KMITL Sci. Tech. J. Vol. 7 No. S2 Nov. 2007

EFFECTS OF SOME HERBAL PLANT EXTRACTS AGAINST PHARAOH ANT, *Monomorium pharaonis* (Linnaeus)

Phongpen Tangchitphinitkan[1*], Suraphon Visetson[1],
Monchan Maketon[1] and Manthana Milne[2]

[1]Department of Zoology, Faculty of Science, Kasetsart University,
Bangkok 10900, Thailand
[2]Department of Agriculture, Ministry of Agriculture and Cooperatives,
Bangkok 10900, Thailand

ABSTRACT

This research was to evaluate the efficiency of three Thai herbs, i.e., tuba root (*Derris elliptica* Benth.), yam bean seeds (*Pachyrhizus erosus* L.) and tea seed cake (*Camellia* sp.) against adult worker of the Pharaoh ant (*Monomorium pharaonis* L.) The results showed that the tuba root extracts exhibited LC_{50} against adult worker ca. 0.22 % w/v whereas yam bean seed extracts showed LC_{50} against adult worker ca. 0.35 % w/v and tea seed cake extracts showed LC_{50} against adult worker ca. 0.55 % w/v after 24 hours exposure, respectively.

KEYWORDS: *Monomorium pharaonis* L., *Derris elliptica* Benth., *Pachyrhizus erosus* L., *Camellia* sp., toxicity

1. INTRODUCTION

Pharaoh ants have become a serious nuisance pest in hospitals, homes, apartment dwellings, hotels, grocery stores, food establishments and other buildings. These ants are capable of mechanically transmitting diseases and contaminating sterile materials. Human always uses synthetic chemical insecticides to control the ant. However, most synthetic insecticides are toxic to human as well as animal, and some of them are toxic to non target animals and remained in environment for a long time.

Researches on plant extracts against agriculture pests have been developed by many scientists. A lot of plants have revealed good potential for insect control namely, neem (*Azadirachta indica* L.) [1], tuba root (*Derris elliptica* Benth.) [2], lemon grass (*Cymbopogon winterinus*, Jewitti) [3], galunga (*Alpinia galunga* L.) [4], chili (*Capsicum frutescens* L.) [5], siam weed (*Eupatorium odoratum* L.) [6] and nut grass (*Cyperus rotandus* L.) [7].

*Corresponding author: Tel: 662 277024
E-mail: phongpen@yahoo.com

Most of them have been proven to be effective for the control of many pests in Thailand. However, no previous research works on plant extracts have been examined for the control of the pharaoh ants. Some herbal extracts which can practically be useful as insecticides for the pharaoh ant are investigated in the present study.

2. MATERIALS AND METHODS

Three plant parts used in this study are as follows: tuba root (*Derris elliptica* Benth), Yam bean seed (*Pachyrhizus crosus* L.) and tea seed cake (*Camellia* sp.) Each treatment, 90 adult workers with 3 replicates using CRD (Completely Randomized Design) [8] were used with all extracts. The impregnated filter paper method modified from Visetson *et al.* [9] was used to evaluate their efficacy in terms of LC_{50} from placing *M. pharaonis* L. on impregnated filter paper with each extracts. The real mortality percentage of the experiment showed that responses in the untreated control are adjusted by Abbott's formula. The LC_{50} at 24 hours are derived from simple linear regressions between mortality percentage and various concentrations.

The plant part of 0.5-1 kg was cut or ground into small pieces and immersed in 95% ethanol for at least three days. The ethanol extract of each herbal plant was evaporated at 40°C by vacuum rotary evaporator. Each herbal plant extract was bioassayed for insecticidal activity on ants by the contact method. Each control group of these ants were contacted in dissolved solvent. The concentrations of tuba root were as follows, 0%, 0.1%, 0.2%, 0.3% and 0.4% w/v. The concentrations of yam bean seed were 0%, 0.2%, 0.4%, 0.6% and 0.8% w/v and the concentration of tea seed cake were 0%, 0.2%, 0.4%, 0.6% and 0.8% w/v. All concentrations were diluted with distilled water.

The mortality of the ants was observed at 24 hours after contact. SPSS (Statistical Package for the Social Sciences) was used to analyze the mortality of the ants.

3. RESULTS AND DISCUSSION

The crude extracts of herbal plants caused 10-90% mortality of Pharaoh ants after contact at 24 hours. The rhizome of tuba root extract at 0, 0.1, 0.2, 0.3, 0.4% w/v showed the mortality percentage of treated adults of *M. pharaonis* L. of 0, 18.89 ± 6.94, 42.22 ± 7.70, 74.44 ± 8.39, 93.33 ± 3.34, respectively (Table 1).

Table 1 Mortality percentage of *M. pharaonis* L. against crude extract of tuba root, *Derris elliptica* Benth. after 24 hrs under laboratory condition

Dose (%w/v)	Total treated	No. Repeated	% average mortality adult after 24 hrs
Control	90	3	0.00^{a}
0.1	90	3	18.89 ± 6.94^{b}
0.2	90	3	42.22 ± 7.70^{c}
0.3	90	3	74.44 ± 8.39^{d}
0.4	90	3	93.33 ± 3.34^{e}

Note: Numbers with different superscripts are significantly different ($p < 0.05$)

The yam bean seed extract at 0, 0.2, 0.4, 0.6, 0.8%w/v showed the mortality percentage of treated adults of *M. pharaonis* of 0, 42.22 ± 21.43, 65.55 ± 22.69, 75.56 ± 15.39, 92.22 ± 8.39, respectively (Table 2).

Table 2 Mortality percentage of *M. pharaonis* L. against crude extract of yam bean seed, *Pachyrhizus erosus* L. after 24 hrs under laboratory condition

Dose (%w/v)	Total treated	No. Repeated	%average mortality adult after 24 hrs
Control	90	3	0.00^{a}
0.2	90	3	42.22 ± 21.43^{b}
0.4	90	3	65.55 ± 22.69^{c}
0.6	90	3	75.56 ± 15.39^{d}
0.8	90	3	92.22 ± 8.39^{e}

Note: Numbers with different superscripts are significantly different ($p< 0.05$).

The tea seed cake extract at 0, 0.2, 0.4, 0.6, 0.8 % w/v showed the mortality percentage of treated adults of *M. pharaonis* L. of 0, 14.44 ± 1.93, 28.89 ± 3.85, 55.56 ± 9.63, 76.66 ± 5.77, respectively (Table 3).

Table 3 Mortality percentage of *M. pharaonis* L. against crude extract of tea seed cake, *Camellia* sp. after 24 hrs under laboratory condition

Dose (%w/v)	Total treated	No. Repeated	% average mortality adult after 24 hrs
Control	90	3	0.00^{a}
0.2	90	3	14.44 ± 1.93^{b}
0.4	90	3	28.89 ± 3.85^{c}
0.6	90	3	55.56 ± 9.63^{d}
0.8	90	3	76.66 ± 5.77^{e}

Note: Numbers with different superscripts are significantly different ($p< 0.05$)

The results of LC_{50} of three herbal plant extracts showed linear response ($Y = -2.666 + 242.2X$; LC_{50} ca. 0.22 % w/v with coefficient determination is 0.992, $Y = 11.55 + 108.9X$; LC_{50} ca. 0.35 % w/v with coefficient determination is 0.928 and $Y = -3.778 + 97.22X$; LC_{50} ca. 0.55 % w/v with coefficient determination is 0.983, respectively) when X means percent concentrations of crude extract and Y means mortality percentage of treated adult of *M. pharaonis* L. (Table 4).

Table 4 Regression equation, LC_{50} and coefficient determination (r^2) between concentrations of three herbal plant extracts

Herbal plant extracts	Regression Equation	LC_{50} (1)	r^2 (2)
Tuba root	Y = -2.666 + 242.2X	0.22	0.992
Yam bean seed	Y = 11.55 + 108.9X	0.35	0.928
Tea seed cake	Y = -3.778 + 97.22X	0.55	0.983

Note: (1) LC_{50} = The median lethal concentration
(2) r^2 = coefficient determination for correlation of mortality percentage against extract concentration on treated Pharaoh ant at 24 hours

Using the impregnated filter paper method with varying extract concentrations, LC_{50} values for three plant extracts (tuba root, yam bean seed and tea seed cake) against the adult worker of *Monomorium pharaonis* L. were 0.22 % w/v, 0.35 % w/v and 0.55 % w/v at 24 hours exposure, respectively. The insecticidal activity of crude extract from tuba root was the highest and the insecticidal activity of crude extract from tea seed cake showed low toxicity. The plant extracts used in this research were more or less the same toxicity as neem seed kernel extracts against *Callosobruchus macalatus* F. [10] and dramatically more or less the same toxicity as derris extracts which showed LC_{50} about 0.5 % w/v against *Plutella xylostella* L. [2]. The effectiveness of tuba root extracts was the same effect as yam bean seed extracts and also tea seed cake extracts that higher concentrations showed more effectiveness than lower ones.

4. CONCLUSIONS

Tuba root (*Derris elliptica* Benth.), yam bean seed (*Pachyrhizus erosus* L.) and tea seed cake (*Camellia* sp.) extracted by soaking with 95% ethanol showed good control of adult worker of Pharaoh ants (*Monomorium pharaonis* L.) indicating LC_{50} at 24 hours ca. 0.22, 0.35 and 0.55 % w/v. These extracts took 24 hrs to cause the mortality rate of about 70-90 % which is rather ineffective when compared to currently available insecticides.

5. ACKNOWLEDGEMENTS

The authors would like to express their grateful appreciation to Assoc. Prof. Dr. Suraphon Visetson, Assoc. Prof. Dr. Monchan Maketon, Dr. Manthana Milne and Assoc. Prof. Dr. Decha Wiwatwittaya for their valuable advice. We are grateful to Department of Zoology, Faculty of Science, Kasetsart University and Graduate School for their valuable advices on the research work.

REFERENCES

[1] Siripassara, A. **1995** *The Application of Neem Extracts in the Controlling of Insect pests of Okra (Abelmoschus esculentus L.) on Farmer's Field* (in Thai). M.S. thesis, Kasetsart University, BKK Thailand.

[2] Visetson, S. and Milne, M. **2001** Effects of Root Extract from Derris (*Derris elliptica* Benth) on Mortality and Detoxification Enzyme Levels in the Diamondback Moth Larvae (*Plutella xylostella* Linn.), *Kasetsart J. (Nat. Sci.), 35*, 157-163.

[3] Thummasarangkoon, W. **2000** *Efficiency of Lemon Grass (Cymbopogon winterianus Jewitti) Extracts on Mortality and The Levels of Detoxification Enzymes in Larva of Culex pipen quinquefasciatus* (in Thai). M.S. thesis, Kasetsart University, BKK Thailand.

[4] Wattanasombat, T. **1995** *Efficiency of Galanga (Alpinia galangal Stuntz.) Extracts on the Mortality Rate and Enzymes Levels of Diamondback Moth (Plutella Xylostella L.)* (in Thai). M.S. thesis, Kasetsart University, BKK Thailand.

[5] Bullangpoti, V., Penssok, J., Wisarntanon, P., Kannasutra, P. and Visetson, S. **2002** Chili Extracts (*Capsicum frutescens* L.) for Control of Corn Weevil (*Sitophilus zaemai* Motschulsky), *Agriculture Sci .J., 33*(6) (Suppl.), 300-304.

[6] Saekin, P. **2000** *Effect of Leaf Extracts From Eupatorium odoratum L. on Detoxification Enzymes Levels in Golden Apple Snail (Pomacea canaliculata L.)* (in Thai). M.S. thesis, Kasetsart University, BKK Thailand.

[7] Ruamthum, W. **2002** *Effect of Nutgrass (Cyperus rotundus L.) Corn Extracts on Extracts on Esterase and Glutathione-S-Transferase Level in Digestive System of the Golden Apple Snails (Pomacea canaliculata Lamarck)* (in Thai). M.S. thesis, Kasetsart University, BKK Thailand.

[8] Zar, H. J. **1999** *Biostatistical Analysis*. 4th ed. Prentice Hall International , Inc. USA.

[9] Visetson *et al*. **2003** *Introduction on Biotoxicology*. Kasetsart University Thailand.

[10] Visetson, S. **2001** Effect of Azadirachtin from Various Thai Neem Extracts on Some Detoxification Enzyme Activity in *Callosobruchus maculatus* F. *20th ASEAN/2nd APRC Seminar on Postharvest Technology*, Chaingmai Thailand, pp. 34-46.