UNIVERSITI PUTRA MALAYSIA

POMACEA INSULARUS (GASTROPODA: PILIDAE): ITS CONTROL UNDER THE INTEGRATED PEST MANAGEMENT (IPM) CONCEPT

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***POMACEA INSULARUS* (GASTROPODA: PILIDAE): ITS CONTROL UNDER THE INTEGRATED PEST MANAGEMENT (IPM) CONCEPT**

By

EDI SURYANTO

Thesis Submitted in Fulfilment of the Requirement for the Degree of Doctor of Philosophy in the Faculty of Science and Environmental Studies Universiti Putra Malaysia

December 2000

Dedicated to

My wife,

Dwi Triyanti Abadi Asih

My children,

Arjuna Eka Purnama

Bayu Dwi Kurniawan,

Candra Trihasana Marsyawan

and *Dewi Oktamasari Yasintia*

Your constant encouragement, sacrifice and support is highly appreciated

My parents, *R.W.Projowidharjo* and *Ny. Suratmirah*

My parents in law, *H.R.M. Soenardi* and *Hj. Ny. Koestiyah*

Your "do'a" for my success is very much acknowledged

My elder sister, *Rr. Sri Mulyantiningsih*

My younger brother, *R. Jendra Wardhana*

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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Chairman: Professor Madya Dr. Jambari H. Ali

Faculty: Science and Environmental Studies

Three control measures of *Pomacea insularus* as parts of IPM (Integrated Pest Management) components were studied; firstly the development of plant molluscicides, secondly the use of fish as its biological control and thirdly its utilisation as quail (*Coturnix coturnix japonica*) feed. Leaf powder of yellow flame (*Peltophorum pterocarpum*) was found to be quite effective in killing the snails. The powder is water soluble (28% solubility) and yielded high extracts (25% of water extraction and 23% of methanol extraction). The LC_{50} value of this powder solution is about 91 mg/L at 72 h. exposure, on two-week-old test snails. Saponins were the active compounds found in the yellow flame leaves. Kept in solution form, the molluscicide strength deteriorated after 30 days with toxicity level reduced to 34%. The toxicity of the molluscicide in the field trials was found to be twice lower than that of Tea Seed Cake (TSC) powder, a molluscicide used in Malaysia. The broadcasting application of 150 kg/ha of this leaf powder molluscicide in 15 cm deep rice field (equivalent to 100 mg/L) killed 100% of the adult snails in three days as

compared to about 75 kg/ha (equivalent to 50 mg/L) of TSC. Study on the control of the snails using fishes revealed that black carp, *Mylopharyngodon piceus* and hybrid African catfish, *Clarias* sp. were good snail predators. In the laboratory trials the former was more vigorous, consuming at the rate of 60% of its body weight, within 24 h, while the latter consumed only 7%. Due to the shape and size of its mouth, black carps had greater ability in swallowing the snails than catfish. Young black carp of 25 g in size could consume snails of up to about 1.0 cm in shell length. There were high correlationships between the size of snails consumed and the size of fish and the mouth width, with the equation of $Y = 0.26 \text{ Ln } (X) + 0.16$ ($r^2 = 0.93$) and of $Y = 0.4 \text{ Ln } (X) + 1.25$ ($r^2 = 0.93$), respectively. Adult catfish (119 – 171 g) could only consume snails of up to 1.5 cm shell length. Results from the release of catfish into the rice field showed a clear trend of a reduction in the snail population. Macroinvertebrates populations presence in the rice field were another source of food supply to the fish, thus enabling the fish to grow without being given supplementary food. Biological control of this snail using fish was, however, confronted with the problem of predators such as birds, crab, eel and otters. Snail meal contained high protein (32%) and mineral (26%). It could be a substitute for fish meal, meat and bone meal or soya bean meal as quail feed without having any effect on its growth performance. Birds fed with snail meal also performed as good as those given commercial feed. The performance indices such as average daily gain (ADG), feed conversion ratio (FCR) and carcass percentage of birds given snail meal protein was comparable with those given conventional protein source. A palatability test conducted had shown that meat of the bird fed with snail meal was well accepted by food panelists. Each control measure of snails that has been studied demonstrated promising results. Thus the implementation of the control measures could be exercised in the field integrally to achieve managable control of the population of *Pomacea insularus*.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
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POMACEA INSULARUS (GASTROPODA: PILIDAE): KAWALAN BERASASKAN KONSEP PENGURUSAN MAKHLUK PEROSAK BERSEPADU

Oleh

EDI SURYANTO

Disember 2000

Pengerusi: Profesor Madya Dr. Jambari H. Ali

Fakulti: Sains dan Pengajian Alam Sekitar

Tiga kaedah kawalan siput gondang emas, *Pomacea insularus* yang merupakan sebahagian daripada Kawalan Makhluk Perosak Bersepadu (IPM) telah dikaji untuk mengetahui keberkesanannya. Pertama adalah penghasilan moluskisida tumbuhan. Kedua adalah penggunaan ikan sebagai agen kawalan biologi dan yang ketiga adalah kegunaan siput sebagai makanan burung puyuh (*Coturnix coturnix japonica*). Serbuk daun batai laut, *Peltophorum pterocarpum* didapati merupakan moluskisida yang berkesan untuk membunuh siput. Daun batai laut mudah terlarut (20% kelarutan), menghasilkan lebih tinggi ekstraks (28% ekstraks air dan 23% ekstraks metanol). Nilai LC_{50} larutan serbuk ini adalah 91 mg/L, pendedahan 72 jam, terhadap siput ujian berumur dua minggu. Saponin adalah sebatian aktif yang terdapat dalam daun batai laut. Disimpan dalam keadaan larutan, racun siput ini merosot kekuatannya selepas 30 hari dengan ketoksikannya menurun kepada 34%.

Kajian racun ini di lapangan mendapati bahawa ketoksikannya hanya separuh daripada Tea Seed Cake (TSC), iaitu sejenis racun siput yang digunakan di Malaysia. Dengan menabur serbuk racun ini pada kadar 150 kg/ha di sawah yang kedalamannya 15 cm (setara 100 mg/L) didapati telah membunuh 100% siput dewasa berbanding dengan 75 kg/ha (setara 50 mg/L) TSC. Kajian kawalan siput menggunakan ikan mendapati bahawa kap hitam, *Mylopharyngodon piceus* dan keli Afrika hibrid, *Clarias* sp. adalah pemangsa yang baik. Kajian di makmal menunjukkan bahawa ikan kap hitam adalah pemangsa siput yang lebih baik yang mampu memakan siput sehingga 60% berat badannya dalam masa 24 jam sementara ikan keli hibrid hanya memakan 7% berat badan sahaja. Disebabkan oleh bentuk dan ukuran mulutnya, kap hitam mempunyai kemampuan yang lebih besar untuk menelan siput berbanding ikan keli hibrid. Anak ikan kap hitam yang bersaiz 25 g mampu memakan siput yang bersaiz sehingga 1 cm panjang cangkerang. Sedangkan ikan keli hibrid dewasa (119 – 171 g) hanya boleh memakan siput yang bersaiz sehingga 1.5 cm panjang cangkerang sahaja. Terdapat hubungan yang erat antara saiz siput yang dimakan dengan saiz ikan dan saiz mulut ikan dengan masing-masing, $Y = 0.26 \ln(X) + 0.16$, ($r^2 = 0.93$) dan $Y = 0.4 \ln(X) + 1.25$, ($r^2 = 0.93$). Keputusan daripada pelepasan ikan keli ke dalam sawah menunjukkan bahawa populasi siput adalah berkurangan. Kehadiran populasi makroinvertebrata dalam sawah padi merupakan satu lagi sumber bekalan makanan kepada ikan, yang membolehkannya membesar tanpa memberi makanan tambahan. Namun kawalan biologi dengan menggunakan ikan ini menghadapi masalah pemangsa seperti burung, ketam, belut dan memerang di sawah. Tepung siput mengandungi protein yang tinggi (32%) dan mineral (26%). Ianya dapat menggantikan tepung ikan, tepung daging tulang atau tepung kacang soya sebagai makanan puyuh tanpa menjejaskan hasilnya. Puyuh yang diberi tepung siput juga memberikan hasil sebaik yang diberi makanan komersil. Keputusan seperti purata tambahan harian (ADG), kadar konversi makanan (FCR) dan peratus karkas (tulang dan daging) bagi puyuh yang diberi tepung siput adalah setanding dengan puyuh yang diberi protein biasa. Dalam ujian citarasa yang dijalankan didapati bahawa daging puyuh yang diberi tepung siput diterima baik oleh ahli panel makanan. Setiap kaedah kawalan yang dikaji menunjukkan keputusan yang menggalakkan. Justeru penerapan kaedah-kaedah kawalan ini secara bersepadu dapat dilakukan di lapangan bagi mencapai populasi *Pomacea insularus* yang terurus.

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ADG	: average daily gain
BW	: body weight
Comm. feed	: commercial feed
Ca	: calcium
CF	: crude fiber
cm	: centimeter
CP	: crude protein
DM	: dry matter
DO	: dissolved oxygen
FC	: Flooding Canal
FCR	: feed conversion ratio
FI	: feed intake
ha^{-1}	: per hectare
IPM	: Integrated Pest Management
IRRI	: International Rice Research Instistute
L	: litre
LC_{50}	: lethal concentration (50% mortality)
LD_{50}	: lethal dosage (50% mortality)
m^{-2}	: per square meter
NaPCP	: Sodium penta chlorphenolate
NRC	: National Research Council

NRF	: Neighbouring Rice Field
NTO	: Non Target Organism
P	: phosphor
ppm	: part per million
PR	: Paved Road
PVC pipe	: poly vinyl chlorida pipe
r^2	: coefficient correlation
rpm	: rotation per minute
SAS	: System of Analytical Statistics
SB	: Soil Bund
SM	: Snail Meal
TSC	: tea-seed cake
UPM	: Universiti Putra Malaysia
USD	: United States Dollar
UV	: ultra violet
v/v	: volume per volume
w/v	: weight per volume
WSM	: whole snail meal