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(54) **Title:** MOLLUSCICIDAL COMPOSITION

(57) **Abstract:** A molluscicidal composition including a metal complexone as the active ingredient and a suitable carrier thereof, wherein the complexone is diethylenetriaminepentaacetate (DTPA).

MOLLUSCICIDAL COMPOSITION

Field of the Invention

The present invention relates to a molluscicidal composition, which preferably acts as zeither a stomach or a contact poison on molluscs. More particularly, the present invention while preferably being degradable is still sufficiently stable in sunlight and yet has reduced, little or no harmful effects on the environment or to non-target organisms. The invention is also directed to the use of such molluscicidal compositions in killing, controlling or inactivating molluscs, in particular, snails or slugs and in also preferably providing a readily available source of iron to soil.

Background to the Invention

Slugs and snails are major pests of agriculture in Australia and many other parts of the world. These molluscs are able to adapt to a wide range of climatic conditions and often become established as pests in a short time. Their biology tends to favour activity in moist conditions such as habitats that are continually wet in temperate regions. However, because of their ability to hibernate in winter and aestivate in summer (i.e. seal themselves in their shell and slow their metabolism down in hot dry conditions), snails are still often found in countries with Mediterranean type climates. Slugs are able to survive in colder climates because of their ability to bury themselves in the soil.

Significant crop damage from slugs and snails occurs in Europe; North, South and Central America; South East Asia; South Africa; Australia and New Zealand. In most cases, it is has been through the introduction of non-native molluscs and lack of sufficient predators thereof that has enabled these species to gain pest status. The white snails, *Theba pisana*, *Cernuella virgata* and *Cochlicella* spp. have become a problem in parts of Australia and South Africa through the introduction of these snails from the Mediterranean. In addition, changes in agricultural practice have also given rise to an increase in pest numbers. For example, as a result of the introduction of minimum-till agriculture, slugs have, during the last decade or so, become a significant pest in the Corn Belt of the United States of America.

Molluscs can be controlled by a combination of agricultural practices, chemical and biological agents. Chemical molluscicidal compositions can be divided into two groups,

(a) contact-action molluscicidal compositions, such as aluminium and copper sulfate, which are applied to the area inhabited by the snail or slug and are taken up passively when the mollusc moves into and across the infected area; and

(b) stomach-action molluscicidal compositions that rely for their action on the mollusc consuming the lethal poison. Methiocarb and metaldehyde are typical stomach poisons. In some situations, metaldehyde may also act as a contact poison.

Both contact and stomach poisons are advantageously presented for use in combination with a carrier. When carriers are used as delivery for stomach poisons, it is necessary that a sufficient amount of the poison be ingested by the mollusc to ensure a lethal dose. In this regard, it is preferred that the carrier of the poison is in the form of a palatable attractant or be the attractant itself.

Metaldehyde is the most widely used molluscicide but it has the disadvantage that it is ineffective under cold, damp conditions. Its efficacy is dependent on high temperature and low humidity for maximum lethal effect, since if the ambient conditions are conducive, molluscs are able to rehydrate and make good the water deficit caused by the excess mucous secretion, which is stimulated by the metaldehyde, rendering the poison ineffective.

The second most widely used group of chemical molluscicides are the carbamates, which are anti-cholinesterase compounds. Methiocarb is the most commonly used carbamate in molluscicidal compositions. Methiocarb is toxic to molluscs over a wide range of conditions and is most effective under very moist conditions. Unfortunately, methiocarb is toxic to a wide range of non-target organisms such as beneficial insects and earthworms.

Henderson and Martin (**An. Appl. Biol.,** (1990), **116**, 273-278) found that ferric ethylenediaminetetraacetic acid (hereinafter referred to as "FeEDTA") was a good contact poison and Puritch *et al.* in International Patent Application No. WO 96/05728 claimed that combining FeEDTA in an "inert" carrier produced an effective stomach poison for the slug species, *Deroceras reticulatum.* The patent also claimed that a simple iron salt and EDTA or its sodium or calcium salt can produce an effective molluscicide but the patent does not disclose how the three components of the composition individually are taken up by the mollusc or which element was responsible for the molluscicidal activity and nor in what manner the elements are combined, if at all, to form a composition. If the elements are not combined, the mechanism by which the iron salt and EDTA were prevented from undergoing a reaction with each other before entering the mollusc was not disclosed.

Australian Patent Application No. AU-B-12203/97 showed that metal complexones, particularly the iron chelate of the hydroxy and oxo-dimer of FeEDTA, are effective molluscicides. A later patent application, International Patent Application No. PCT/AU98/00941, disclosed that the efficacy of metal complexone-based molluscicidal compositions can be enhanced by the incorporation of additives. These additives were shown to effectively mop up any strong chelators such as phytates, which would otherwise chelate the metal and prevent it from acting as a poison, thereby reducing the efficacy of the composition.

In a second patent application to Puritch *et al*, International Patent Application No. WO99/39576, Puritch *et al.* claimed that the complexone ferric diethylenedisuccinic acid (hereinafter referred to as

"FeEDDS') or a simple iron salt together with the sodium salt of EDDS or EDDS (as the acid) are an effective molluscicide. EDDS is more readily biodegradable than EDTA, although it is well known that the iron complexes of EDDS are photodegraded. Whilst ultimate degradation is desirable, rapid biodegradation of EDDS and its metal chelates result in the reduced efficacy of the molluscicidal composition under typical conditions of use. Indeed, research and experimental trials using FeEDDS, incorporated in a molluscicidal composition, have found that its efficacy decreased when the trials were conducted in full sunlight.

Since most plants requiring protection from mollusc infestation are grown in partial to full sunlight, the present inventor set out to find a metal complexone that was more stable in full sunlight than EDDS, but less recalcitrant than EDTA. While it is believed that the poisoning effect is most likely due to the metal ion, what is not totally clear from the literature or earlier research is whether a stronger or weaker chelating agent would be more effective in making the toxic metal ion more effective.

Logically, one would expect that the stronger the chelator, the more tightly the metal ion is bound and the greater the likelihood that when ingested, the metal complexone would simply and harmlessly pass through the mollusc. The ligand diethylenetriaminepentaacetic acid (hereinafter referred to as "DTPA") is a stronger chelator then EDTA and as such it therefore would be expected to chelate the metal ion so strongly that the metal DTPA complex so formed, once ingested, would pass straight through the mollusc without releasing any metal ion into the mollusc's digestive system. The present inventor has surprisingly found that metal DTPA provides a molluscicidal composition of comparable efficacy to that of compositions including either FeEDDS or FeEDTA; however, it is more biodegradable than FeEDTA (Means, Kucak and Crerar, in: "Relative Degradation Rates of NTA, EDTA and DTPA and Environmental Implications", **Environmental Pollution**, Series B, Vol 1, (1980), pp 45-60) but more stable than FeEDDS (R.

Takahashi, N. Fujimoto, M. Suzuki and T. Endo, "Biodegradabilities of ethylenediamine-N,N"-disuccinic acid (EDDS) and other chelating agents in Bioscience", **Biotechnology and Biochemistry**, 61, (1997), 1957-1959).

There is a further distinct advantage in using metal DTPA instead of FeEDTA, since the strongly bound metal ion in both metal NaDTPA or metal HNaDTPA can act as a source of metal ion in slightly alkaline soils. This is particularly advantageous in citrus and vine plantations, where soils tend to be alkaline. These plantations often suffer from severe snail infestations and from iron deficiencies which lead to chlorosis and subsequent reduction in yield and fruit quality. In Australia, the snail species, *Helix aspersa, Theba pisana, Cernuella virgata* and *Microxeromagna vestita* are pests in citrus orchards. Thus, where the metal of the metal DTPA is iron, additional advantages are derived.

In very alkaline soils, iron is generally locked up as an insoluble hydrated iron oxide or if the soil is phosphate rich, as iron phosphate. In the form of iron oxide, the iron is virtually unavailable to plants except in high organic soils, in which the microbes act on the iron and chelate it to make it soluble. As stated above, in citrus plantations, this iron deficiency can result in chlorosis being a serious problem.

The most commonly used substance for treating chlorosis is FeEDDHANa (Sodium ferric ethylenediamine-N,N'-bis(2-hydroxyphenylacetate), which is sold in Australia as Libfer® SP, Rexolin® and Rexiron®. This compound is fairly expensive and is usually applied to the soil as a drench, granule or powder. It degrades in sunlight to give insoluble iron oxide. The amount of FeEDDHANa needed to treat iron deficiencies is fairly large. It is common to apply 5 kg/ha once or twice a year.

Other possible sources of iron for high pH soils are ferric glucoheptonate, ferric humate and ferric lignosulfonate. These compounds are cheaper and are potentially superior sources of iron. The present inventor has established through a series of trials that they are not repulsive to snails and can be combined with Ferric EDTA or Ferric DTPA to provide a dual purpose product that will kill snails and be a good source of nutritional iron in high pH soils.

Summary of the Invention

According to the present invention, there is provided a molluscicidal composition including a metal complexone and a suitable carrier therefor, wherein the complexone is diethylenetriaminepentaacetate (DTPA).

Preferably, the metal of the metal complexone is selected from the group consisting of Group 2 metals, transition metals or Group 13 metals, or mixtures thereof. More preferably, the metal is a transition metal. Most preferably, the metal is selected from iron(II) or iron(III), copper, aluminium or zinc, or mixtures thereof. In a further most preferred composition, the metal is iron(III). Typically, for FeDTPA, the amount of iron required for efficacy is between about 0.4-0.8 wt. % of the total composition.

Preferably, the molluscicidal composition is selected from the group of stomach-action molluscicidal compositions or contact-action molluscicidal compositions. More preferably, the composition is in the form of a stomach-action composition.

Preferably, the carrier is in a liquid or a non-liquid form. More preferably, the carrier is in a non-liquid form and for a stomach-action composition, the carrier preferably includes an attractant, and preferably one that is palatable thereby yielding an edible bait to the mollusc. The attractant is preferably selected from a mollusc food, such as a cereal, wheat flour, arrowroot or rice flour, bran, carrot, beer, rice hulls, comminuted cuttle fish, starch or gelatin, or mixtures thereof. Other carriers of interest include polymeric materials, pumice, carbon and those materials commonly used as carriers in insecticides. Carriers may also be in a liquid form which enable the composition to be applied moist or wet. Thus, the carrier may be any suitable solvent in which the metal complexone is miscible or immiscible to enable it to be spray-applied either as a solution or poured on the target area as a suspension. Preferably, the composition or the carrier itself may include other additives known in the art such as mollusc phagostimulants, for example, sucrose or molasses; lubricants, such as calcium or magnesium stearate, talc or silica; binders which are suitably waterproof, such as a fatty acid alcohol; fungicides and a bittering agent. Any bittering agent is preferably BITREX® which renders the composition less attractive to non-target organisms and children. In order to inhibit deterioration of the composition, it has been found that the carrier may also include preservatives such as sodium benzoate, vitamin E, alpha-tocopherol, 4-nitrophenol, ascorbic acid, methyl paraben, propyl paraben or sodium bisulfite.

Preferably, a waterproofing agent is included and for example, in drier climates, such as in Australia and the Mediterranean, the water proofing agent is preferably selected from Guar gum, Lotus bean gum or a fatty acid alcohol. Typically, where the waterproofing agent is a fatty acid alcohol, this is preferably present in an amount of between 1-5 wt. % of the total composition. More preferably, the fatty acid alcohol is selected from the group of C_{16}-C_{18} fatty acid alcohols. Most preferably, the C_{16}-C_{18} fatty acid alcohols comprise about 2 wt. % of the total composition and the C_{16}-C_{18} fatty acid alcohol mixture is HYDRENOL MY, which is a mixture of hexadecanol, heptadecanol and octadecanol.

Preferably, the composition of the present invention further includes an additive that enhances the lethal activity of the composition. It has been determined that the increase in lethal activity results from the improved absorption of the toxic metal ion. Preferably, the activity-enhancing additive is selected from a surfactant or an additional source of metal ion, preferably ferric ion. In one preferred form of the invention, where the activity-enhancing additive is a surfactant, the surfactant is preferably selected from the group of cationic, anionic or non-ionic surfactants. More preferably, the surfactant is anionic or non-ionic. Typically, the amount of surfactant added is between about 0.05-1 wt. % of the total composition. It is further to be understood by those skilled in the art that the term "surfactant" includes such species as EDDS and/or the salts thereof and the like.

Where the activity-enhancing additive is an additional source of metal ion, preferably ferric ion, the iron is preferably added in the form of a ferric salt or in the form of a clay to the composition. Preferably, when the additional ferric ions are added in the form of a salt, the ferric salt is ferric orthophosphate and the preferred amount added is between about 1-5 wt. % of the total composition. More preferably, the amount is between about 1-3 wt. % of the total composition.

Preferably, the composition further includes a pH adjusting agent such that the pH of the composition is in the range of 6 to 8. Preferably, the pH adjusting agent is selected from calcium carbonate, potassium carbonate, magnesium carbonate, sodium bicarbonate, potassium hydroxide, ascorbic acid, tartaric acid or citric acid, or mixtures thereof. Such pH adjusting agents can preferably be added in an amount of between 1-5 wt. % of the total composition.

In a preferred aspect of the invention, there is provided a molluscicidal composition that also acts as a source of readily available iron to a soil, the pH of which is in the range of 5 to 9.5. To this end, the scope of the present invention includes a molluscicidal composition which further includes a nutritional iron source, such as FeEDDHANa (Sodium ferric ethylenediamine-N,N'-bis(2-hydroxyphenylacetate), FeEDDHMAK (Potassium ferric ethylenediamine-N,N'-bis(2-hydroxy-4-methyl phenylacetate), ferric glucoheptonate, ferric humate or ferric lignosulphate, or mixtures thereof, to provide a dual purpose product that will kill snails and be a good source of nutritional iron in alkaline soils.

It is to be understood by those skilled in the art that the scope of the present invention includes the composition disclosed herein when used on its own or when used in combination with at least one other molluscicide. For example, it is envisaged that the molluscicidal composition could incorporate FeDTPA in combination with another metal complexone such as FeEDDS, FeEDTA or mixtures thereof.

The composition is advantageously presented in a solid form such as tablets, a powder, granules or pellets. Those skilled in the art will appreciate that it is preferable to prepare the products, which are the subject of the present invention, in a form that is easy for consumers to use. Pellets, for example, can be easily scattered across the area to be protected. Preferably, the composition is in the form of a pellet. More preferably, the pellet is between about 1 and 4 mm long.

Where the terms "comprise", "comprises", "comprised" or "comprising" are used in this specification, they are to be interpreted as specifying the presence of the stated features, integers, steps or components referred to, but not to preclude the presence or addition of one or more other feature, integer, step, component or group thereof.

The term "complexone" as used herein refers to an organic ligand containing at least one iminodiacetic group $-N(CH_2CO_2H)_2$ or two aminoacetic groups $-NHCH_2CO_2H$, which form stable complexes with most cations. The hydrogen on the nitrogen or carbon can be replaced by a substituent. Suitable complexones include those disclosed in Wilkinson, G. "Comprehensive Coordination Chemistry" Volume 2, chapter 20.3 pp 777-792, which is incorporated herein by reference.

It is further to be understood by those skilled in the art that the terms "mollusc", "snail" or "slug" refers to both the terrestrial or aquatic varieties of such species.

Examples

The invention will now be illustrated with reference to the following non-limiting Examples:

In this work the experimental set-up was such that each "plot" consisted of a food container with a lid with about 10 small air holes in it. In the bottom of each container was a six layer pad of moist paper towel and two medium slices of carrot. Each treatment was applied to six replicates. FERRAMOL®, BLITZEM® and MESUROL® pellets were applied at the manufacturers' recommended rates. MULTIGUARD® pellets and pellets of the composition of the invention were applied at a rate of approximately 15 kg/hectare. Four slugs, *Deroceras reticulatum,* which had been starved for at least 24 hours were added immediately after the pellets had been spread. On the specified day after treatment, (hereinafter referred to as "DAT"), the number of dead slugs was noted. The experimental plots were housed in a laboratory. The nightly temperature was not allowed to go down below 5°C, the maximum day temperature did not exceed 17°C. Experiments were carried out in winter during the months of June and July. The experiments were designed to minimise the influence of field variables so that a comparison could be made between different activities, different concentrations of the same active and the effect of additives.

Details of the formulations are given below:

Formulations used in this work:

Formulation 1	IID2 2.2% D-FE-11*, 7% calcium carbonate, remainder wheat flour/bran 3:1
Formulation 2	IID3 3.1% D-FE-11*, 7% calcium carbonate, remainder wheat flour/bran 3:1
Formulation 3	IID4 5.0% D-FE-11*, 7% calcium carbonate, remainder wheat flour/bran 3:1

Formulation 4	IID6 6.2% D-FE-11*, 7% calcium carbonate, remainder wheat flour/bran 3:1
Formulation 5	IID7 7.3% D-FE-11*, 7% calcium carbonate, remainder wheat flour/bran 3:1
Formulation 6	2D3 4.1% D-FE-11*, 7% calcium carbonate, 2% calcium propanoate, remainder wheat flour/bran 3:1
Formulation 7	2D4 8.3% D-FE-11*, 7% calcium carbonate, 2% calcium propanoate, remainder wheat flour/bran 3:1
Formulation 8	IIDSDS 5.1% D-FE-11*, 0.7% ferric phosphate, 0.16% sodium dodecyl sulphate, remainder wheat flour/bran 4:1

MULTIGUARD® 6% iron EDTA complex

BLITZEM® 1.5% metaldehyde in a cereal based bait

MESUROL® 2.0% methiocarb in a cereal bait

FERRAMOL® a 1.0% iron phosphate bait sold in Austria

* D-FE-11 is Dissolvine® D-FE-11 made by Akzo-Nobel it is the iron(III) hydrogen sodium salt of diethylenetriaminepentaacetic acid, FeHNaDTPA

BLITZEM is a registered trade mark of Arthur Yates & Co. Ltd.

MESUROL is a registered trade mark of Bayer Australia Pty. Ltd.

FERRAMOL is a registered trade mark of W. Neudorff GmbH KG.

MULTIGUARD® is a registered trade mark of Multicrop (International) Pty Ltd.

Example 1

In this example, the efficacy of compositions containing a range of concentrations of ferric DTPA were compared with the commercial product MULTIGUARD®. The results of this experiment are given in Table 1.

Table 1 Comparison of the efficacies of various formulations containing FeDTPA or FeEDTA

Formulation	4 DAT	8 DAT	12 DAT
Control	0	0	1
MULTIGUARD®	13	19	23
Formulation 1	1	9	15
Formulation 2	4	9	16
Formulation 3	2	18	19
Formulation 5	6	19	23

Summary

It can be seen that formulation 5 based on ferric DTPA and corresponding to approximately the same iron concentration as is used in MULTIGUARD® gives a similar kill rate to the MULTIGUARD®. Formulations 1, 2 and 3 are somewhat lower in iron concentration than MULTIGUARD® and give an effective kill rate.

Example 2

In this experiment MULTIGUARD® was compared to Formulation 4 which contained a slightly lower iron concentration than MULTIGUARD®

but was otherwise similar except that Formulation 4 was based on ferric DTPA. The results are shown in Table 2.

Table 2 Comparison of the efficacy of MULTIGUARD® with Formulation 4

Formulation	3 DAT	5 DAT	7 DAT	11 DAT	16 DAT
Control	0	0	0	0	0
MULTIGUARD®	15	20	21	23	23
Formulation 4	3	7	14	20	21

Summary

As can be seen from Table 2 the kill rate for Formulation 4 after 2 weeks is similar but the kill is as effective as that achieved with MULTIGUARD®.

Example 3

In this Example, the efficacy of Formulations 6 and 7 were compared with that of an Austrian product, FERRAMOL® which is believed to be based on 1% iron phosphate. Formulations 6 and 7 are superior in their kill rate and Formulation 7, which is based on ferric DTPA, has a much more rapid kill rate. It contains about three times the amount of iron of FERRAMOL®. Formulation 6 contains about 40% more iron than FERRAMOL® but the amount of active ingredient as iron per hectare is less. The results are shown in Table 3.

Table 3 Comparison of the efficacy of Formulations 6 and 7 with that of FERRAMOL®

Formulation	3 DAT	6 DAT	11 DAT
Control	0	2	2
FERRAMOL®	2	7	14
Formulation 6	3	9	21
Formulation 7	10	24	24

Summary

It can be seen that Formulations 6 and 7 give superior kill rates to the iron phosphate bait, FERRAMOL®.

Example 4

In this Example, various FeDTPA formulations were trialed against two common products on the Australian home garden market, BLITZEM® and BAYSOL® which are based on metaldehyde and methiocarb, respectively. The results are shown in Table 4.

Table 4 Comparison of the efficacies of Formulations 4, 5, 7 and 8 with that of BLITZEM® and BAYSOL®

Formulation	3 DAT	5 DAT	7 DAT
Control	0	0	0
BLITZEM®	4	10	14
BAYSOL®	3	5	12
Formulation 4	0	2	10
Formulation 5	2	12	13
Formulation 7	1	9	14
Formulation 8	1	5	8

Summary

The results given in Table 4 show that the kill rate of Formulations 4, 5, 7 and 8 are broadly comparable with the common metaldehyde and methiocarb products.

Example 5

In this example, two formulations, one with 7.5% FeDTPA and one with 7.6% FeDTPA plus 11.3% REXIRON® (a commercial product containing 6% iron as FeEDDHANa) together with MULTIGUARD®, BAYSOL® (a commercial methiocarb bait) and DEFENDER® (a commercial metaldehyde bait) were evaluated on the snail, *Helix aspersa*. The two FeDTPA baits performed at least as well as the commercial baits. The second bait containing REXIRON® acts as a dual product, as a molluscicide and as a source of nutritional iron, that is available even in high pH soils, such as those encountered in citrus orchards and vineyards. The crop used in the trial was capsicum. The results are shown in Table 5.

Table 5 Comparison of the efficacies of various formulations containing FeDTPA with those of other commercial baits.

Formulation	4DAT	6DAT	8DAT	10DAT	12DAT
Control	0	0	0	3	4
7.5% FeDTPA	3	12	13	19	20
7.6% FeDTPA + 11.3% REXIRON®	4	9	17	20	22
MULTIGUARD®	12	14	15	17	19
BAYSOL®	5	9	13	18	18
DEFENDER®	5	17	17	17	18

Example 6

In this trial, MULTIGUARD® was compared with 7.5% FeDTPA, 7.6% FeDTPA plus 8.1% REXOLIN® Q (a commercial product containing 7% iron as FeEDDHA) and a control trialed for the snail species, *Helix aspersa.* The product containing 7.5% FeDTPA performed with about the same level of success as the commercial MULTIGUARD® product and the formulation containing REXOLIN® Q. The latter formulation acts both as a molluscicide and a source of nutritional iron even in a high pH soil. The crop used in the trial was Lobelia. The results of the trial are shown in Table 6.

Table 6 Comparison of the efficacy of various formulations containing FeDTPA.

Formulation	3 DAT	5 DAT	9 DAT	11 DAT	13 DAT
Control	0	0	0	0	1
MULTIGUARD®	13	21	22	22	23
7.5% FeDTPA	3	12	17	19	21
7.6% FeDTPA + 8.1% REXOLIN® Q	1	6	15	19	21

Summary

From the results shown in Tables 5 and 6, it can be seen that nutritional sources of iron can be incorporated into a FeDTPA molluscicidal composition with little effect on the efficacy of the composition.

The claims defining the invention are as follows:

1. A molluscicidal composition including a metal complexone and a suitable carrier therefor, wherein the complexone is diethylenetriaminepentaacetate (DTPA).

2. A molluscicidal composition according to Claim 1, wherein the metal of the metal complexone is selected from the group consisting of Group 2 metals, transition metals or Group 13 metals, or mixtures thereof.

3. A molluscicidal composition according to claim 2, wherein the metal is a transition metal.

4. A molluscicidal composition according to claim 3, wherein the metal is selected from iron(II) or iron(III), copper, aluminium or zinc, or mixtures thereof.

5. A molluscicidal composition according to claim 4, wherein the metal is iron(III).

6. A molluscicidal composition according to claim 5, wherein when the metal complexone is FeDTPA, the amount of iron required for efficacy is between about 0.4-0.8 wt. % of the total composition.

7. A molluscicidal composition according to any one of claims 1 to 6, wherein the molluscicidal composition is selected from the group of stomach-action molluscicidal compositions or contact-action molluscicidal compositions.

8. A molluscicidal composition according to claim 7, wherein the composition is in the form of a stomach-action composition.

9. A molluscicidal composition according to claim 8, wherein the carrier is in a liquid or a non-liquid form.

10. A molluscicidal composition according to claim 9, wherein the carrier is in a non-liquid form.

11. A molluscicidal composition according to claim 10, wherein the carrier includes a palatable attractant including a mollusc food, wherein said food is selected from a cereal, wheat flour, arrowroot or rice flour, bran, carrot, beer, rice hulls, comminuted cuttle fish, starch or gelatin, or mixtures thereof.

12. A molluscicidal composition according to claim 11, wherein the carrier further includes polymeric materials, pumice or carbon.

13. A molluscicidal composition according to claim 9, wherein the carrier is in a liquid form thereby enabling the composition to be applied moist or wet.

14. A molluscicidal composition according to claim 13, wherein the carrier is any suitable solvent in which the metal complexone is miscible or immiscible to enable it to be spray-applied either as a solution or poured on the target area as a suspension.

15. A molluscicidal composition according to claim 14, wherein the composition further includes at least one mollusc phagostimulant, wherein the phagostimulant is selected from sucrose or molasses; at least one lubricant, wherein the lubricant is selected from the group of calcium or magnesium stearate, talc or silica; at least one waterproof binder, wherein said binder is a fatty acid alcohol; a fungicide and a bittering agent.

16. A molluscicidal composition according to claim 15, wherein the bittering agent is BITREX®.

17. A molluscicidal composition according to claim 15 or claim 16, wherein the composition further includes at least one preservative selected from the group of sodium benzoate, vitamin E, alpha-tocopherol, 4-nitrophenol, ascorbic acid, methyl paraben, propyl paraben or sodium bisulfite.

18. A molluscicidal composition according to any one of claims 15, 16 or 17, wherein the waterproofing agent is selected from the group of Guar gum, Lotus bean gum or a fatty acid alcohol.

19. A molluscicidal composition according to claim 18, wherein the waterproofing agent is a fatty acid alcohol.

20. A molluscicidal composition according to claim 19, wherein the fatty acid alcohol is present in an amount of between 1-5 wt. % of the total composition.

21. A molluscicidal composition according to claim 20, wherein the fatty acid alcohol is selected from the group of C_{16}-C_{18} fatty acid alcohols, or mixtures thereof.

22. A molluscicidal composition according to claim 21, wherein the C_{16}-C_{18} fatty acid alcohol mixture is HYDRENOL MY, which is a mixture of hexadecanol, heptadecanol and octadecanol.

23. A molluscicidal composition according to any one of claims 20 to 22, wherein the C_{16}-C_{18} fatty acid alcohol comprises about 2 wt. % of the total composition.

24. A molluscicidal composition according to any one of the preceding claims, wherein the composition further includes an additive to enhance the lethal activity of the composition.

25. A molluscicidal composition according to claim 24, wherein the activity-enhancing additive is selected from a surfactant or an additional source of metal ion.

26. A molluscicidal composition according to claim 25, wherein the additional source of metal ion is ferric ion.

27. A molluscicidal composition according to claim 25, wherein the activity-enhancing additive is a surfactant.

28. A molluscicidal composition according to claim 27, wherein the surfactant is selected from the group of cationic, anionic or non-ionic surfactants.

29. A molluscicidal composition according to claim 28, wherein the surfactant is selected from anionic or non-ionic.

30. A molluscicidal composition according to claim 29, wherein the amount of surfactant added is between about 0.05-1 wt. % of the total composition.

31. A molluscicidal composition according to claim 29 or claim 30, wherein the surfactant is selected from EDDS, or the salts of EDDS, or mixtures thereof.

32. A molluscicidal composition according to claim 26, wherein the iron is in the form of a ferric salt or in the form of a clay.

33. A molluscicidal composition according to claim 32, wherein when the ferric salt is ferric orthophosphate and the amount of ferric orthophosphate added is between about 1-5 wt. % of the total composition.

34. A molluscicidal composition according to claim 33, wherein the amount is between about 1-3 wt. % of the total composition.

35. A molluscicidal composition according to any one of the preceding claims, wherein the composition further includes a pH adjusting agent such that the pH of the composition is in the range of 6 to 8.

36. A molluscicidal composition according to claim 35, wherein the pH adjusting agent is selected from the group of calcium carbonate, potassium carbonate, magnesium carbonate, sodium bicarbonate, potassium hydroxide, ascorbic acid, tartaric acid or citric acid, or mixtures thereof.

37. A molluscicidal composition according to claim 36, wherein the pH adjusting agent is added in an amount of between 1-5 wt. % of the total composition.

38. A molluscicidal composition according to any one of the preceding claims, further including a nutritional source of iron, wherein said iron source is selected from the group of FeEDDHA, FeEDDHMA, ferric glucoheptonate, ferric humate or ferric lignosulphonate, or mixtures thereof.

39. A molluscicidal composition according to any one of the preceding claims, wherein the composition is used in combination with at least one other molluscicide.

40. A molluscicidal composition according to claim 39, wherein the other molluscicide is another metal complexone.

41. A molluscicidal composition according to claim 40, wherein the metal complexone is selected from FeEDDS, FeEDTA or mixtures thereof.

42. A molluscicidal composition according to any one of the preceding claims, wherein the composition is presented in a solid form selected from tablets, a powder, granules or pellets.

43. A molluscicidal composition according to claim 42, wherein the composition is in the form of a pellet.

44. A molluscicidal composition according to claim 43, wherein the pellet is between about 1 and 4 mm long.

45. A molluscicidal composition according to any one of claims 1 to 44, substantially as hereinbefore described with reference to any one of the accompanying Examples.

46. Use of the molluscicidal composition of any one of claims 1 to 44, substantially as hereinbefore described.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU01/00905

A.	**CLASSIFICATION OF SUBJECT MATTER**
Int. Cl. [7]:	A01N 37/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Chemical Abstracts

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
STN WPILS CAPLUS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	AU 41078/99 A1 (Colin Leslie Young) 17.02.2000.	1-46
X	AU 12970/97 A1 (Colin Leslie Young) 31.07.97, see page 24, example 20 and table 20 in particular.	1-46
X	Arch. Environ. Contam. Toxicol., vol. 31, 433-443, van Dam, R.A. et al. (1996) Comparitive Acute and Chronic Toxicity of Diethylenetriamine Pentaacetic Acid (DTPA) and Ferric-Complexed DTPA to Daphnia carinata, see the whole document.	1-45

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 August 2001	5 SEPTEMBER 2001

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Agronomy Journal, vol. 84, 496-503, Glinski, D.S. et al. (1992) Iron Fertilization Effects on Shoot/Root Growth, Water Use, and Drought Stress of Creeping Bentgrass, see the whole document.	1-45
X	Journal of American Chemical Society, vol. 90, no.8, 2044-2048, Hall, L.H. et al. (1968) Preparation and Coordination Studies of the Complex Acid, Dihydrogen Diethylenetriaminepentaacetatoferrate (III) Dihydrate, and Several of Its Metal (I) Salts, see the whole document.	1-45

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU01/00905

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
AU	41078/99						
AU	12970/97	US	6093416	CN	1209726	DE	921726
		EP	0921726	ES	21333246	GB	2316006
		JP	2000503322	NZ	325747	PL	328148
		TW	403631				

END OF ANNEX