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CA 2338434 C 2008/03/25

(11)(21) **2 338 434**

(12) **BREVET CANADIEN
CANADIAN PATENT**

(13) **C**

(86) Date de dépôt PCT/PCT Filing Date: 1999/07/02
(87) Date publication PCT/PCT Publication Date: 2000/01/20
(45) Date de délivrance/Issue Date: 2008/03/25
(85) Entrée phase nationale/National Entry: 2001/01/23
(86) N° demande PCT/PCT Application No.: NZ 1999/000104
(87) N° publication PCT/PCT Publication No.: 2000/002447
(30) Priorité/Priority: 1998/07/08 (NZ330949)

(51) Cl.Int./Int.Cl. *A01N 37/02* (2006.01),
A01N 25/04 (2006.01), *A01P 15/00* (2006.01),
A01P 19/00 (2006.01)
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(54) Titre : PESTICIDE SOUS FORME DE GEL
(54) Title: PESTICIDE IN GEL FORM

(57) **Abrégé/Abstract:**

The invention relates to a bait matrix which includes a gelling agent and a pesticide. The bait matrix is useful for controlling pests by attracting and poisoning them. The gel matrix is substantially weatherproof and hence can be used when exposed to the weather.



**PCT**WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : A01N 25/04	A1	(11) International Publication Number: WO 00/02447 (43) International Publication Date: 20 January 2000 (20.01.00)
(21) International Application Number: PCT/NZ99/00104 (22) International Filing Date: 2 July 1999 (02.07.99) (30) Priority Data: 330949 8 July 1998 (08.07.98) NZ (71) Applicant (for all designated States except US): KIWICARE CORPORATION LIMITED [NZ/NZ]; 171 Pages Road, Aranui, Christchurch (NZ). (72) Inventor; and (75) Inventor/Applicant (for US only): MARSHALL, Robert, John [CA/NZ]; 991 Colombo Street, Christchurch (NZ). (74) Agents: HAWKINS, Michael, Howard et al.; Baldwin Shelston Waters, NCR Building, 342 Lambton Quay, Wellington (NZ).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>
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PESTICIDE IN GEL FORM

Field of Invention

The invention relates to a newly developed gel. The gel may be used as the matrix or basis for a bait product for controlling pests. However, other uses are envisaged.

Background of the invention

Animal baits are limited to cereal pellet, carrot, and paste. None of these are durable and those that are available to farmers are either expensive or relatively ineffective. GB-2305607 describes poisonous baits for controlling noxious pests, particularly insects, comprising a 1-arylpyrazole as the active ingredient, a gelling agent, and a bait substance.

Known pest control compositions which use vertebrate pesticides are vulnerable due to the high annual cost and also due to the increasing scrutiny being placed on pesticide usage worldwide. Market access for agriculture produce could be threatened if food production methods fail to meet the increasingly stringent standards demanded by consumers. Careful management is required to provide confidence and safety of the pesticide. This must be based on toxicological data relating to public health and environmental effects and strategies for minimising risks.

One possible environmental effect is the risk of poisoning of non target species. Examples of accidental poisoning have been demonstrated for native birds, native bats, invertebrates including honeybees, deer, livestock and domestic pets. Deaths are always undesirable even for common species and unacceptable for rarer species, populations of which may be unable to withstand such losses.

There is a requirement for a bait product which is weatherproof and therefore durable when placed out in the open weather. A bait product which could be handled easily and which does not disintegrate in the user's hands would also be an advantage.

Summary of the Invention

It is an object of the invention to go some way in overcoming the disadvantages with known bait product systems or to at least provide the public with a useful choice.

It is also an object of the present invention to provide a novel gel which is substantially weatherproof.

Accordingly, provided is a weather proof durable bait matrix comprising a gelling system which substantially resistant to dehydration, the gelling system including

- at least one gelling agent;
- a preservative;
- glucose syrup as evaporation control means;
- an attractant;
- a human deterrent; and
- a pesticide

As described, the gelling system includes an active pesticide ingredient and provides for the slow release of the active ingredient. The bait matrix provides for a stable weather proof environment for the pesticide.

The invention also provides a pesticide composition comprising a gelling agent and a pesticide and optionally other ingredients.

Gelling agents such as carrageenan or sodium alginate may be used. Two gelling agents may be used together.

The pesticide 1080 (sodium fluoroacetate) may be incorporated in the gel. However other pesticides are envisaged such as cholecalciferol (Vitamin D₃). Other toxins could be used such as nicotine, aconitine or scilliroside or α -chloralose. Sodium fluoroacetate may be used in an amount of 1.5g/kg. Cholecalciferol may be used in an amount of 6g/kg.

Optional ingredients include:

an attractant to attract the pest and/or mask the taste of the pesticide. An orange flavour may be added for example to gels used to kill possums. A preservative may be added. This may, for example be Glydant Plus. However

other preservatives may be used such as Delvocid, Suttocide A, sodium metabisulphite and potassium sorbate.

Bitrex is also an optional ingredient. This is a human deterrent. Other deterrents which could be used include cinnamamide/diatite bird repellent. Dye may be added.

The gel preferably has a relatively low dehydration rate such that it is adapted to subsist in the open environment for at least a month.

The gel is preferably adapted to target the pest of interest but adapted such that it does not attract and will non-target other animals.

Embodiments of the invention will now be described, by way of example only.

DETAILED DESCRIPTION OF THE INVENTION

Example 1

The following example details the ingredients in a gel composition containing the pesticide 1080 (sodium fluoroacetate). Such a pesticide would be useful, for example to kill possums. Table 1 describes the ingredients in the composition.

The carrageenan and sodium alginate are gelling agents. The orange flavour is an attractant and masks the taste of the 1080. The Glydan Plus is a preservative and bitrex is a very bitter substance. Bitrex is included as a safety control to deter humans and in particular children from eating the gel based poison. It will be readily appreciated that the 1080 can be substituted by any other poisons such as cholecalciferol (Vitamin D₃).

Preservatives and stabilisers are included to ensure that the composition has a shelf life of at least one year.

The composition may be supplied ready for use in a purpose designed bait station.

Table 2 details the physical/chemical properties of the composition.

In field use, the bait is very resistant to dehydration losing a maximum of 14% weight when left in exposed situations for three months. The gel is also resistant to direct rainfall before noticeable loss of shape occurs and drainage holes ensure that water does not collect in the bait station. The durability of the bait in the field means that it can be used sparingly (and hence economically), and at a recommended dispersion of no more than one to two bait stations per hectare.

Example 2

The bait station

The bait station is made from 2-3mm thick plastic to withstand animals chewing. It is designed so that the targeted animals can easily access the bait through the front opening.

To assess the likely exposure of non-target species to a hazardous material, a pen trial was conducted to measure the amount of spillage that occurs when opossums feed at gel bait stations.

Example 3

Spillage of bait from bait stations

Four possums maintained in an outdoor pen measuring 5 x 5 m were each presented with a gel bait station containing 300 g gel, and a 'Killmore' bait station (as commonly used in possum control) containing 300 g RS5 pellet baits. The bait stations were fitted to vertical fence posts such that the lowest part of the opening of each bait station was 35 cm above ground. This is a convenient

TABLE 1

FORMULATED PRODUCT			
Composition (if necessary continue onto a separate sheet)			
Common Name/Trade name (use common names where possible)	Chemical Name where: a A trade name is given b There is no common name	Purpose (eg active ingredient, wetter, surfactant)	Concentration either in g/litre (liquids) or g/kg (solids)
WATER		VEHICLE	285.78
TSP		pH ADJUSTMENT	2.0
SUGAR		GEL CONTROL & PALATABILITY	490.0
GLUCOSE SYRUP		EVAPORATION CONTROL	180.0
DYE		1080 COLOUR IDENTIFICATION CODE	1.00
CARRAGEENAN		THICKENER	15.0
SODIUM ALGINATE		THICKENER	14.0
ORANGE FLAVOUR		1080 MASK AND PALATABILITY	10.0
SODIUM HYDROXIDE		pH ADJUSTER	QS TO 9.0
SODIUM FLUOROACETATE		ACTIVE	1.5
GLYDANT PLUS	DMDM HYDANTOIN + 3-iodo-2-propynyl carbamate	PRESERVATIVE	0.7
BITREX	DENATONIUM BENZOATE	SAFETY CONTROL	0.02

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TABLE 2

PHYSICAL/CHEMICAL PROPERTIES OF PRODUCT	
Storage Stability	GOOD
Density (Liquids only)	N/A
Flammability (liquids - flashpoint, solids - whether flammable or not)	N/A
Acidity (where relevant)	-
Alkalinity (where relevant)	pH 9.0
Colour	GREEN
Particle size range (where relevant)	N/A
Chemicals with which product is known to be:	
(a) Compatible	N/A
(b) Incompatible	N/A
Other properties eg corrosiveness	NOT CORROSIVE
Stability (in hours) of stated field dilutions	N/A

height for possums to feed from bait stations while standing on the ground. Bait stations were reweighed after each 24 hour period for eight days and the amount of each bait type eaten calculated. Baits and bait fragments that were spilled during each 24 hour period were collected and weighed.

During the eight nights for which possums fed on baits, only 0.1 g on average was split each night, compared with 3.3 g of pellets (Table 3). Expressed as a percentage of the amounts eaten, the overall mean weight of gel split was 0.3%, which was significantly less than the 3.2% of RS5 pellets split.

TABLE 3 Spillage of RS5 pellets and gel bait expressed as daily mean per possum, and as a percentage of the mean weight of each bait type eaten each day.

	RS5 pellet		Gel bait	
Day	Mean weight spilled (g) per possum	Mean spillage as a % of mean weight of bait eaten	Mean weight spilled (g) per possum	Mean spillage as a % of mean weight of bait eaten
1	3.8	2.6	0.1	0.1
2	3.1	1.0	0	0
3	4.0	9.0	0	0
4	4.5	8.0	0.5	0.9
5	3.8	7.8	0.3	0.5
6	3.0	4.3	0	0
7	1.1	3.8	0	0
8	2.9	6.8	0	0

Example 4Palatability of gel bait to non-target species

The responses of a range of non target animals to gel bait were observed to assess palatability of the bait. Apple paste bait was also presented to these animals as a control treatment. This bait type has been used for many years as possum bait.

a) Native birds

The responses of groups of captive fruit-eating birds to gel bait were observed at Orana Park, Christchurch. Species, which were observed as groups of individuals, were kaka (n=3), brown kiwi (2), kea (6), kereru (4), and kakariki (5). Gel bait (100 g) was presented in plastic dishes to each bird species on two days for eight hours. On separate days the birds were also presented with two varieties of apple paste bait, BB13 and BB3 (Animal Control Products Ltd, Wanganui). The daily order of presentation of pastes to birds was randomised and birds' normal diet was maintained throughout trials. The response to baits of two individual birds of each species was observed during the first 30 minutes for which baits were presented each day.

The responses of native birds (listed in Table 4) in the wild to gel baits were observed at a site on the edge of mixed beech (*Nothofagus sp*) forest at Bullock Creek, Paparoa National Park. Gel bait and two types of apple paste bait, BB13 and BB16 (Animal Control Products Ltd, Wanganui) were placed in separate bowls (100 g per bowl) on four tree-mounted platforms with fuschia flowers as an attractant, and in four bowls sited on the ground. They were observed for two hours from dawn and two hours before dusk each day for seven days. The same baits were used throughout the study to simulate normal field presentation, but they were removed at night to prevent possums from eating them.

In both the pen and field studies, the main data recorded were the time spent feeding on each bait type and the amount eaten. Control samples, unavailable to birds, were used to provide correction for weight variation due to climate.

b) Honey bees

Approximately 200 forager bees were trained to feed on sugar (sucrose) syrup at a table placed 20 m away from a hive. Gel bait, and 'BB13' apple paste bait known to be attractive to bees (Goodwin & Ten Houten 1991), were presented to the bees by placing 2 g of each material separately in Petri dishes. Ten dishes of each bait type were placed randomly on the table with 10 cm separating dishes. The number of bees visiting the two bait types was compared by counting the number of bees at each type during 10 minute sampling periods. Twelve sampling periods were used, distributed between 10-15 hours during fine weather.

c) Invertebrates and skinks

Time-lapse video recording was used to monitor the response of common skinks, large headed weta, common snails, and ground beetles to gel bait and BB13 apple paste. Between six and 10 individuals of each species were housed together in glass tanks (0.72 x 0.38 x 0.38 m). Tanks for weta, snails and beetles had a floor-lining of soil, leaf-litter and sphagnum moss. Small logs with a hollow core were provided for shelter for weta, as recommended by Barrett (1991). Snails and beetles sought shelter in the leaf litter. Tanks for skinks had a floor-lining of fine shingle and stones and bark were provided as shelter. Fresh native plant material and apple was supplied every two days, and processed pet meat was supplied every two weeks. Water was always freely available for all animals.

Approximately 10 g gel bait was placed on plastic beaker lids and activity was monitored for two overnight periods of 16 hours for each group of animals. For each species, the total number of encounters with bait (ie. contact with bait), the number of feeding sessions, and the total time spent feeding were recorded.

d) Short-tailed bats

Gel baits and BB13 apple paste baits weighing 100 g were presented to six uniquely marked short-tailed bats, maintained on behalf of the Department of Conservation at Wellington Zoo. Baits were presented in Petri dishes for the first three hours of each night during the normal main feeding period. Honey-water (ie. an aqueous solution of x% honey), which was part of the bats' normal diet, was presented on two nights as a positive control. Time spent feeding on baits or honey water was monitored using video equipment and infra-red illumination. The weight of bait or honey eaten was calculated at the end of the three hour observation period.

Results

a) Native birds

Of the six species observed at Orana Park, four ate appreciable quantities of apple paste, while kereru and kakariki ate only small amounts (Table 4). By contrast, kea was the only species to eat significant amounts of gel bait. A total of 87 g was eaten by the six birds over two days. Three weka ate a total of about 1 g of bait.

Table 4

Mean weight (g) of gel and two types of apple paste eaten per bird. Six native species of captive birds were presented with bait during two days.

TABLE 4 Mean weight (g) of gel and two types of apple paste eaten per bird. Six native species of captive birds were presented with bait during two days.

Common name (see Appendix 1 for generic names)	BB13 paste	BB16 paste	Gel bait
Kaka	8.6	2.0	0.0
Brown kiwi	7.0	17.9	0.1
Weka	19.6	0.3	0.4
Kea	5.1	2.8	14.4

Kereru	0.5	1.0	0.0
Kakariki	1.3	0.0	0.0
All species	42.2	24.0	14.9

Of the 16 species observed in the field study area, four were observed approaching within 3 m of a bait bowl, altogether on 17 occasions (Table 5). However, none of these species, which included two flocks of silvereye, actually encountered or fed on bait. Only two of the sixteen species, weka (a family of three individuals) and robin (three individuals), were actually observed interacting with baits. Weka interacted only with the baits that were presented on the ground while robin interacted with the baits on the platforms as well as those placed at ground level. Approximately 98% of the total time spent feeding on gel by birds was attributable to weka, which fed approximately equally on paste bait (47%) and gel bait (51%). The small amount of feeding by robin was mainly on paste (1.5%) rather than gel (0.5%).

Table 5

The number of times bird of 6 species were seen near and encountering baits, and the total time spent feeding on bait by each species. Eleven other species present at the study site were not seen closer than 3 m from the gel bait.

TABLE 5 The number of times bird of 6 species were seen near and encountering baits, and the total time spent feeding on bait by each species. Eleven other species (see Appendix 1) present at the study site were not seen closer than 3 m from the gel bait.

Common Name (see Appendix 1 for generic name)	No. of occasions seen within 3 m, but without encountering bait	No. bait encounters		Total time spent investigating or feeding on bait (min)	
		BB13	Gel	BB13	Gel
Bellbird	6	0	0	0	0
Fantail	1	0	0	0	0
Silvereye	2 (flocks)	0	0	0	0
South Island robin	0	2	1	0.5	0.2
Tui	6	0	0	0	0
Weka	0	19	27	14.7	16.9

b) Honey bees

The total number of bees present during all counts combined for each bait type (ie. 120 10 minute counts) was 154 for BB13 paste and 12 for gel bait. The mean number of bees observed on dishes for each 10 minute sample period was significantly less for gel bait (mean=0.1) than for BB13 paste (mean=1.28) (paired 't' = 13.4, d.f. = 10, $p < 0.001$). Bees appeared to be feeding on the paste bait throughout most of the time spent on this bait type as the proboscis of most bees could be clearly seen penetrating the surface of the bait. However, due to the firmer texture of the gel, bees were not able to penetrate the surface and it is likely that most of the time was spent investigating the bait and attempting, unsuccessfully, to feed on it.

c) Invertebrates and skinks

Some of the small non-target animals observed in laboratory tanks were seen feeding on baits. Snails (three out of eight observed) and weta (one of eight) fed on gel bait, while snails (one of eight), weta (two of eight), and skinks (two of 10) fed on BB13 paste (Table 6).

Table 6

Feeding responses of skinks, weta, snails and ground beetles to gel and paste bait. Baits were presented to each group of animals for two overnight periods of 16 hours.

TABLE 6 Feeding response of skinks, weta, snails, and ground beetles to gel and paste bait. Baits were presented to each group of animals for 2 overnight periods of 16 h.

Common name (see Appendix 1 for generic name)	No. animals in group	Gel			BB13 paste		
		No. investigations	No. feedings	Total feeding time (min)	No. investigations	No. feedings	Total feeding time (min)
Skinks	8	2	0	0	8	2	2.8
Wētā	10	5	1	0.3	2	2	5.9
Snails	8	3	3	39.4	1	1	21.5
Beetles	6	0	0	0	4	0	0

d) Short-tailed bats

Short-tailed bats were observed visiting all food types. However, while they fed vigorously on honey water and BB13 apple paste, they did not feed on gel bait (Table 7).

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Table 7

Feeding response of six short-tailed bats presented with gel and paste baits and honey water for three hours on different nights. Results for all bats are combined.

TABLE 7 Feeding response of six short-tailed bats presented with gel and paste baits and honey water for 3 h on different nights. Results for all bats are combined.

Food type	Number of visits	% of visits where feeding definitely occurred	% of visits where feeding possibly occurred	Weight of bait eaten (g)
Honey water	23	78	4	4.24
Honey water	51	65	14	8.01
BB13 paste	68	88	1.5	5.73
Gel bait	52	0	0	0.0

Although a gel has been described incorporating the poison 1080 which has specifically been trialled for possums, it is envisaged that poison in an amount and of a type suitable for ferrets, stoats, weasels, deer, pigs, tar and chamois could be used. Poisons suitable for coyotes, groundhogs, rodents of all kinds and snakes could also be used in such a gelling system.

Poison in the above described gelling system may also be used to control undesirable birds such as for example, crows, rooks, pigeons and the like.

It will be appreciated that whilst certain animals are undesirable in any particular region, they may be desirable in others.

Poison may be used in the above gel composition to kill wasps.

The gelling composition may be used above or below ground. It may be placed using aerial placement or ground placement.

The gelling system may be used as a waterproof feeding system for aquaculture such as salmon farming, prawns, shrimp and crayfish farming.

It may also be used as a medium for processed imitation meats or processed foods for vegans and/or vegetarians.

Industrial Applicability

The gel matrix is useful for attracting and poisoning pests. It may be used outside as it is substantially resistant to weather elements. It is able to be handled easily and does not disintegrate in a user's hands or when exposed to the elements. Pests are an environment nuisance and their targeted removal is of environmental benefit.

CLAIMS

1. A weather proof durable bait matrix comprising a gelling system which is substantially resistant to dehydration, the gelling system including
 - at least one gelling agent;
 - a preservative;
 - glucose syrup evaporation control means;
 - an attractant;
 - a human deterrent; and
 - a pesticide.
2. A bait matrix according to claim 1 in which the pesticide is selected from 1080 (sodium fluoroacetate), cholecalciferol, nicotine, aconitine, scilliroside and α -chloralose.
3. A bait matrix according to claim 1 or 2 in which the gelling agent is carrageenan or sodium alginate.
4. A bait matrix according to any one of claims 1-3 in which two gelling agents are used.
5. A gel according to any one of claims 1-4 in which the attractant is an orange flavour.
6. A gel according to any one of claims 1-6 in which the preservative is selected from Glydant Plus, Delvocid, Suttocide A, sodium metabisulphite and potassium sorbate.
7. A gel according to one of claims 1 to 6 in which the human deterrent is Bitrex.
8. A gel according to any one of claims 1 to 7 which further includes a dye.

9. A gel according to any one of claims 1 to 8 which is adapted to target the pest of interest but which does not attract non-target animals.