Molluscidal activity of trifenmorph in field trials

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Trifenmorph granules provided 100% control of Biomphalaria glabrata and B. tenagophila when applied at 2 kg of active ingredient per hectare, except at one site with a pH of 5.6 where the snail population was reduced by only 50%. Granulation was found to facilitate application by either hand or mistblower, and reduces the risk of infection to the spray team. Applied to canal margins the granules had a residual toxic effect.

Trifenmorph has been shown by Boyce et al. (1) and Crossland (2) to be an effective molluscicide for controlling the intermediate snail hosts of the Schistosomatidae. Paulini a reported that the application of wettable powders or emulsifiable concentrates requires the use of up to 10 l of water for each 2–3 g of molluscicide and in highly endemic areas exposes spray teams to possible infection while fetching the large quantities of water necessary as a diluent or washing equipment after spray applications.

Additionally, in irrigation or drainage canals with fluctuating water levels large numbers of snails remain below the surface of the mud or aestivate along the edges, and are not reached by conventional molluscicides. The snails in aestivation may harbour immature stages of S. mansoni (4).

An experimental granular formulation of trifenmorph containing 4% active ingredient was tested at 3 field sites in Brazil to verify its efficacy as a molluscicide and to establish the practicality of granules in terms of ease of application, reduction in hazard to spray teams, and residual action when applied to the margins of canals.

MATERIALS AND METHODS

Trifenmorph granules (4% active ingredient) b were tested against Biomphalaria glabrata or B. tenagophila at the following sites.

Site A: São Miguel Estate, Ceará-Mirim, Rio Grande do Norte

A sugar cane field with numerous lateral drainage canals and a snail population that varied from 0 to 200 B. glabrata per m² was selected for treatment. The granules were applied at 50 kg/ha, or twice the dose reported (Crossland, personal communication, 1971) to have given a 100% kill in laboratory tests. This corresponds to 0.2 g of active ingredient per m². The product was scattered manually over standing water (maximum depth 30 cm, usual depth 2 cm), moist margins of the canals, and dried canals that might harbour aestivating snails. A total of 9 kg of granules was applied. A separate area with similar conditions was left untreated as a control. Observations were made after 24 hours, 5 days, 1 month, and 2 months.

Site B: Itaoca, Itapemirim, Espírito Santo

A temporary pond with a surface area of 457 m² was selected. The population of B. tenagophila had previously been recorded at over 1 000 snails per m², but at the time of treatment, 5 weeks after the pond had almost completely dried up, it was less than 200 snails per m². A total of 2 kg of formulation, or approximately 0.18 g of trifenmorph per m², was applied with a Hatsuta Blowmic Am-8 portable mistblower equipped with a granule spreader and operated with the volume control at position 2.

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b This experimental formulation was provided by Shell Research Ltd, Woodstock Agricultural Research Centre, Sittingbourne, Kent, England.
Granules reached all but a 1.5-m swath in the centre, where the water was 0.5 m deep. Observations were made after 3 days and monthly thereafter.

**Site C: João Ferreira Estate, Itapemirim, Espírito Santo**

A former marsh drained by over 700 m² of canal and now used for field crops was selected. The water was 0–8 cm deep in lateral canals and 15–20 cm deep in the slowly flowing main canal; the pH was 5.6. Although there had previously been more than 100 *B. tenagophila* per m² of surface in the main canal, because of a recent drought the population had fallen to about 1 snail per 6 m². At the time of application adult snails, young snails, and egg masses were found. A total of 4 kg of granules—0.23 g of trifenmorph per m²—was applied with a Hatsuta Blowmic Am-8 portable mistblower in an attempt to eliminate the residual snail population. Observations were made after 3 days, 1 month, and 2 months.

**RESULTS**

At site A, almost complete mortality was achieved within 24 hours. Two surviving snails were found in one lateral canal. Sporadic death of the fry of small fish species was also observed initially. However, both medium-sized and small fish were observed alive in the treated area after 5 days, when the snail population had been eliminated. The site remained free of snails until the annual floods reintroduced *B. glabrata*.

<table>
<thead>
<tr>
<th>Site</th>
<th>Reduction of population after various intervals (%)</th>
<th>1 day</th>
<th>3–5 days</th>
<th>1 month</th>
<th>2 months</th>
<th>5 months</th>
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* The sites are described in the main text.
* Estimated by comparing observed population with that present at time of application. Continued absence of snails implies not continued toxicity, but absence of repopulation.
* Area flooded and repopulated from outside.

**DISCUSSION**

Trifenmorph granules applied at 2 kg of active ingredient per ha were effective against *B. glabrata* and *B. tenagophila* in a drainage system and a temporary pond. The failure to provide complete control at a third site can probably be attributed to a combination of low pH and the presence of flowing water in the main canal. Snails were eliminated in the lateral canals holding stationary water, regardless of its pH.

Granules are a desirable formulation. After the first rainfall, lasting 1 hour, a check at site A showed that the granules along canal margins and on dry canal beds were still intact 6 days after application. The eventual dissolution of these granules and delayed release of trifenmorph into the water probably acts to eliminate snails that escape the initial application, such as those found in the first observations at sites A and B. The granules are convenient to use; they can be spread by hand with no equipment at all, and the use of portable mistblowers equipped with granule spreaders allows application at normal walking pace. Site B was treated in less than 3 minutes. For larger sites a 2-man team is used: one operates the mistblower while the other keeps it refilled. Refilling is done without switching the machine off or removing it from the operator's back. Because water is not used as a diluent, the spray team is not exposed to infection while fetching water to prepare the formulation. Likewise, the spray tank does not become dirty during granule application and so does not need washing at the site.

**ACKNOWLEDGEMENTS**

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RÉSUMÉ

ACTIVITÉ MOLLUSCICIDE DU TRIPHENMORPHE LORS D’ESSAIS SUR LE TERRAIN

Le triphenmorphe est un molluscicide efficace contre les espèces de Biomphalaria qui transmettent la schistosomiasis. Pour pallier les inconvénients résultant de son emploi sous forme de poudres mouillables ou de concentrés pour émulsions, on a utilisé des granules, contenant 4 % de produit actif, appliqués manuellement ou mécaniquement, ce qui évite le contact entre l'opérateur et l'eau et élimine le risque d'infection.

Le molluscicide a été appliqué en trois endroits, à la dose approximative de 0,2 g de produit actif par m². Cette dose, correspondant à 50 kg de granules par hectare, est deux fois plus forte que celle qui tue 100 % des mollusques au laboratoire. Dans une plantation de cannes à sucre, à Rio Grande do Norte, on a obtenu en 24 heures l'élimination complète de B. glabrata qui s'est maintenue pendant 4 mois. Certains granules ont été retrouvés intacts 6 jours après l'application et la destruction totale du mollusque est peut-être due à la libération tardive d'une partie du produit actif. Les poissons de taille petite ou moyenne n'ont subi aucun dommage, mais on a observé sporadiquement la destruction du frai au cours du 1er jour. Des résultats similaires ont été obtenus dans un bassin temporaire, d'une superficie de 457 m², à Espirito Santo, où B. tenagophila a été complètement éliminé pour une durée de 5 mois. Par contre, dans un marais proche, on n'a pas réussi à détruire complètement cette espèce, cet échec relatif étant attribué à l'existence de courants et au faible pH(5,6) de l'eau.

Les granules de triphenmorphe apparaissent donc comme une formulation convenant au traitement rapide et sans danger des eaux dormantes où ils assurent la destruction à 100 % des mollusques.

REFERENCES