J.Sci.Soc. Thailand 13 (1987) 29-45

THAI PISCICIDAL PLANTS, I

SOMMAI CHIAYVAREESAJJA[a], WILAWAN MAHABUSARAKAM[b], JAMES F. MAXWELL[c], PICHAET WIRIYACHITRA[b,e], and G. H. NEIL TOWERS[d]

[a] *Department of Aquatic Sciences, Faculty of Natural Resources, Prince of Songkla University, Hat Yai 90110, Thailand.*

[b] *Department of Chemistry, Faculty of Science, Prince of Songkla University.*

[c] *Herbarium, Department of Biology, Prince of Songkla University.*

[d] *Department of Botany, University of British Columbia, Vancouver, Canada.*

[e] *To whom correspondence should be addressed at Faculty of Pharmacy, Chiang Mai University, Thailand.*

(Received 22 July 1986)

Abstract

A total of 251 tests from 221 species of native Thai plants were made on Tilapia (Oreochromis niloticus *Linn.) for toxicity. Five of these plants were found to be extremely effective, while another 14 had good results, and 67 had moderate results. The rest showed no activity.*

Introduction

This is the first in a series of research reports on the usefulness of Thai plants in a project designed to discover safe and effective natural products from native Thai species that have piscicidal properties and can be used in aquaculture.

Although many plant species, both in Thailand and in other countries, are actually used to kill fish, the major aim of this project is to discover other species, especially those that are readily available, can be easily grown and which have more effective piscicidal properties.

Materials and Methods

Plant Collection

Using basic references[1,2] and information from local farmers, fishermen, and colleagues (*vide* acknowledgements), a minimum of 2 kg of fresh plant material, mostly leaves, of various species were collected from the southern provinces in Thailand. In many instances specific species noted in the literature or from local reports were gathered, while in other cases related species or even family representatives were collected. It was also decided to collect species from many other families and genera since most of these apparently have not been tested by other workers.

Only specimens that could be identified, except for several species of *Zingiber*,

were collected and voucher material of all of these plants were deposited in the Herbarium, Department of Biology, Prince of Songkla University.

The actual selection of most plants was based primarily on their availability and abundance since rare species or plants that are difficult to obtain, although possibly interesting chemically, are not practical choices since they do not meet the requirements of the project.

Activity Screening

Dilution Water : Tap water was stocked and aerated for 4 days before use. The quality of this dilution water, dissolved oxygen content, hardness, pH, and temperature were measured. Dissolved oxygen (DO) content and hardness were measured following a standard procedure[3], while the pH was tested with a pH meter, and the temperature determined with a mercury thermometer. The DO was found to be 7.55 ppm, pH to be 7.03, water hardness 28.50 ppm, and the water temperature to be 25°C. This dilution water was also used for the acclimatization of the experimental fish.

Crude Extract : Fresh plant material (5 g) and 250 ml of dilution water were mixed for several minutes in an electric blender. The mixture was filtered and squeezed through muslin cloth before being refiltered through Whatman filter paper (no. 40) with a vacuum pump. The concentration of the stock solution is, therefore, 2% (w/v).

Test Solution : Five concentrations of test solution, viz. 10000, 1000, 100, 10, and 1 ppm, each 200 ml, were prepared from the 2% stock solution and put in a 250 ml beaker. There were six treatments of these five concentrations plus a control which had only dilution water. There were no replicates.

Experimental Fish : Fry of Tilapia (*Oreochromis niloticus* Linn.) about 1 cm in length, were bred in concrete tanks. They were acclimatized in the dilution water and were not fed for 24 hours before testing. Five fish were used in each concentration of the test solution and control. The length and weight of the fish were measured after the experiment. The average weight of the fish was found to be 0.123 g and the length between 0.9-1.3 cm.

Trial Period : Fish mortalities were observed at intervals of 5, 10, 15, 30 minutes, 1, 2, 4, and 6 hours after the fish were put in the test solution.

Results

A total of 251 tests were made on 221 species of native Thai plants, some involving various parts of the same species of plant. The results are tabulated in Table 1. The species are listed in decreasing order of piscicidal effectiveness.

Discussion

As noted above, no replicates were made in the tests since the intent was to screen for active plants. In all instances higher concentrations of extracts resulted in higher fish mortalities.

It is evident from Table 1 that there are a number of species which have good potential for use as piscicides. Most of these species are common in the southern provinces of Thailand and can be easily grown, especially those which top the list i.e. those which are the most active species at low concentrations.

One of the fundamental intents, as noted above, of this project was to find plant species that can be easily prepared to kill fish. The simplest crude extract is, therefore, an aqueous extract from these plants. This report does not include the activity of the water insoluble substances in these plants.

Of the 274 known families of flowering plants in Thailand, examples from 54 were collected during this project with the largest representation of species from Leguminosae (34), Zingiberaceae (18), and Compositae (14).

It is a common practice in fish and shrimp farming in Thailand to use tea seed cake for the eradication of fish in ponds[4]. This material is obtained from the seeds of *Camellia sinensis* (L.) O.K. (Theaceae), the leaves of which are used for brewing tea. Most of this material is imported from China and only a limited quantity can be obtained from tea plantations in northern Thailand. In Thai tea plantations, the pruning method is used to cultivate commercial tea, thus the terminal shoots are pruned for the leaf crop. Flowers and fruits are, therefore, unable to develop. Toxicity tests on some seeds that were obtained from Thai tea plantations gave only moderately good results. We, therefore, do not consider Thai tea seeds to be a good source of a piscicidal agent because of limited availability and also because they are not as effective as leaves from some of the commonly found plants, all of which are readily available in the southern provinces, listed at the top of Table 1.

Tests are presently being made on the toxic activity of the plants listed in Table 1 on other aquatic organisms to determine whether there is any selective toxicity. Those plants which show interesting selective activity against shrimp, for example, are being investigated chemically to determine their active components. With proper toxicity tests and their critical evaluation, improvements may be made prior to testing the chemicals in the field.

Acknowledgements

We would like to thank our collaborators in the Department of Chemistry, Prince of Songkla University, Dr. Vitchu Lojanapiwatna, Dr. Pimchit Dampawan, and Dr. Surin Laosooksathit for their assistance in the chemical laboratory; Mr. Nitti Rittibhonbhan and Ms. Jarunee Janpramuk, aquatic scientists in the Faculty of Natural Resources and Associate Professor Puangpen Sirirugsa, Department of Biology, Prince of Songkla University, Dr. Brian Harvey in the Department of Biology, University of Victoria for their interest and expertise in the project; we also thank Elizabeth Towers for aquisition of premiminary lists of fish poisons of the world.

Table 1. RESULTS OF THE TOXICITY OF SOME THAI PLANTS ON TILAPIA *(OREOCHROMIS NILOTICUS* LINN.)

NO.	Botanical Name	Family	Part Tested	Lethal Concentration min. conc. for 100% dead (ppm)	Lethal Concentration max. conc. for 0% dead (ppm)	Voucher Specimen
1	*Diospyros sumatrana* Miq.	Ebenaceae	Leaves	100	10	Maxwell 85-57
2	*Diospyros sumatrana* Miq. (male)	Ebenaceae	Leaves	100	10	Maxwell 84-379
3	*Sapindus emarginatus* Vahl	Sapindaceae	Fruit	100	10	purchased from a Bangkok herbalist shop
4	*Sapindus rarak* DC.	Sapindaceae	Fruit	100	10	purchased from a Bangkok herbalist shop
5	*Schima wallichii* (DC.) Korth.	Theaceae	Leaves	100	10	Tongseedum 6
6	*Aralidium pinnatifidum* Miq.	Arlidiaceae	Leaves	1,000	10	Maxwell 85-279
7	*Barringtonia pterocarpa* Kurz	Lecythidaceae	Fruit	1,000	10	Maxwell 84-60
8	*Chaetocarpus castanocarpus* (Roxb.) Thw.	Euphorbiaceae	Leaves	1,000	10	Maxwell 84-28
9	*Costus speciosus* (Koen.) Sm.	Zingiberaceae	Rhizome	1,000	10	Sirirugsa 17
10	*Diospyros cauliflora* Bl.	Ebenaceae	Leaves	1,000	10	Maxwell 84-486
11	*Diospyros diepenhorstii* Miq.	Ebenaceae	Leaves	1,000	10	Maxwell 85-210
12	*Diospyros ferrea* (Willd.) Bakh. var.ferrea	Ebenaceae	Leaves	1,000	10	Maxwell 85-205
13	*Erythroxylum cuneatum* (Miq.) Kurz	Erythroxylaceae	Stem	1,000	10	Maxwell 85-759
14	*Euphorbia cotinifolia* H.B.K.	Euphorbiaceae	Stem	1,000	10	Song See 9
15	*Glochidion hypoleucum* (Miq.) Boerl.	Euphorbiaceae	Leaves	1,000	10	Maxwell 84-343
16	*Phoebe lanceolate* (Wall.) Nees	Lauraceae	Leaves	1,000	10	Maxwell 85-153
17	*Pittosporum ferrugineum* W. Ait.	Pittosporaceae	Leaves	1,000	10	Maxwell 85-68
18	*Uncaria cordata* (Lour.) Merr. var.cordata	Rubiaceae	Fruit	1,000	10	Maxwell 84-399
19	*Zingiber sp.*	Zingiberaceae	Fruit	1,000	10	Maxwell 84-813

Table 1. Continued.

NO.	Botanical Name	Family	Part Tested	Lethal Concentration min. conc. for 100% dead (ppm)	Lethal Concentration max. conc. for 0% dead (ppm)	Voucher Specimen
20	*Achronychla laurifolia* Bl.	Rutaceae	Leaves	1,000	10	Maxwell 84-761
21	*Adina dissimilis* Craib	Rubiaceae	Leaves	1,000	10	Ramsri 4
22	*Aidia cochinchinensis* Lour.	Rubiaceae	Leaves	1,000	10	Maxwell 84-266
23	*Alpinia mutica* Roxb.	Zingiberaceae	Rhizome	1,000	100	Maxwell 85-477
24	*Amomum uliginosum* Koen.	Zingiberaceae	Rhizome	1,000	100	Maxwell 85-615
25	*Anacardium occidentale* L.	Anacardiaceae	Leaves	1,000	100	Congdon 292
26	*Ancistrocladus tectorius* (Lour.) Merr.	Ancistrocladaceae	Leaves	1,000	100	Maxwell 85-393
27	*Ardisia colorata* Roxb.	Myrsinaceae	Leaves	1,000	100	Maxwell 85-331
28	*Ardisia littoralis* Andr.	Myrsinaceae	Leaves	1,000	100	Maxwell 85-740
29	*Barringtonia pendula* (Griff.) Kurz	Lecythidaceae	Leaves	1,000	100	Maxwell 85-470
30	*Buchanania arborescens* (Bl.) Bl.	Anacardiaceae	Leaves	1,000	100	Maxwell 85-87
31	*Caesalpinia digyna* Rottl.	Leguminosae (Caesalp.)	Leaves	1,000	100	Maxwell 85-939
32	*Calycopteris floribunda* (Roxb.) Lmk.	Combretaceae	Leaves	1,000	100	Tongseedum 13
33	*Calycopteris floribunda* (Roxb.) Lmk.	Combretaceae	Bark	1,000	100	Tongseedum 13
34	*Canthium horridum* Bl.	Rubiaceae	Leaves	1,000	100	Maxwell 84-324
35	*Catunaregam tomentosa* (Bl. ex DC.) Tirv.	Rubiaceae	Leaves	1,000	100	Maxwell 85-69
36	*Cerbera manghas* L.	Apocynaceae	Leaves	1,000	100	Congdon 122
37	*Chisocheton laxiflorus* King	Meliaceae	Leaves	1,000	100	Maxwell 85-673
38	*Cinnamomum iners* Reinw. ex Bl.	Lauraceae	Leaves	1,000	100	Maxwell 86-141
39	*Clausena excavata* Burm. f.	Rutaceae	Leaves	1,000	100	Tongseedum 23

Table 1. Continued.

NO.	Botanical Name	Family	Part Tested	Lethal Concentration min. conc. for 100% dead (ppm)	Lethal Concentration max. conc. for 0% dead (ppm)	Voucher Specimen
40	*Combretum quadrangulare* Kurz	Combretaceae	Leaves	1,000	100	Maxwell 85-1145
41	*Croton delpyi* Gagn.	Euphorbiaceae	Leaves	1,000	100	Maxwell 85-940
42	*Dalbergia candentensis* (Denn.) Pr.	Lequminosae (Papilion.)	Leaves	1,000	100	Maxwell 84-238
43	*Dalbergia tamarindifolia* Roxb.	Leguminosae (Papilion.)	Leaves	1,000	100	Maxwell 84-559
44	*Dalbergia tamarindifolia* Roxb.	Leguminosae (Papilion.)	Stem	1,000	100	Maxwell 84-559
45	*Derris amoena* Bth. var.amoena	Leguminosae (Papilion.)	Leaves	1,000	100	Maxwell 85-213
46	*Derris scandens* (Roxb.) Bth.	Leguminosae (Papilion.)	Leaves	1,000	100	Maxwell 85-240
47	*Derris scandens* (Roxb.) Bth.	Leguminosae (Papilion.)	Stem	1,000	100	Maxwell 84-240
48	*Dysolylum procerum* Wall. ex Hiern.	Meliaceae	Leaves	1,000	100	Maxwell 85-907
49	*Elettariopsis curtisii* Bak.	Zingiberaceae	Rhizome	1,000	100	Maxwell 85-434
50	*Embelia ribes* Burm. f.	Myrsinaceae	Leaves	1,000	100	Maxwell 84-517
51	*Embelia ribes* Burm.f.	Myrsinaceae	Stem	1,000	100	Maxwell 84-517
52	*Entada glandulosa* Pierre ex Gagn.	Leguminosae (Mimosoid.)	Fruit & Seeds	1,000	100	Maxwell 85-793
53	*Etlingera littoralis* (Koen.) Gise. (*Achasma megalocheilos* Griff.)	Zingiberaceae	Rhizome	1,000	100	Maxwell 85-525
54	*Euodia robusta* Hk.f.	Rutaceae	Leaves	1,000	100	Maxwell 84-454
55	*Excoecaria cochinchinensis* Lour. var. *cochinchinensis*	Euphorbiaceae	Leaves	1,000	100	Sirirugsa 844
56	*Garcinia mangostana* L.	Guttiferae	Fruit (Pericarp)	1,000	100	Mai 4

Table 1. Continued.

NO.	Botanical Name	Family	Part Tested	Lethal Concentration min. conc. for 100% dead (ppm)	Lethal Concentration max. conc. for 0% dead (ppm)	Voucher Specimen
57	*Hiptage benghalensis* (L.) Kurz	Malpighiaceae	Leaves	1,000	100	Maxwell 85-185
58	*Knema globularia* (Lmk.) Warb.	Myristicaceae	Leaves	1,000	100	Maxwell 84-409
59	*Litsea grandis* (Nees) Hk.f.	Lauraceae	Leaves	1,000	100	Maxwell 84-555
60	*Mammea siamensis* (Miq.) T. And.	Guttiferae	Leaves	1,000	100	Maxwell 86-70
61	*Millettia atropurpurea* Bth.	Leguminosae (Papilion.)	Leaves	1,000	100	H. & C. 469
62	*Millettia atropurpurea* Bth.	Leguminosae (Papilion.)	Fruit & Seeds	1,000	100	H. & C. 469
63	*Myrica esculenta* B.-H. ex D. Don	Myricaceae	Fruit	1,000	100	Maxwell 85-529
64	*Myrica esculenta* B.-H. ex D. Don	Myricaceae	Stem	1,000	100	Maxwell 85-529
65	*Neonauclea pallida* (Reinw. ex Hav.) Bakh.f.	Rubiaceae	Leaves	1,000	100	Maxwell 85-416
66	*Olax scandens* Roxb.	Olacaceae	Leaves	1,000	100	Maxwell 84-235
67	*Pittosporum ferrugineum* W. Ait.	Pittosporaceae	Stem	1,000	100	Maxwell 85-68
68	*Planchonella obovata* (R. Br.) Pierre	Sapotaceae	Leaves	1,000	100	Maxwell 85-538
69	*Ploiarium alternifolia* (VahI) Mel.	Theaceae (Bonnetiaceae)	Stem	1,000	100	Maxwell 85-764
70	*Polygonum stagnium* Ham. ex Meissn.	Polygonaceae	Leaves	1,000	100	Maxwell 85-1049
71	*Pometia pinnata* J.R. & G. Forst.	Sapindaceae	Leaves	1,000	100	Maxwell 85-599
72	*Pterolobium microphyllum* Mig.	Leguminosae (Caesalp.)	Leaves	1,000	100	Maxwell 85-160
73	*Pterolobium microphyllum* Mig.	Leguminosae (Caesalp.)	Stem	1,000	100	Maxwell 85-160
74	*Rothmannia schoemanni* (Teij. & Binn.) Tirv.	Rubiaceae	Leaves	1,000	100	Maxwell 85-157
75	*Rothmannia schoemanni* (Teij. & Binn.) Tirv.	Rubiaceae	Stem	1,000	100	Maxwell 85-157

Table 1. Continued.

NO.	Botanical Name	Family	Part Tested	Lethal Concentration min. conc. for 100% dead (ppm)	Lethal Concentration max. conc. for 0% dead (ppm)	Voucher Specimen
76	*Sandoricum koetjape* (Burm. f.) Merr.	Meliaceae	Leaves	1,000	100	Newman 47
77	*Saraca indica* L.	Leguminosae (Caesalp.)	Leaves	1,000	100	Maxwell 84-80
78	*Schima wallichii* (DC.) Korth.	Theaceae	Stem	1,000	100	Tongseedum 6
79	*Smilax blumei* A. DC.	Smilacaceae	Leaves	1,000	100	Maxwell 85-5
80	*Spatholobus harmandii* Gagn.	Leguminosae (Papilion.)	Leaves	1,000	100	Maxwell 84-553
81	*Spatholobus harmandii* Gagn.	Leguminosae (Papilion.)	Stem	1,000	100	Maxwell 84-553
82	*Symplocos cochinchinensis* (Lour.) S. Moore ssp. *laurina* (Retz.) Noot.	Symplococaceae	Leaves	1,000	100	Maxwell 85-829
83	*Taxillus chinensis* (DC.) Dans.	Loranthaceae	Leaves	1,000	100	Maxwell 84-36
84	*Uncaria cordata* (Lour.) Merr. var. cordata	Rubiaceae	Leaves	1,000	100	Maxwell 85-399
85	*Urena lobata* L. ssp. sinuata (L.) Borss. var. *sinuata*	Malvaceae	Whole Plant	1,000	100	Song See 19
86	*Zingiber purpureum* Roxb.	Zingiberaceae	Rhizome	1,000	100	Newman 27
87	*Zingiber* sp.	Zingiberaceae	Rhizome	1,000	100	Maxwell 84-813
88	*Albizia myriophylla* Bth.	Leguminosae (Mimosoid.)	Leaves	10,000	100	Maxwell 84-629
89	*Allophylus cobbe* (L.) Raeus.	Sapindaceae	Fruit	10,000	100	Sirirugsa 831
90	*Ancistrocladus tectorius* (Lour.) Merr.	Ancistrocladaceae	Stem	10,000	100	Maxwell 85-393
91	*Blumea balsamifera* (L.) DC.	Compositae	Leaves	10,000	100	Maxwell 84-271
92	*Boesenbergia sp.*	Zingiberaceae	Rhizome	10,000	100	Maxwell 85-1131
93	*Bouea oppositifolia* (Roxb.) Meisn.	Anacardiaceae	Leaves	10,000	100	Maxwell 84-206

Table 1. Continued.

NO.	Botanical Name	Family	Part Tested	Lethal Concentration min. conc. for 100% dead (ppm)	Lethal Concentration max. conc. for 0% dead (ppm)	Voucher Specimen
94	*Canthium horridum* Bl.	Rubiaceae	Stem	10,000	100	Maxwell 84-324
95	*Cinnamomum parthenoxylon* (Jack) Meissn.	Lauraceae	Leaves	10,000	100	Maxwell 85-112
96	*Diospyros wallichii* King & Gamb. ex King	Ebenaceae	Leaves	10,000	100	Maxwell 85-902
97	*Euphorbia cotinifolia* H.B.K.	Euphorbiaceae	Leaves	10,000	100	Song See 9
98	*Horsfieldia irya* (Gaertn.) Warb.	Myristicaceae	Leaves	10,000	100	Maxwell 85-328
99	*Melastoma sanguineum* Sims	Melastomataceae	Leaves	10,000	100	Tongseedum 19
100	*Memecylon caeruleum* Jack	Melastomataceae	Leaves	10,000	100	Sirirugsa 865
101	*Metadina trichotoma* (Z. & M.) Bakh.f.	Rubiaceae	Leaves	10,000	100	Maxwell 85-352
102	*Mischocarpus sundaicus* Bl.	Sapindaceae	Leaves	10,000	100	Maxwell 84-408
103	*Moghania macrophylla* (Willd.) O.K.	Leguminosae (Papilion.)	Leaves	10,000	100	Maxwell 84-401
104	*Nephelium lappaceum* L.	Sapindaceae	Pericarp	10,000	100	Clot 12
105	*Pterospermum lanceaefolium* King	Sterculiaceae	Leaves	10,000	100	Maxwell 86-173
106	*Pterospermum lanceaefolium* King	Sterculiaceae	Stem	10,000	100	Maxwell 86-173
107	*Pueraria phaseoloides* (Roxb.) Bth.	Leguminosae (Papilion.)	Leaves	10,000	100	Maxwell 84-511
108	*Tephrosia vestita* Vog.	Leguminosae (Papilion.)	Stem	10,000	100	Maxwell 84-285
109	*Abrus precatorius* L.	Leguminosae (Papilion.)	Leaves	10,000	1,000	H. & C. 124
110	*Ageratum conyzoides* L.	Compositae	Whole Plant	10,000	1,000	Song See 21
111	*Allophylus cobbe* (L.) Raeus.	Sapindaceae	Leaves	10,000	1,000	Sirirugsa 831
112	*Allophylus cobbe* (L.) Raeus.	Sapindaceae	Stem	10,000	1,000	Sirirugsa 831
113	*Artocarpus dadah* Mig.	Moraceae	Leaves	10,000	1,000	Maxwell 86-27
114	*Barringtonia macrostachya* (Jack) Kurz	Lecythidaceae	Leaves	10,000	1,000	Maxwell 85-437

Table 1. Continued.

NO.	Botanical Name	Family	Part Tested	Lethal Concentration min. conc. for 100% dead (ppm)	Lethal Concentration max. conc. for 0% dead (ppm)	Voucher Specimen
115	*Barringtonia pterocarpa* Kurz	Lecythidaceae	Leaves	10,000	1,000	Maxwell 84-60
116	*Blumea balsamifera* (L.) DC.	Compositae	Stem	10,000	1,000	Maxwell 85-271
117	*Butea superba* Roxb.	Leguminosae (Papilion.)	Leaves	10,000	1,000	Song See 11
118	*Callicarpa longifolia* Lmk. var. *longifolia*	Verbenaceae	Leaves	10,000	1,000	Maxwell 84-202
119	*Calophyllum inophyllum* L.	Guttiferae	Leaves	10,000	1,000	Warapohn 16
120	*Calopogonium mucunoides* Desv.	Leguminosae (Papilion.)	Leaves	10,000	1,000	Song See 16
121	*Canthium dicoccum* (Gaertn.) Merr. var. *dicoccum*	Rubiaceae	Leaves	10,000	1,000	Maxwell 85-456
122	*Cassia alata* L.	Leguminosae (Caesalp.)	Leaves	10,000	1,000	Maxwell 84-577
123	*Cassia fruticosa* Mill.	Leguminosae (Caesalp.)	Fruit	10,000	1,000	Kosol 21
124	*Catunaregam tomentosa* (Bl. ex DC.) Tirv.	Rubiaceae	Fruit	10,000	1,000	Maxwell 85-69
125	*Clerodendrum inerme* (L.) Gaertn.	Verbenaceae	Leaves	10,000	1,000	Siriragsa 647
126	*Clitoria ternatea* L.	Leguminosae (Papilion.)	Stem	10,000	1,000	Sirirugsa 213
127	*Combretum trifoliatum* Vent.	Combretaceae	Leaves	10,000	1,000	Maxwell 85-986
128	*Coreopsis grandiflora* Hogg. ex Sweet	Compositae	Leaves	10,000	1,000	Song See 6
129	*Coreopsis grandiflora* Hogg. ex Sweet	Compositae	Stem	10,000	1,000	Song See 6
130	*Dalbergia rostrata* Hassk.	Leguminosae (Papilion.)	Leaves	10,000	1,000	Maxwell 85-893
131	*Dendrotrophe varians* (Bl.) Mig.	Santalaceae	Leaves	10,000	1,000	Maxwell 85-113
132	*Derris thyrsiflora* (Bth.) Bth.	Lequminosae (Papilion.)	Leaves	10,000	1,000	Maxwell 85-370
133	*Dillenia indica* L.	Dilleniaceae	Leaves	10,000	1,000	Ramsri 90
134	*Diospyros curranii* Merr.	Ebenaceae	Leaves	10,000	1,000	Maxwell 85-772

Table 1. Continued.

NO.	Botanical Name	Family	Part Tested	Lethal Concentration min. conc. for 100% dead (ppm)	Lethal Concentration max. conc. for 0% dead (ppm)	Voucher Specimen
135	*Dysolylum procerum* Wall. ex Hiern.	Meliaceae	Stem	10,000	1,000	Maxwell 84-907
136	*Erythroxylum cuneatum* (Mig.) Kurz	Erythroxylaceae	Leaves	10,000	1,000	Maxwell 85-759
137	*Eurya acuminata* DC. var. *acuminata*	Theaceae	Leaves	10,000	1,000	Maxwell 85-688
138	*Eurya nitida* Korth. var. *nitida*	Theaceae	Leaves	10,000	1,000	Maxwell 84-8
139	*Euodia robusta* Hk. f.	Rutaceae	Stem	10,000	1,000	Maxwell 85-454
140	*Fagerlindia fasciculata* (Roxb.) Tirv. var. *fasciculata*	Rubiaceae	Leaves	10,000	1,000	Maxwell 84-268
141	*Glycosmis chlorosperma* Spr.	Rutaceae	Leaves	10,000	1,000	Maxwell 84-681
142	*Goniothalamus subevenius* King	Annonaceae	Leaves	10,000	1,000	Maxwell 85-863
143	*Ilex cymosa* Bl.	Aquifoliaceae	Leaves	10,000	1,000	Maxwell 85-612
141	*Indigofera oblongifolia* Forsk.	Leguminosae (Papilion.)	Leaves	10,000	1,000	Maxwell 84-294
145	*Indigofera oblongifolia* Forsk.	Leguminosea (Papilion.)	Fruit	10,000	1,000	Maxwell 84-294
146	*Lepisanthes rubiginosa* (Roxb.) Leenth.	Sapindaceae	Leaves	10,000	1,000	Maxwell 85-957
147	*Leucas lavandulifolia* Sm.	Labiatae	Whole Plant	10,000	1,000	Maxwell 84-301
148	*Linostoma pauciflorum* Griff.	Thymeleaceae	Stem	10,000	1,000	Maxwell 85-38
149	*Mallotus macrostachyus* (Miq.) M.A.	Euphorbiaceae	Fruit	10,000	1,000	Maxwell 84-209
150	*Mischocarpus sundaicus* Bl.	Sapindaceae	Stem	10,000	1,000	Maxwell 84-408
151	*Mucuna gigantea* (Willd.) DC.	Leguminosae (Papilion.)	Leaves	10,000	1,000	Maxwell 85-631
152	*Mucuna gigantea* (Willd.) DC.	Leguminosae (Papilion.)	Stem	10,000.	1,000	Maxwell 85-631
153	*Ochreinauclea maingayi* (Hk.f.) Ridsd.	Rubiaceae	Leaves	10,000	1,000	Maxwell 85-649
154	*Physalis minima* L.	Solanaceae	Whole Plant	10,000	1,000	Maxwell 85-1159

Table 1. Continued.

NO.	Botanical Name	Family	Part Tested	Lethal Concentration min. conc. for 100% dead (ppm)	Lethal Concentration max. conc. for 0% dead (ppm)	Voucher Specimen
155	*Ploiarium alternifolia* (Vahl) Mel.	Theaceae (Bonnetiaceae)	Leaves	10,000	1,000	Maxwell 85-764
156	*Spilanthes paniculata* Wall. ex DC.	Compositae	Whole Plant	10,000	1,000	Maxwell 85-714
157	*Tephrosia vestita* Vog.	Leguminosae (Papilion.)	Leaves	10,000	1,000	Maxwell 84-285
158	*Terminalia catappa* L.	Combretaceae	Leaves	10,000	1,000	Chotip & Ratana 16
159	*Thottea tomentosa* (Bl.) Hou	Aristolochiaceae	Leaves	10,000	1,000	Maxwell 85-1168
160	*Toddalia asiatica* (L.) Lmk.	Rutaceae	Stem	10,000	1,000	Maxwell 84-178
161	*Uvaria rufa* Bl.	Annonaceae	Stem	10,000	1,000	Maxwell 84-429
162	*Vitex ovata* Thunb.	Verbenaceae	Leaves	10,000	1,000	Em-Orn 32
163	*Zingiber officinale* Rosc.	Zingiberaceae	Rhizome	10,000	1,000	Maxwell 85-786
164	*Zingiber zerumbet* (L.) Sm.	Zingiberaceae	Rhizome	10,000	1,000	Maxwell 85-590
165	*Zingiber* sp.	Zingiberaceae	Fruit	10,000	1,000	Maxwell 85-813
166	*Aglaia odorata* Lour.	Meliaceae	Leaves	---	--- A	Sirirugsa 45
167	*Alibizia myriophylla* Bth.	Leguminosae (Mimosoid.)	Stem	---	--- A	Maxwell 85-629
168	*Brucea javanica* (L.) Merr.	Simaroubaceae	Whole Plant	---	--- A	Sirirugsa 344
169	*Elephatopus scaber* L. var. *scaber*	Compositae	Root	---	--- A	Maxwell 86-47
170	*Aralidium pinnatifidum* Miq.	Aralidiaceae	Leaves	---	--- B	Maxwell 85-279
171	*Argyreia capitiformis* (Poir.) Oost.	Convolvulaceae	Flower	---	--- B	Maxwell 84-510
172	*Atalantia monophylla* (L.) DC.	Rutaceae	Leaves	---	--- B	Maxwell 84-531
173	*Canthium dicoccum* (Gaertn.) Merr. var. *dicoccum*	Rubiaceae	Stem	---	--- C	Maxwell 85-456

Table 1. Continued.

NO.	Botanical Name	Family	Part Tested	Lethal Concentration min. conc. for 100% dead (ppm)	Lethal Concentration max. conc. for 0% dead (ppm)		Voucher Specimen
174	*Cleome rutidosperma* DC.	Capparidaceae	Whole Plant	---	---	C	Wiparadee 30
175	*Helicteres hirsuta* Lour.	Sterculiaceae	Leaves	---	---	C	Sutas 87
176	*Kleinhovia hospita* L.	Sterculiaceae	Leaves	---	---	C	Maxwell 85-409
177	*Mikania cordata* (Burm.f.) B.L. Rob.	Compositae	Leaves	---	---	C	Song See 23
178	*Aglaia argentea* Bl.	Meliaceae	Leaves	---	---	D	Maxwell 86-17
179	*Atalantia monophylla* (L.) DC.	Rutaceae	Stem	---	---	D	Maxwell 84-531
180	*Caladium bicolor* (W.Ait.) Vent.	Araceae	Leaves	---	---	D	Jongkolnee 8
181	*Callicarpa candicans* (Brum.f.) Hochr.	Verbenaceae	Leaves	---	---	D	Maxwell 85-159
182	*Calophyllum calaba* L. var. *bracteatum* (Wight) P.F. Stev.	Guttifereae	Leaves	---	---	D	Maxwell 85-1181
183	*Catunaregam spinosa* (Thunb.) Tirv.	Rubiaceae	Stem	---	---	D	Maxwell 85-998
184	*Clitoria ternatea* L.	Leguminosae (Papilion.)	Leaves	---	---	D	Sirirugsa 213
185	*Costus globosus* Bl.	Zingiberaceae	Fruit	---	---	D	Maxwell 84-141
186	*Eupatorium odoratum* L.	Compositae	Leaves	---	---	D	JRC 212
187	*Fibraurea tinctora* Lour.	Menispermaceae	Stem	---	---	D	Maxwell 85-522
188	*Genetum microcaprum* Bl.	Genetaceae	Leaves	---	---	D	Maxwell 85-530
189	*Lantana camara.* L.	Verbenaceae	Leaves	---	---	D	Canadon & Hamilton 9
190	*Lepisanthes tetraphylla* (Vahl) Radlk.	Sapindaceae	Leaves	---	---	D	Maxwell 85-137
191	*Linostoma pauciflorum* Griff.	Thymeleaceae	Stem	---	---	D	Maxwell 84-38
192	*Mikania cordata* (Burm.f.) B.L. Rob.	Compositae	Stem	---	---	D	Song See 23
193	*Vernonia cinerea* (L.) Less.	Compositae	Whole Plant	---	---	D	Sirirugsa 183

Table 1. Continued.

NO.	Botanical Name	Family	Part Tested	Lethal Concentration min. conc. for 100% dead (ppm)	max. conc. for 0% dead (ppm)		Voucher Specimen
194	*Wedelia biflora* (L.) DC.	Compositae	Leaves	---	---	D	H. & C. 328
195	*Wedelia biflora* (L.) DC.	Compositae	Stem	---	---	D	H. & C. 328
196	*Wedelia trilobata* (L.) Hitch.	Compositae	Whole Plant	---	---	D	Thanom 54
197	*Amaranthus spinosus* L.	Amaranthaceae	Whole Plant	---	---	E	Sirirugsa 271
198	*Amomum testaceum* Ridl.	Zingiberaceae	Rhizome	---	---	E	Maxwell 85-708
199	*Argvreia capitiformis* (Poir.) Oost.	Convolvulaceae	Leaves	---	---	E	Maxwell 84-510
200	*Argyreia mollis* (Burm.f.) Choisy	Convolvulaceae	Leaves	---	---	E	Maxwell 84-427
201	*Argyreia (q.v.Lettsomia roseo-purpurea* Kerr)	Convolvulaceae	Leaves	---	---	E	Maxwell 86-6
202	*Blumea balsamifera* (L.) DC.	Compositae	Root	---	---	E	Maxwell 85-271
203	*Boesenbergia longipes* (King & Pr.) Schltr.	Zingiberaceae	Whole Plant	---	---	E	Maxwell 84-375
204	*Caladium bicolor* (W.Ait) Vent.	Araceae	Tuber	---	---	E	Jongkolnee 8
205	*Callicarpa longifolia* Lmk. var. *longifolia*	Verbenaceae	Stem	---	---	E	Maxwell 84-202
206	*Calotropis gigantea* (Willd.) Dry.ex W.T.Ait.	Asclepiadaceae	Leaves	---	---	E	Pichate 20
207	*Capparis sepiaria* L.	Capparidaceae	Leaves	---	---	E	Tongseedum 9
208	*Cassia fruticosa* Mill.	Leguminosae (Caesalp.)	Leaves	---	---	E	Kosol 21
209	*Cassia occidentalis* L.	Leguminosae (Caesalp.)	Whole Plant	---	---	E	Chuenhatai 29
210	*Catunaregam spinosa* (Thunb.) Tirv.	Rubiaceae	Leaves	---	---	E	Maxwell 85-998
211	*Cleistanthus polyphyllus* F.N. Will.	Euphorbiaceae	Leaves	---	---	E	Maxwell 85-428

Table 1. Continued.

NO.	Botanical Name	Family	Part Tested	Lethal Concentration min. conc. for 100% dead (ppm)	max. conc. for 0% dead (ppm)		Voucher Specimen
212	*Clerodendrum villosum* Bl.	Verbenaceae	Leaves	---	---	E	H. & C. 213
213	*Clitoria ternatea* L.	Leguminosae (Caesalp.)	Leaves	---	---	E	Sirirugsa 213
214	*Cosmos sulfureus* Cav.	Compositae	Whole Plant	---	---	E	Song See 5
215	*Dalbergia* sp.	Leguminosae	Leaves	---	---	E	Maxwell 85-593
216	*Derris* sp.	Leguminosae	Leaves	---	---	E	Maxwell 85-283
217	*Ehretia laevis* Roxb.	Boragianceae	Leaves	---	---	E	Maxwell 85-108
218	*Elephantopus scaber* L. var.*scaber*	Compositae	Leaves	---	---	E	Maxwell 86-47
219	*Erechtites hieracifolia* (L.) Rafin. ex DC.	Compositae	Levers	---	---	E	Maxwell 86-25
220	*Eupatorium odoratum* L.	Compositae	Stem	---	---	E	JRC 212
221	*Eupatorium odoratum* L.	Compositae	Root	---	---	E	JRC 212
222	*Fibraurea tinctoria* Lour.	Menispermaceae	Leaves	---	---	E	Maxwell 85-522
223	*Gliricidia sepium* (Jacq.) Kunth ex Walp.	Leguminosae (Papilion.)	Leaves	---	---	E	Congdon 207
224	*Gnetum macrotachym* Hk.f.	Gnetaceae	Leaves	---	---	E	Maxwell 85-446
225	*Gnetum macrostachym* Hk.f.	Gnetaceae	Stem	---	---	E	Maxwell 85-446
226	*Gnetum microcarpum* Bl.	Gnetaceae	Stem	---	---	E	Maxwell 85-530
227	*Heliotropium indicum* L.	Boraginaceae	Leaves	---	---	E	H. & C. 486
228	*Indigofera oblongifolia* Forsk.	Leguminosae (Papilion.)	Stem	---	---	E	Maxwell 84-294
229	*Lansium domesticum* Corr.	Meliaceae	Pericarp	---	---	E	Maxwell 85-310
230	*Linostoma pauciflorum* Griff.	Thymeleaceae	Leaves	---	---	E	Maxwell 84-38
231	*Mallotus macrostachyus* (Miq.) M.-A.	Euphorbiaceae	Leaves	---	---	E	Maxwell 84-209
232	*Merremia umbellata* (L.) Hall.f. ssp. *orientalis* (Hall.f.) Oost.	Convolvulaceae	Leaves	---	---	E	Maxwell 85-1087

Table 1. Continued.

NO.	Botanical Name	Family	Part Tested	Lethal Concentration min. conc. for 100% dead (ppm)	max. conc. for 0% dead (ppm)	Voucher Specimen
233	*Morinda elliptica* (Hk.f.) Ridl.	Rubiaceae	Leaves	---	--- E	Tongseedum 22
234	*Nephelium lappaceum* L.	Sapindaceae	Seed	---	--- E	Clot 12
235	*Parkia speciosa* Hassk.	Leguminosae (Mimosoid.)	Leaves	---	--- E	Maxwell 85-431
236	*Phrynium capitatum* Willd.	Marantaceae	Rhizome	---	--- E	Maxwell 85-1079
237	*Piper umbellatum* L. var.*glabrius* (Miq.) DC.	Piperaceae	Leaves	---	--- E	Maxwell 85-544
238	*Pycnospora lutescens* (Poir.) Schindl.	Leguminosae (Papilion.)	Leaves	---	--- E	Maxwell 85-109
239	*Selaginella willdenowii* (Desv.) Bak.	Selaginellaceae	Leaves	---	--- E	Ramsri 114
240	*Stachyphrynium cylindricum* (Ridl.) K. Sch.	Marantacae	Rhizome	---	--- E	Maxwell 85-951
241	*Sterculia rubiginosa* Vent. var.*rubiginosa*	Sterculiaceae	Leaves	---	--- E	Maxwell 86-7
242	*Stylosanthes sundaica* Taub.	Leguminosae (Papilion.)	Whole Plant	---	--- E	Maxwell 84-215
243	*Tiliacora triandra* (Coebr.) Diels	Menispermaceae	Leaves	---	--- E	Maxwell 85-1082
244	*Toddalia asiatica* (L.) Lmk.	Rutaceae	Leaves	---	--- E	Maxwell 84-178
245	*Uncaria lanosa* Wall. var. *lanosa*	Rubiaceae	Whole Plant	---	--- E	Song See 32
246	*Uvaria rufa* Bl.	Annonaceae	Leaves	---	--- E	Maxwell 84-429
247	*Vernonia arborea* B.-H. var.*arborea*	Compositae	Leaves	---	--- E	Maxwell 84-176
248	*Vernonia arborea* B.-H. var.*arborea*	Compositae	Stem	---	--- E	Maxwell 84-176
249	*Vitex pubescens* Vahl	Verbenaceae	Leaves	---	--- E	Newman 46
250	*Vitex pubescens* Vahl	Verbenaceae	Fruit	---	--- E	Newman 46
251	*Zingiber* sp.	Zingiberaceae	Stem	---	--- E	Maxwell 85-813

A = 80% dead at 10,000 ppm; B = 60% dead at 10,000 ppm; C = 40% dead at 10,000 ppm; D = 20% dead at 10,000 ppm;E = 0% dead at all concentrations.

The project has been supported by the International Development Research Centre with IDRC Research Grant 3-P-84-150-12 (Fish Poisons, UBC/Thailand) and we gratefully acknowledge their financial contributions and encouragement in the development and progress of this basic experimental work.

References

1. Burkill, I.H. (1966) *A Dictionary of the Economic Products of the Malay Peninsula,* 2 vols., Ministry of Agriculture and Cooperatives, Kuala Lumpur, Malaysia.
2. Grainge, M. *et al.* (1985) *Plant Species Reportedly Possessing Pest-Control Properties--An EWC/UH Database,* Resources Systems Institute, East-West Centre, Honolulu.
3. Greenberg, A.E., Connors, J.J. and Jenkins, D. (1981) *Standard Methods for the Examination of Water and Waste Water,* 15th ed., American Public Health Association, pp. 615-649.
4. Terazaki, M., Tharnbuppa, P. and Nakayama, Y. (1980) *Aquaculture,* **19** 235-242.

บทคัดย่อ

จากการทดสอบฤทธิ์ของพันธุ์ไม้ไทย 221 ชนิด ในการฆ่าปลานิล *(Oreochromis niloticus* Linn.) รวม 251 ครั้ง พบว่าพันธุ์ไม้ 5 ชนิดสามารถฆ่าปลาได้อย่างมีประสิทธิภาพสูงมาก 14 ชนิด แสดงฤทธิ์ในเกณฑ์ดี และ 67 ชนิด แสดงฤทธิ์ในเกณฑ์ปานกลาง นอกนั้นไม่แสดงฤทธิ์เลย