



NSWRAB SOP3

Ground baiting of rabbits with pindone

Background

Poisoning with pindone is used to minimise the impact of the introduced European rabbit (*Oryctolagus cuniculus*) on agricultural production and the environment. 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 relevant legislation that applies in NSW. The SOP should only be used subject to the applicable legal requirements (including WHS) operating in the relevant jurisdiction.

Individual SOPs should be read in conjunction with the overarching Code of Practice for that species to help ensure that the most appropriate control techniques are selected and that they are deployed in a strategic way, usually in combination with other control techniques, to achieve rapid and sustained reduction of pest animal populations and impacts.

Application

- Subject to an authorised control officer (ACO) risk assessment (where required).
- 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. e.g., 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 by non-target animals

- o fencing to exclude larger species such as macropods
- o 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, e.g., at the end of summer or early autumn. Baiting is less effective during the breeding season when rabbit movements are limited.
- There are two types of registered pindone products; ready-to-use baits and concentrates used to prepare baits:
 - o Ready-to-use oat or carrot baits are available 'over-the-counter' from retail merchants or from licensed contractors and government pest control agencies.
 - o Liquid (sodium salt) or powder (free acid) pindone concentrates are restricted chemical products available only to authorised control officers (ACOs). Pindone acid has low water solubility while the sodium salt is soluble in water.
- Preparation of baits for rabbits with pindone concentrate can only be carried out by ACOs, and pindone bait products (non-liquid formulations) can only be used by ACOs and persons meeting the criteria listed in the Pesticide Control (pindone products) Order.
- Pindone concentrate or bait products authorised for use in Australia must be used in accordance with the instructions on the approved label or with an APVMA permit. Persons receiving ACO-prepared bait must be supplied with the LLS pindone directions for use before being issued baits.
- In NSW pindone must also be used in accordance with the *Pesticides Act 1999* and the Pindone Pesticide Control Order (which include distance restrictions, signage and notification requirements). The pindone user should refer to the [NSW Vertebrate Pesticide Manual](#) for all relevant legislation and its application.

Animal welfare implications

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.

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 that feed on poisoned rabbits and carcasses, e.g., dasyurids and raptors.
- Rabbits dying from pindone poisoning can become lethargic and less aware of their surroundings. This can predispose these animals to predation that 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.

Workplace health and safety considerations

- Pindone is toxic to humans and should be handled with care according to the approved label. 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.
- If poisoning occurs, go straight to a hospital or doctor or contact the Poisons Information Centre (Ph 13 11 26) IMMEDIATELY. Urgent hospital treatment is likely to be needed. 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, the Pesticide Control (Pindone Products) Order, and the NSW DPI Vertebrate Pesticide Manual.

Procedures

- A risk assessment may be required to determine if it is appropriate to supply pindone baits to any person.
- Users of pindone must always refer to any risk assessment and to specific permit, approved label and current Pesticide Control (Pindone Products) Order (Pindone PCO) for up-to-date information on conditions of use including distance restrictions, public notification and bait preparation, distribution, storage, transportation and disposal.
 - Pindone PCO: <https://www.epa.nsw.gov.au/your-environment/pesticides/pesticides-nsw-overview/pesticide-control-orders>
 - NSW DPI Vertebrate Pesticide Manual: <https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/publications/nsw-vertebrate-pesticide-manual>

References

- Anon. (2016). *Threat abatement plan for competition and land degradation by rabbits*. Commonwealth of Australia. Available at: <http://www.environment.gov.au/biodiversity/threatened/publications/tap/competition-and-land-degradation-rabbits-2016>
- Anon. (2018). *Vertebrate Pesticide Manual*. NSW Department of Primary Industries, Orange. Available at: <https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/publications/nsw-vertebrate-pesticide-manual>
- Anon. (2002). *The NRA review of pindone*. National Registration Authority for Agricultural and Veterinary Chemicals, Canberra.
- Eason, C. & Jolly, S. (1993). Anticoagulant Effects of Pindone in the Rabbit and Australian Bushtail Possum. *Wildlife Research*, 20: 371-374.
- Martin, G. R., et al. (1994). Assessment of the potential toxicity of an anticoagulant, pindone (2-pivalyl-1, 3-indandione), to some Australian birds. *Wildlife Research*, 21: 85-93.
- Martin, G. R., et al. (1991). Assessment of the potential toxicity of a poison for rabbits, pindone (2-pivalyl 1, 3 indandione), to domestic animals. *Australian Veterinary Journal*, 68: 241-243.
- Mason, G. & Littin, K. E. (2003). The humaneness of rodent pest control. *Animal Welfare*, 12: 1-37.
- Twigg, L. E., Lowe, T. J., Martin, G. R. & Gray, G. S. (1999). *A review of the anticoagulant pesticide pindone*. Vertebrate Pest Research Services. Agriculture, Western Australia.
- Williams, K., Parer, I., Coman, B., Burley, J & Braysheer, M. (1995). *Managing vertebrate pests: rabbits*. Australian Government Publishing Service, Canberra.