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BIOLOGICAL AND CHEMICAL CONTROL OF THE VECTOR SNAIL *MELANIA SCABRA* (GASTROPODA : PROSOBRANCHIA)

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ABSTRACT

Studies on Biological and chemical control of the snail, *Melania scabra* have been made in the field as well as in the laboratory.

Water beetles, crabs and fishes like *Ophiocephalus gachua* were found to be the natural enemies of the snail.

Fruit extracts of plants like *Acacia arabica*, *Acacia* sp., *Acacia concinna*, *Sapindus emarginatus* and *Neem margosa* were found to kill the snail population on large scale.

Series of experiments carried on the artificial control of *Melania*, using various poisonous chemicals have revealed that copper sulphate and cupric chloride are the most satisfactory molluscicides to be used in the control of *Melania scabra* in the field.

INTRODUCTION

In recent years several attempts have been made to control the vector snails of helminths. Dawood and Dazo (1966) performed field tests on two new molluscicides. Repellent action of some chemical molluscicides on Schistosome vector snails has been studied by Etges and Gilbertson (1966). Attempts to control the snails infested with of Bilharzia, have been made by several workers. Although such attempts were performed on the basis of biological information, just how much such attempts will add to the control of snails remains an open question. This uncertainity may be attributed to the fact that very little is known about the ecology of these snails, although a voluminous literature dealing with the control is available. Nagabhushanam and Muley (1975) studied the ecology of the snail, *Melania scabra*. Studies on breeding habits (Muley, 1977) and embryology and development of the snail have been made by Muley (in press). The snail is a continuous breeder and is widely distributed in various parts of India. As it is reported to be the important vector snail, it was found worthwhile to study its ecolog and control in detail. The present paper deals with i) Biological control and ii) artificial or chemical control of the snail.

MATERIAL AND METHODS

The snails, *Melania scabra*, required for the laboratory studies were collected from the river Godavari near Pravarasangam, Ahmednagar district, Maharashtra, India. Field and laboratory studies were made on the biological control of *Melania*, using fruit extracts of various plants like Babhul, Reetha, Shikakai and Neem. The dry fruits of these plants were grinded to a powder and extracts of required concentrations of these fruits were

prepared in tap water. The snails in groups were put in these extracts and their survival for a specific period in respective concentrations of these fruit extracts was observed. Biological control of the snails by various aquatic animals like water beetles, crabs and fishes was observed in the field. Studies on chemical control of the snail were made using various poisonous chemicals. Various concentrations of these chemicals were prepared, by dissolving the chemical in tap water or distilled water where required. The snails were placed in the known concentration and their activities and behavioural responses were noticed. After 24 hours the snails were brought back to the tap water and the percentage mortality was determined. This data helped to compare the toxicity of various chemicals and to select an effective molluscicide to check the overgrowing population of the snail.

OBSERVATIONS

1. *Biological control.*

(a) *Control of the snails by poisonous plants :*

Laboratory experiments with extracts of leaves, roots and fruits of various plants have shown that when the snails are put in such extracts they were killed after some time. Five such plants, whose fruits contain some snail destroying substances were *Sapindus emarginatus* (Ritha or soap berry), *Acacia arebica*, *Acacia* sp. (Babhu), *Acacia concinna* (soap nut or shikakai) and *Neem margosa* (Neem). The fruits of these poisonous plants were allowed to soak in snail infested waters in large numbers, but the fruits when applied in crushed and powdered forms and dissolved in water gave quick and satisfactory results (Table 1).

(b) *Control of the snails by animal predators :*

(i) *Helminth parasites :*

Most of the snails, were found to be infected with certain monostome cercariae. Studies on the survival of these infected snails have revealed that such snails could not survive for more than 8 to 10 days in the laboratory conditions as compared to the control snails which are non-infected but kept under similar laboratory conditions.

(ii) *Water beetles :*

Water beetles like *Diadiscus* sp. belonging to family Diaticidae were found to break the shell of the snail and eat the soft tissue, when kept in the vicinity. The beetles break the hard shell of the snail with their mandibles.

(iii) *Crabs :*

The crab, *Barytelphusa cunicularis*, was found to attack and eat the snail. Like the beetles the crab also breaks the hard shell, though the snail tries to withdraw the body in the shell and closes the operculum.

(iv) *Fish predators :*

Fish predators like *Ophiocephalus gachua*, were found to break the shell and eat the flesh of *Melania*. Analysis of stomach contents of the fish showed that the fish completely swallows the snail and digests the flesh leaving behind the broken parts of the shell.

2. *Artificial or chemical control.*

An attempt has been made by the application of several chemicals and molluscicides, to control the population of the snail. Most of these chemicals used were found to be lethal for one or other species of slug or snail. The concentrations of these chemicals were so made, that they would not cause any harm to the associated fauna. Application of molluscicides in part was adapted as recommended in WHO report (1961).

Selected concentrations varied from 0.00005% to 1.0%. These were found to be effective in the control of the snail. All the observations were made for twenty four hours. The results of experiments are tabulated in Table 2.

It is evident from the results that cyanides are highly lethal for the snail, but their use needs care. Copper sulphate was found to be more lethal next to cyanides. Salts of mercury were found to be equally lethal to the survival of *Melania*. Chlorides of Ammonia and other chemicals were moderate in their action.

DISCUSSION

Biological control, when considered from the ecological view point as a phase of natural control, can be defined as "the action of parasites, predators or pathogens in maintaining another organism's population density at a lower average that would occur in their absence" (Paul De Bach, 1964). Regulation of an organism's abundance below the level of economic injury is the target of the field of applied biological control. Similarly check of overgrowing population of the species by its natural enemies is the basic principle of biological control. Several beetles families are notorius for having a species that live largely or entirely upon pulmonate gastropods (Bequaert, 1925, 1926). Water beetles belonging to family Dyaticidae and family Hydrophillidae, crabs like *Barytelphusa cunicularis* and fish like *Ophiocephalus gachua* were found to be natural enemies of the snail, *Melania scabra*. They were found to attack and feed on the snail, naturally controlling the overgrowing population of the snail. Plants like *Acacia arebica, Acacia* sp., *A. concinna, Sapindus emarginatus* and *Neem margosa* were found to kill the snail population when their fruit extracts were applied in the laboratory and field. Fruits of these plants contain some snail destroying substances. But it was found that the effect of saponin or other lethal substances from the fruits will not last long and the application of the fruits will have to be repeated many times. Under these conditions this mode of control is no better than chemical control (Anantaraman, 1955). In the present investigation the biological control of *Melania* as observed was found to be temporary in true sense because the predators and plants are annual breeders or seasonally fruiting and thus these natural enemies are often unable to keep the snail population in check.

None of the methods of control outlined above were fully satisfactory. Hence more potent poisons need to be found for use against the snail. An attempt was made by the application of several chemicals and molluscicides, so as to select an effective one.

Voluminous literature on the chemical control of various snail vectors is available. However, the methods of control of the snail differ from country to country. In the present investigation the cyanides of sodium and potassium were found to be the most effective, but as they were so deliquescent in handling, they were found to be useless for large scale trials. Sulphates of Ammonia and Mercury salts were found to be moderate in their action. Copper sulphate and cupric chloride are the most potent poisons next to cyanides against *Melania*. Hence the careful application of these chemicals may be recommended for the control of this snail.

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Table 1 Control of *Melania scabra* using fruit extracts of various plants.

S. No.	Name of the plant	Common name	Lethal concentration of the extract	Time in minutes for 100% mortality
1.	*Sapindus emarginatus*	Ritha or soap berry	2.0 %	40
2.	*Acacia arebica*	Babhul	1.0%	30
3.	*Acacia sp.*	Babhul	1.0%	30
4.	*Acacia concinna*	Shikakai	0.7%	30
5.	*Neem margora*	Neem	0.5%	20

Table 2. Effect of various poisonous chemicals on the behaviour and survival of *Melania scabra*.

S. No.	Substate	Lethal concentration for 24 hours	Action	Remark
1.	Sodium cyanide	0.00005%	Retract the body in shell, closes the operculum, no activites died in 25 seconds.	Most lethal.
2.	Potassium cycanide	0.0005%	Retract the body in shell, closed the operculum, no activities, dies in 30 seconds.	Most lethal.
3.	Copper sulphate	0.0001%	Body erected outside for 10 seconds, again retracted, no activities, dies in 3 to 4.5 minutes.	Highly lethal.
4.	Cupric chloride	0.0001%	Body erected out of shell, retract within 2 minutes, closed the operculum died in 6.0 minutes.	Highly lethal.
5.	Ammonium sulphate	0.1%	Animal active, more towards the bordens of the container. Less active after 3 hours. Retract the body in shell, close the operculum, died after 4 hours.	Less lethal.
6.	Ammonium chloride	0.005%	No activities, operculum closed, body withdrawn in shell died after 50 minutes.	Moderate in action.
7.	Ammonium oxalate	0.1%	No activities, operculum closed, body withdrawn in shell died within 25 minutes in 1.0" Bolution.	Less lethal.
8.	Ammonium potassium sulphate.	0.1%	Animal active as soon as dropped. Withdraws the body in shell. Clores the operculum 100 percent mortality observed after 24 hours.	Less lethal.
9.	Mercuric sulphate	0.0001%	No activities of the snails, after 40 minutes. Opercuti closed. All died after 24 hours.	Highly lethal.
10.	Mercuric chloride	0.00005%.	All the snails active for 10 to 15 minutes. Stretch the body out of shell and again withdraw after 30 minutes. Operculi closed. All died within 24 hours.	Most lethal.
11.	Mercuric acetate	0.01%	Animals less active. Operculi closed after 20 minutes. All died within 20 hours.	Moderate in action.

REFERENCES

ANANTARAMAN, M. 1955. Biological control of aquatic snails. *J. vet. Sc. Anim. Husb.*, **25(1)** : 66-67.

BEQUAERT, J. C. 1925. The arthropod enemies of mollusks with description of a new dipterus parasite from Brazil. *J. Parasit,* **11** : 201-212.

BEQUAERT, J. C., 1926. A dipterus parasite of a snail from Brazil, with an account of the arthropod enemies of mollusks. In : *Medical report of the Hamilton Rice Seventh expedition of the Amazon. Harvard Inst. for Trop. Biol. and Med. Contr.* **4** : 292-303.

DAWOOD, I. K. AND DAZO, B. C. 1966. Field tests on two new molluscicides (Molucid and W. L. 8008) in the Egypt—49 Project area. *Bull. Wld. Hlth. Org.*, **35** : 913-920.

ETGES, F. J. AND GILBERTSON, D. E., 1966. Repellent action of some chemical molluscicides on schistosome vector snails. *Am. J. trop. Med. Hyg.*, **15** : 618-624.

MUKHERJEE, R. P., 1966. Seasonal variations of cercarial infections in snails. *J. Zool. Soc. India,* **18** (142) : 36-45.

MULEY, E. V. 1977. Studies on breeding habits and development of the broodpouch of a viviparous prosobranch *Melania scabra. Hydrobiologia,* **54** : 181-185.

MULEY, E. V. (in press) Embryology and development of fresh water Prosobranch, *Melania scabra. Hydrobiologia.*

NAGABHUSHANAM, R. AND MULEY, E. V. 1975. Studies on the ecology of the Fresh water prosobranch *Melania scabra. Marathwada Univ. J. Sc.* **14** (7) : 285-294.

PAUL DE BACH, 1964. *Biological control of Insect pests and weeds.* Section I. Chapman and Hall Ltd. London : 6.

WHO REPORT, 1961. Molluscicides, second Report of the Expert Committee on Bilharziasis. *Wld. Hlth. Org. tech. Rept. ser.* **214** : 5-50.