

GROUND BAITING OF RABBITS WITH PINDONE (RAB004) STANDARD OPERATING PROCEDURE

BACKGROUND

Poisoning with pindone is used to minimise the impact of the introduced European rabbit (*Oryctolagus cuniculus*) on agricultural production and the environment. Other rabbit control methods include poisoning with 1080, warren destruction, warren fumigation, surface harbour removal, shooting, trapping, exclusion fencing and biological control with rabbit haemorrhagic disease virus (RHDV) and myxomatosis.

Poisoning with pindone is used to reduce rabbit populations in areas where it is impractical or unsuitable to use 1080 e.g. urban/residential and semi-rural areas.

Pindone is a first-generation anticoagulant that acts by blocking the synthesis of vitamin K-dependant clotting factors, which causes fatal haemorrhages in susceptible animals. Poisoning with pindone can occur with a large single dose, but it is more effective when given as a series of smaller doses over a period of 4 to 12 days.

Rabbits are amongst the most susceptible species to the effects of pindone; however other animals especially birds, cats, native rodents and macropods may be vulnerable to poisoning. Good baiting technique helps to minimise the risk to non-target species and maximise the effect on targeted rabbit populations.

This standard operating procedure (SOP) is a guide only; it does not replace or override the legislation that applies in the relevant state or territory jurisdiction. The SOP should only be used subject to the applicable legal requirements (including OH&S) operating in the relevant jurisdiction.

APPLICATION

- Baiting with pindone should only be used in a strategic manner as part of a co-ordinated program designed to achieve sustained effective control.
- Pindone is mostly used for rabbit control where 1080 (sodium monofluoroacetate) cannot be used because of the risk of poisoning to humans or domestic animals eg. urban/residential and semi-rural areas..
- Before commencing a baiting program, an assessment of likely non-target exposure should be performed, preferably by authorised personnel with knowledge of local native fauna. If there is a significant risk of poisoning non-target animals, bait should not be laid or measures must be taken to reduce the risk. Such measures could include:
 - use of bait stations or enclosures to restrict access to non-target animals;
 - fencing to exclude larger species such as macropods; and
 - avoidance of baiting near areas of native vegetation that is likely to harbor smaller non-target animals such as bandicoots.
- Although poisoning programs can be carried out year-round, baiting is most effective when alternative food for rabbits is scarce eg. at the end of summer or early autumn. Baiting is less effective during the breeding season when rabbit movements are limited.
- Baiting of rabbits with pindone must be carried out in accordance with relevant State, Territory and Commonwealth legislation (see Appendix). The pindone user may need to make a referral under the EPBC Act.

GROUND BAITING OF RABBITS WITH PINDONE (RAB004) STANDARD OPERATING PROCEDURE

- Pindone must be used according to instructions on approved labels and guidelines issued by relevant State authorities for vertebrate pest control.
- There are two types of registered pindone products; ready-to-use baits and concentrates used to prepare baits:
- Ready-to-use oat or carrot baits are available 'over-the-counter' from retail merchants or from licensed contractors and government pest control agencies.
- Liquid (sodium salt) or powder (free acid) pindone concentrates are restricted chemical products available only to authorised people who have appropriate training in their use. Pindone acid has low water solubility while the sodium salt is soluble in water.

ANIMAL WELFARE CONSIDERATIONS

Impact on target animals

- Pindone interferes with the routine synthesis of vitamin K-dependent blood clotting factors in the liver. Without these factors, the normal daily damage to blood vessels can no longer be repaired. Poisoned animals usually die from multiple causes associated with anaemia or hypovolemic shock. A large single dose (18 mg/kg for rabbits) or repeated smaller doses (0.52 mg/kg/day over 7 days) are generally needed to induce death.
- After ingestion of anticoagulants, there is usually a lag period of 3-5 days before the onset of clinical signs. This delayed onset reflects the time required to deplete existing stores of vitamin K and blood clotting factors. Initial signs of poisoning are depression/lethargy and anorexia followed by manifestations of haemorrhage including anaemia, laboured breathing, pale mucous membranes and weakness. Bleeding may be visible around the nose, mouth, eyes and anus and animals may pass bloody faeces. Swollen tender joints are common as a result of bleeding into the confined joint space.
- Discomfort and pain from haemorrhages in internal organs, muscles and joints typically lasts for several days before death. The time to death is around 10 to 14 days after the initial dose.
- To minimise the animal welfare implications of leaving dependent young to die a slow death from starvation it is preferable not to undertake baiting programs when rabbits are known to be breeding. This is also the time when young rabbits do not travel far from their burrows and bucks vigorously defend their territorial boundaries, making it less likely that all rabbits will have access to bait. In many areas of Australia there is a peak in breeding from late winter to early summer when pastures have greened up after rain.

Impact on non-target animals

- Poisoning of non-target species can occur either directly by eating the carrot, oat or pellet baits intended for rabbits (primary poisoning) or through the tissues from a dead or dying poisoned animal (secondary poisoning).
- Although information on the toxicity and non-target impacts of pindone is limited, it is thought to be moderately toxic to a range of species. Whilst rabbits are extremely susceptible, sheep, possums and horses are comparatively resistant. Cattle, goats, chickens, cats and dogs are less susceptible than rabbits, but still may be at risk if exposed to large doses or smaller doses on successive days. A number of native species are likely to be as sensitive as rabbits to the effects of pindone. Macropods, bandicoots and a range of granivorous birds are susceptible to primary poisoning. Secondary poisoning can occur in species which feed on poisoned rabbits and carcasses eg. dasyurids and raptors.

GROUND BAITING OF RABBITS WITH PINDONE (RAB004) STANDARD OPERATING PROCEDURE

- Rabbits dying from pindone poisoning can become lethargic and less aware of their surroundings. This can predispose these animals to predation which can in turn place predators at greater risk from secondary poisoning.
- Non-target species that accidentally receive a high enough dose of pindone will exhibit the same clinical signs as target rabbits i.e. physical weakness and lethargy, coughing and respiratory distress, pallor, anorexia, and ventral haematomas as well as internal haemorrhages.
- Because pindone is slow acting, if accidental poisoning of stock or companion animals occurs, vitamin K₁ (phytomenadione) can be administered by a veterinarian as an effective antidote. It is usual to treat an affected animal with vitamin K₁ for at least one week after an initial loading dose. If bleeding is severe, whole blood or plasma can be given to replace clotting factors and red blood cells.
- To minimise the potential for toxic baits to be lethal to non-target animals, the following baiting strategies are recommended:
 - *Pre-feeding with non-poisoned bait* – allows an assessment of what animals are eating the bait.
 - *Bait type* – use of surface coated rather than vacuum impregnated oat baits will reduce exposure of granivorous birds to the toxin. Most of these birds will only eat the kernel and discard the poisoned husk.
 - *Colouring of baits* – baits that are dyed a green colour are unattractive or less obvious to birds.
 - *Use of bait stations* – bait can be placed under mesh canopies where it is accessible to rabbits but restricts access by non-target species such as kangaroos and wallabies.
 - *Placement of baits* – the laying of poisoned bait in a wide swathe (i.e. broadcast or scattered) instead of a concentrated trail, may decrease the consumption of poisoned bait by non-target species and thus their risk of poisoning. However, uneaten broadcast bait is difficult to cover or collect and destroy after a baiting program. Laying the bait as a concentrated trail in a narrow pre-cut furrow allows subsequent identification of the trail of pre-feed and poisoned bait, attraction of rabbits to the trail and ease of covering up any uneaten poison bait after the program. The bait should always be placed in the prime feeding areas of rabbits.
 - *Timing of baiting* – rabbits mostly feed at night, therefore bait laid in the evening will be mostly consumed overnight before diurnal non-target species such as birds will have access. However, nocturnal mammals will be at risk when bait is laid in the evening.
 - *Collection of uneaten bait and rabbit carcasses* – any uneaten bait and poisoned rabbit carcasses are collected and destroyed or buried.

HEALTH AND SAFETY CONSIDERATIONS

- Operators using pindone must strictly follow the directions on the approved label when preparing for use, using, storing or disposing of the pesticide.
- Pindone is toxic to humans and should be handled with care. Exposure can occur from ingestion, inhalation of generated dust or skin contact/absorption. Toxic effects are produced after exposure to a high dose or repeated low doses over several days.
- Appropriate personal protective equipment including overalls, rubber boots, face mask or safety glasses, and elbow length PVC or rubber gloves must be worn when handling pindone and poisoned bait.
- If pindone gets on skin, immediately wash area with soap and water.
- After use and before eating drinking or smoking, wash hands, arms and face with soap and water.
- After use, wash contaminated clothing, boots and gloves.

GROUND BAITING OF RABBITS WITH PINDONE (RAB004) STANDARD OPERATING PROCEDURE

- If poisoning occurs, go straight to a hospital or doctor or contact the Poisons Information Centre (Ph 13 11 26).
- Vitamin K1 is an effective antidote and is readily available from hospitals and veterinary practices.
- For further information refer to the Material Safety Data Sheet (MSDS), available from the supplier.

EQUIPMENT REQUIRED

Poisoned baits

- In most states, poisoned bait is prepared by the application of pindone concentrate to oats, chopped carrots or manufactured pellets in simple mixing equipment. This creates a surface coating of the poison. Other material such as coloured dyes, sugar and starch may also be added. In Western Australia, pindone is vacuum impregnated into oats, forcing the poison into the kernel.
- The final concentration of pindone will be either 0.25g/kg (or 0.025% w/w) or 0.5g/kg (or 0.05% w/w) depending on bait type.
- Carrot baits are readily accepted by rabbits but must be freshly prepared and tend to dry out quickly in hotter climates. In comparison, oats and pellets are less susceptible to drying, and are more readily available, cheaper and easier to store and distribute.
- There are five registered ready-to-use oat or carrot baits available 'over-the-counter' from retail merchants or from licensed contractors and government pest control agencies:
- Rabbait® Pindone Oat Bait (Animal Control Technologies)
- Oat Bait for Rabbits (Aldi)
- Bunnybait Oat Bait for Rabbits (Aldi)
- Pindone Carrots Rabbit Bait (DNRE, VIC)
- Pindone Impregnated Oats (APB, WA)
- There are four registered pindone concentrates. These are restricted chemical products available only to authorised people who have appropriate training in their use:
- Pin-25 Rabbit Bait Rodenticide (Rentokil)
- Pindone-25 Rabbit Bait Rodenticide (Aldi)
- Rabbait® Aqueous Pindone Concentrate (Animal Control Technologies)
- Pindone 25 Liquid Concentrate (Aldi)

Preparation of poisoned rabbit baits from pindone powder or liquid concentrate must only be performed by authorised officers or persons under their direct supervision. Specific instructions on bait preparation can be found on the approved labels and in various state guidelines e.g. vertebrate pesticide control manuals, Landcare Notes, Farmnotes etc.

Other equipment

- hoe, disc or mattock for digging shallow furrow or specially designed baitlayer
- carrot cutter (if required)
- bait mixer e.g. cement mixer or mixing drum (if required)

GROUND BAITING OF RABBITS WITH PINDONE (RAB004) STANDARD OPERATING PROCEDURE

- leakproof containers for storing poison bait
- personal protective equipment
- towel, soap, dish or bucket
- first aid kit
- warning signs
- marking tape

PROCEDURES

Always read relevant permit for conditions and directions for use.

Assessment of site and estimation of rabbit numbers

- A careful on-site risk assessment should be undertaken before a baiting program is commenced. To reduce the risks of pindone exposure to humans and non-target animals and to maximise effect on rabbit populations, bait should NOT be laid in the following instances:
- in the vicinity of macropod, bandicoot and native rodent refuge areas;
- when rain is expected in the next 24 hours;
- in urban areas on residential blocks less than 1000m² in size;
- in areas that are accessible to livestock or domestic animals;
- where streams, waterways or rivers may become contaminated;
- where foodstuff or feed intended for human or animal consumption may become contaminated; or
- where children may have access.
- Warrens, rabbit harbour and scratching and feeding areas should be located to ensure accurate placement of bait.
- The density of rabbits on the site should be estimated using spotlight counts and/or warren monitoring. The location and numbers of rabbits on neighbouring properties should also be approximated.
- Contact your local authority for more information and advice on site assessment and monitoring of rabbit numbers.

Notification and warning signs

- In most States formal notification of neighbours is not required (exception is NSW), but it is recommended that all adjoining neighbours be notified by telephone, personal contact or in writing of the commencement of a baiting program. In NSW, formal notification MUST be given at least 72 hours prior to laying baits.
- All stock should be removed from the baited area during a baiting program. Dogs should be muzzled or restrained and cats confined to prevent them from eating poisoned rabbit carcasses.
- Warning signs must be erected at all entry points to the property, entrances to the actual poisoning site and at property boundaries fronting a public thoroughfare. Each sign should include the date laid, which toxin has been used, and for which pest animal. They must remain up for a minimum of 4 weeks after baiting.

GROUND BAITING OF RABBITS WITH PINDONE (RAB004) STANDARD OPERATING PROCEDURE

- More detailed information on notification and warning signs can be found in the relevant product labels, permits and State guidelines e.g. Vertebrate Pest Control manuals, Landcare notes, Farmnotes etc.

Laying of bait

- Most States use a '*pulse baiting technique*' where 2 to 3 free feeds of non-poisoned baits are laid at intervals of 2 days. Free feeding is followed by 2 to 3 feeds of pindone poisoned baits laid 3 to 5 days apart. Although not essential, free feeding of non-poisoned baits allows estimation of amount of poisoned bait required and assessment of any non-target uptake. It also allows rabbits to become accustomed to eating the bait and for toxic bait to be eaten rapidly when applied.
- Western Australia uses a '*one-shot baiting technique*' where a trail of pindone impregnated oats, proportionally mixed with untreated oats, is laid at a specified rate. Bait is topped up as required using the minimum amount of bait possible. Separate free feeding is not offered.
- The placement of bait is critical. Trails of bait must be laid through feeding areas where rabbit activity is highest and preferably where the pasture is short or absent. It is recommended that two trails are laid. One at a minimum of 30 metres from where rabbits are living, and another 40 metres out from the first trail. Bait is distributed using either of the following methods:
- *Furrow baiting* – bait is placed in a furrow 10cm wide and 2cm deep that has been cut into the soil using a hoe, mattock, disc or specially designed baitlayer.
- *Broadcast or scatter baiting* – bait is scattered in a swathe around 5 metres wide, often using a vehicle-mounted or towed spreader. This method is used in areas where it is impossible to run a trail e.g. rocky terrain, near fallen timber, in crops, where erosion may be a problem. A strip of spring steel can be attached to the bait laying vehicle so that a scratch mark is left in the soil enabling the scatter bait trail to be found later.
- Baits should be laid in the evening.
- Monitoring of numbers and amount of free-feed taken will help to estimate the quantity of poisoned bait required. Sufficient bait is required to allow all rabbits in an area to consume approximately 15-30g of bait from each application. Adjust quantities so that no more than 20% of the bait remains on the following morning. As a general guide the following amounts are recommended for '*pulse baiting*':

Conventional baiting

- NSW and Victoria use a '*conventional*' baiting technique' where free-feeds of non-poisoned baits are laid prior to a single application of 1080 poisoned bait. The procedures used for each State are as follows:
- NSW – 3 free-feeds must be laid at least 3 days apart. The 1080 bait must be laid 3 to 5 days after the last free-feed.
- Victoria – 2 free-feeds are laid. The interval between the first and second feed should be not less than 6 days and that between the second and poison feed not less than 4 days.
- Free-feeding of non-poisoned bait is an essential step to allow rabbits to become accustomed to eating bait material. It also enables an estimation of amount of poisoned bait required. Suggested quantities of bait for the first free-feeding are:

GROUND BAITING OF RABBITS WITH PINDONE (RAB004) STANDARD OPERATING PROCEDURE

Density of rabbits	Low	Medium	High
Kg oat bait per km trail	3	6	9
Kg carrot bait per km trail	10	20	30

- The recommend rate of lay for one-shot baiting is: 17 kg/km for furrow trails and 20 kg/km for broadcast or scatter trails.
- Rabbit numbers will start to progressively decline about 10 days after the first application of poison bait.

Collection of uneaten bait and rabbit carcasses

- All bait that is uneaten 4 days after bait consumption ceases should be collected and destroyed either by incineration or burying at a depth of 500mm. Alternatively, trails of poisoned oat or pellet bait can be covered with sufficient soil to prevent non-targets from gaining access.
- Carcasses of poisoned rabbits should be collected for a minimum of 12 days after the last poison feed. They should be destroyed by incineration or buried at a minimum depth of 500mm in a disposal pit.

PROCEDURAL NOTES

- Bait containing pindone is likely to lose potency after laying in wet conditions, with bait prepared from the water soluble form (sodium salt) expected to do so more rapidly. It is therefore recommended to avoid laying bait if rain is predicted overnight.
- More detailed information on pindone use can be found on approved labels, from various state guidelines (e.g. vertebrate pest control manuals, Landcare Notes, Farmnotes etc.) and relevant federal, state and territory legislation.

REFERENCES

1. Anon. (1997). Vertebrate Pesticide Manual: A guide to the use of vertebrate pesticides in Queensland. Department of Resources, Queensland.
2. Anon. (2002). The NRA review of pindone. National Registration Authority for Agricultural and Veterinary Chemicals. Canberra.
3. Anon. (2004). Vertebrate Pest Control Manual. Agricultural Protection Program. NSW Agriculture.
4. Bloomfield, T. (2001). Landcare Notes. Rabbit control using pindone poison. Department of Natural Resources and Environment, Victoria.
5. Martin, G. R., Kirkpatrick, W. E., King, D. R., Robertson, I. D., Hood, P. J and Sutherland, J. R. (1994). Assessment of the potential toxicity of the anticoagulant pindone (2-pivalyl 1, 3 indandione), to some Australian birds. *Wildlife Research*, **21**, 85-93.

GROUND BAITING OF RABBITS WITH PINDONE (RAB004) STANDARD OPERATING PROCEDURE

6. Martin, G. R., Sutherland, R. J., Robertson, I. D., Kirkpatrick, W. E., King, D. R. and Hood, P. J. (1991). Assessment of the potential toxicity of the anticoagulant pindone (2-pivalyl 1, 3 indandione), to domestic animals. *Australian Veterinary Journal*, **68**, 241-243.
7. Eason, C. T. and Jolly, S.E. (1993). Anticoagulant effects of pindone in the rabbit and Australian brushtail possum. *Wildlife Research*, **20**, 371-374.
8. Mason, G. and Littin, K. E. (2003). The humaneness of rodent pest control. *Animal Welfare*, **12**, 1-37.
9. Twigg, L. E., Lowe, T. J., Martin, G. R. and Gray, G. S. (1999). A review of the anticoagulant pesticide pindone. Vertebrate Pest Research Services. Agriculture, Western Australia.
10. Williams, K., Parer, I., Coman, B., Burley, J and Braysher, M. (1995). *Managing vertebrate pests: rabbits*. Australian Government Publishing Service, Canberra.

APPENDICES

Relevant federal, state and territory legislation for the use of 1080

Federal

Environment Protection and Biodiversity Conservation Act 1999

Information available from the Department of Sustainability, Environment, Water, Population and Communities website: <http://www.environment.gov.au/epbc/>

Australian Capital Territory

Environment Protection Act 1997

New South Wales

Pesticides Act 1999

Northern Territory

Poison and Dangerous Drugs Act 1999

Territory Parks and Wildlife Conservation Act 1998

Queensland

Health (Drugs and Poisons) Regulations 1996

South Australia

Controlled Substances Act 1984

Controlled Substances (Poison) Regulations 1996

Tasmania

Poisons Act 1971

Agricultural and Veterinary Chemicals (Control of Use) Act 1995

GROUND BAITING OF RABBITS WITH PINDONE (RAB004) STANDARD OPERATING PROCEDURE

Victoria

Agricultural and Veterinary Chemical (Control of Use) Act 1992

Western Australia

Poisons Act 1964

Poisons Regulations 1965

The Centre for Invasive Species Solutions manages these documents on behalf of the Environment and Invasives Committee (EIC). The authors of these documents have taken care to validate the accuracy of the information at the time of writing. This information has been prepared with care but it is provided “as is”, without warranty of any kind, to the extent permitted by law.

If you have printed this document please ensure you regularly check <https://pestsmart.org.au> for the latest updates of these documents.