication of *Aedes aegypti* must be looked for in the control of DHF because if eradication of *Aedes aegypti*

is not succeeded they will propagate with the help of human behavior facilitating the breeding of *Aedes aegypti*. To reach the goal advance research in biology, species and control of *Aedes aegypti* and other related species are needed.

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