

MOLLUSCAN PESTS AND THEIR MANAGEMENT : A REVIEW

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ABSTRACT

The mollusca constitutes second largest phylum of the kingdom animalia. Their name is derived from the Latin word “mollus” meaning “soft”, which is generally protected by hard calcium containing shell. Around 85,000 species of mollusca have been listed. The phylum mollusca is typically divided into six taxonomic classes viz., Cephalopoda (e.g. Squid, cuttlefish, octopus etc.), Monoplacophora (e.g. neopilina), Amphineura (e.g. chiton), Scaphopoda (e.g. denalium), Bivalvia (e.g. ostrea, mytillus etc.) and Gastropoda (e.g. snails, slugs, conch shell, cypraea). Class gastropoda includes 8per cent species of phylum mollusca.

KEY WORDS: kingdom, Mollusca, Phylum

INTRODUCTION

The mollusca constitutes second largest phylum of the kingdom animalia. Their name is derived from the Latin word “mollus” meaning “soft”, which is generally protected by hard calcium containing shell. Around 85,000 species of molluscs have been listed. The phylum mollusca is typically divided into six taxonomic classes viz., Cephalopoda (e.g. Squid, cuttlefish, octopus etc.), Monoplacophora (e.g. neopilina), Amphineura (e.g. chiton), Scaphopoda (e.g. denalium), Bivalvia (e.g. ostrea, mytillus etc.) and Gastropoda (e.g. snails, slugs, conch shell, cypraea). Class gastropoda includes 80 per cent species of phylum mollusca (Srivastava, 1992).

General characteristics of phylum Mollusca

Body of mollusca is soft and unsegmented and is triploblastic with bilateral symmetry. Body is divided into head, foot and visceral mass. An

exoskeleton of calcareous shell of one or more pieces secreted by mantle protects the body. Head is indistinct bearing mouth and provided with eyes, tentacles and other sense organs. They have open circulatory system and respire by means of gills or taenidia or by both. Sense organs include eyes, statocytes and receptors for touch, smell and taste are present (Srivastava, 1992).

Division of phylum Mollusca

Phylum Mollusca is divided into six taxonomic classes

I. Monoplacophora:- Ex. neopilina. The typical characteristics of this class are that they possess segmented muscles and having 5-6 pairs of gills and 6 pairs of nephridia and they are unisexual.

II. Amphineura:- Ex. chitons. The most significant characteristics of this class are that they possess 8 broad plates on shell and having many external gills and single pair of nephridia and they are unisexual.

III. Scaphopoda:- Ex. denalium. The most significant characteristics of this class are that their shell opens at the ends and their mantle and shell are tubular and curved. Gills are absent in denalium and they are unisexual.

IV. Bivalvia:- Ex. anodonta, oyster, teredo, unio etc. The most significant characteristics of this class are that they have bivalved shell and one or two pairs of gills are present and they are unisexual.

V. Cephalopoda:- Ex. nautilus, octopus, squid, cuttlefish etc. The most significant characteristics of this class are that they having large head with conspicuous eyes and possess one or two pairs of gills.

VI. Gastropoda:- Ex. snails, slugs, cypraea, conch shell, etc.

Gastropoda, an agriculturally important class of phylum Mollusca

General Morphology

A thin tissue, called the mantle, encompasses the soft body of the molluscs and secretes a calcium carbonate shell in molluscs such as clams. Snails and slugs glide by contracting muscles within the foot. A slime trail secreted by the snail reduces abrasion between the foot and substrate. Mantle cavity is a space between mantle and visceral mass contains gills, anus, gonophores and nephridiophores. Most molluscs possess a calcium carbonate shell that protects their soft bodies. Snails sense their environment through smell and touch. Primitive eyes are located on the end of the antennae on the head allowing light detection but without the capacity of visualization of the environment.

Feeding behaviour

The radula of snails consists of small chitinous teeth embedded in muscles allowing the snail to rasp from substrate material or tear plant tissue. Cone shells are snails that hunt other creatures using a venomous tooth made of chitin which harpoons the prey. Various species of slug

can eat algae, animal faeces, carrion, centipedes, fungi, green plants, insects, lichens, worms and other slugs (Sallam and Wakeil, 2009).

Life cycle

All slugs and snails are hermaphrodite. Mating, egg-laying, hatching and development are not well synchronized even within single species and various stages of development found round the year. Most species live one season or less and adults may deposit eggs throughout the season. While mating, snails needs introductory behavioural fore play and adjust themselves in such a way that they could bring their genital organ in a position which facilitates mating. While mating, slugs tend to twist around each other like spiral vine and then transfer their spermatophores into the female. Courtship may last for 3-4 hrs in snails and slugs depending upon the species. In case of snails, eggs hatch within 7-15 days and development of young ones takes place within 15-25 days and becomes fully matured within 45-59 days in general and may took 321-364 days to reach adulthood because their size and shape are slowly increase. In case slug life cycle is near about same in duration as of snail.

Species composition

Arion rufus (Linnaeus), *Deroceras reticulatum* (Muller), *D. leave* (Muller), *D. gracile* (Rafinesque), *Lehmannia poirieri* (Mabille), *Limax marginatus* (Muller), *L. maximus* (L.), *L. flavus* (L.) and *Milax gagates* (Draparnaud) are the major species of slugs (Ebeling, 1959); whereas, *Achatina fulica* (Bowdich), *Pomacea canaliculata* (Lamarck), *Opeas gracile* (Hutton), *Zootecus insularis* (Ehrenberg), *Ariophanta bajadera* (Pfeifer), *A. solata* (Benson), *A. ligulata* (Ferruse), *Cryptozona bistrialis* (Xestina), *C. semirugata* (Beck), *C. belangiri* (Deshayes), *Macrochlamys indica* (Blanford) and *Bensonia monticola* (Hutton)

are major species of snails (Ray and Mukharjee, 1963; Subba Rao, 1975; Subba Rao and Mitra, 1979; Raut and Ghosh, 1984; Bhalla and Pawar, 1977; Srivastava, 1992).

Nature of damage

Land molluscs damage cereal, potatoes, vegetables, lettuce, carrots, cabbage, maize, clover as well as other agricultural and horticultural crops. Slugs eat a wide array of broadleaf plants and grasses including most crops and many weeds; they harm crops both by killing seedlings outright, causing poor stands and damage to the leaves of young plants. They feed by scraping the surface of host plants. The symptoms of their damage varies by crop to crop *e.g.* feed on recently-planted seeds of wheat, scrape strips of leaves in corn and many small grain plants; create craters in the cotyledons and ragged holes on leaves of soybean. Similar ragged holes are seen on leaves of canola, alfalfa and other broadleaf crops. Slime trails are often seen in close association with their damage (Douglas and Tooker, 2012). Land snail eats leaves, root, seeds, seedlings and tuber of nearly all vegetables, field crops, oil plants, ornamental plants as well as fruits in field, garden and green house (Sallam and Wakeil, 2009). Land molluscs attacks on raw succulent vegetables, seeds, seedlings, roots and tuber crops; and leave unpleasant slimy tracks on the injured parts (El-Okda, 1980). The food preference and consumption of certain vegetable plants and field crops for three land snails viz., *Monacha cantiana*, *Succina putris* and *Theba pisana* was studied by El- Deeb *et al.* (2001). Shahawy *et al.* (2008) studied the relative susceptibility of five fruits species (apple, orange, pear, plum trees and banana) to the four land snail species under laboratory conditions and found that *T. pisana*, *Helicella vestalis* and *Cochlicella acuta* preferred pear highly, while *Eobania*

vermiculata prefers banana. Moreover, pear and orange were mostly attacked by *T. pisana* and banana by *E. vermiculata*.

Management

Cultural control

Elimination of hiding places and birth sites, mulching of compost or composted manure, use of additional organic material which help in building the population of natural predators (ground beetles, rove beetles and other garden creatures), avoidance of their favourite cuisine, sanitation by removal of trash, weedy growth, daytime shelters and keeping a broad, clean and dry section between crops and sources are important cultural practices for the management of snails and slugs (Olkowski *et al.*, 1991). Ploughing of the soil before sowing seeds of wheat in early spring is found effective means of ecological control (Wouters, 1970). Plowing the soil twice a year also reduces both snails and slugs populations (Shetlar, 1995). Cultivating the soil in late autumn destroys many of the immature and adult snails as well as eggs that have been deposited in the soil. Improvement of soil structure resulted in exposure of the sensitive egg and juvenile slugs. Clearing of field edges and irrigation ditches after the harvest reduces the level of infestation (Sallam and Wakeil, 2009).

Mechanical and physical control

Hand collection with subsequent squashing of the slugs and snails is the oldest mechanical methods (Mahrous *et al.*, 2002). Keeping solution containing 3 to 5 per cent rubbing alcohol, chop sticks, broad-pointed tweezers, tongs or hatpins can be suggested for the efficient collection of snails and slugs. Hand-picking during night when the slugs and snails have left their hiding places was found effective (Hamir, 2010). Sodium chloride (common salt), an effective dehydrating agent can be applied as barrier application on snail infested area. Practice of collection of the snails daily and

killing them in strong solution of common salt or in boiling water is also recommended. Burning the vegetation on which aestivating snails attach reduce the snail populations (Joubert and Walters, 1951). Protective barriers of dehydrating substance such as cattle salt, caustic soda, kainite or completely dry quick lime act as barrier. Nakhla (1995) protected orchard trees from land snails by using a band of metal/copper/aluminium sheets or wire screen around the tree trunk. Baited pit traps, collecting stations, textual barriers, desiccating barriers, toxic barriers and physical barriers have been recommended for the management of snails and slugs under field conditions (Olkowski *et al.*, 1991).

Legislative control

Dispersal of economic pest mollusca occurred by man, plants, seeds, soil, ships, trains, airplane, cars, cargo, baggage, postal packages and food stuffs (Herzberg and Herzberg, 1962; Godan, 1983) and hence required plant quarantine treatments. Richardson & Roth (1963) used carboxide instead of methyl bromide for fumigation against aestivated *Cochlicella barbara* (L.) and *T. pisana* on military cargo from Mediterranean areas. Ittah and Zisman (1992) evaluated volatile allyl alcohol derivatives for control of *T. pisana* snails on cut roses for export without any fear of phytotoxicity.

Microbial and biological control

Verticillium chlamydosporium was found effective when applied at the time of oviposition (Mead, 1961). The combination of *Bacillus thuringiensis* and the parasitic nematode, *Rhabditis* sp. played an effective role in controlling *E. vermiculata* as well as other terrestrial snail and slugs in Egypt (Azzam and Belal, 2002). The nematode, *Phasmarhabditis hermaphrodita* (Schiender) has been successfully used for the control of slugs in field (Wilson *et al.*, 1996). The

parasitic nematode, *Rhabditis* sp. was recorded for the first time in Egypt and showed high infectivity on different snails and slugs (Azzam, 1998). The period need for the death of snail, *E. vermiculata* decreased by increasing concentrations (10-300 I./ Snail) of parasitic nematode, *Rhabditis* sp. (Azzam and Hegab, 2000). Protozoa, flat worms, lung worms, carabid beetles and glowworm larvae of lampyrid beetles as well as the larvae of Sciomyzidae (Diptera) are found the major predators/parasites associated with molluscs (Baker, 1989). Ground beetles, rodents, rove beetles and birds are feeding on slugs (Olkowski *et al.*, 1991; Fouad *et al.*, 2000; Hamir, 2010).

Botanical control

Azadirachtin an active component isolated from neem kernel was reported for its molluscicidal activity against *Lymnea lutea* (Ramesh, 1983). El- Hawashy *et al.* (1996) reported that ethanolic extracts from the leaves of cauliflower, oshar (*Ligusticum porteri*) and pergularia (*Pergularia daemia*) were most effective against snails, *E. vermiculata* when tested as residue film technique and recorded 88.8, 88.8 and 77.7 percent mortality, respectively. Snails and slugs were effectively managed by sprinkling of tobacco dust around plants (Anon., 2011).

Chemical control

Metaldehyde, methiocarb (Mesurol), common salt or combinations of these chemicals are known molluscicides. Metaldehyde stimulate the mucous gland which cause excessive sliming and leading to death due to dehydration (Henderson, 1970; Henderson and Triebkorn, 2002; Abd El-Wakeil, 2005). Methiocarb was found more poisonous than metaldehyde against slugs, *D. reticulatum* (Getzin and Cole, 1964; Abd El-Wakeil, 2005). Bhavsar and Patel (2011) evaluated thiamethoxam and diafenthiuron and observed molluscicidal

activity against the terrestrial snail. El-Massry *et al.* (1998) tested urea, ferrous sulphate and calcium super phosphate against many species of land snails, wherein urea recorded the highest toxic effect. Wheat and rice bran containing 0.5 per cent methomyl showed high attractant action and toxicity for land snails (El-Sebae *et al.*, 1982). El-Okda *et al.* (1989) recorded higher toxicity of aldicarb, oxamyl and lannate all at 0.5 per cent to land molluscs, *Helix aspersa*, *Eobania* sp., *Theba* sp., *Rumania* sp. and *Oxychilus* sp. Methomyl, dithiocarb, carbaryl, chlorpyrifos and dimethoate were found effective against snails after 12 days under laboratory conditions (Ghamry *et al.*, 1994). The baits formulated from the iron phosphate ceased the feeding of snails and slugs (Anon., 1996).

CONCLUSION

Among molluscs, snails and slugs causes economic and severe damage to cereal, potatoes, vegetables, lettuce, carrots, cabbage, maize, clover as well as other agricultural and horticultural crops. These pests can be manage by ploughing of soil before sowing, daily hand collection and killing them with a strong solution of common salt or in boiling water, burning of vegetation to clear pests before sowing, installation of beer-baited traps and scraping off the accumulated population, use of protective barriers and application of poisonous baits. In addition to this, application of neem seed kernel extract, tobacco dust and bio agents viz., *B. thuringiensis* or *V. chlamydosporium* were also found effective. Metaldehyde, methiocarb, methomyl, carbaryl, chlorpyrifos, etc. are proved as effective molluscicides. Several natural enemies also associated with this pest and play important role in the biological control. Looking to the status of this pest, it is required to initiate the studies on abundance of species composition in an area, economic status of the molluscs

as pests in crops, seasonal incidence as well as impact of biotic and abiotic factors on their activity, hunt for effective chemicals or other control measure strategies (IPM) and quarantine strategies to check the spread of snails and slugs from endemic areas.

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