Preliminary trial of a water-resistant bait for feral pig control

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ABSTRACT

Feral pigs are regarded as a pest in New Zealand forests because they damage habitats essential for the survival of species such as kiwi and giant land snails. Consequently pigs need to be controlled if these species are to be protected. Most control is done by shooting using dogs to help locate pigs, but this is not possible in areas where there are ground birds or in remote areas. Therefore an alternative option such as poison baiting is required. We investigated the development of a pig bait that would be suitable for burying or using in a bait station, while reducing the likelihood of non-target species, such as birds, eating the bait. We manufactured a water-resistant pig bait that was eaten by domestic pigs in similar quantities to a non-water-resistant pig bait manufactured by Animal Control Products Ltd. The bait also killed domestic pigs when it contained warfarin. In a preliminary field trial, all feral pigs that visited the baiting site located, dug up, and ate a non-toxic version of the bait when it was buried. When the bait was fed from a bait station, 44% of the pigs present ate the bait. However, this figure would increase if more bait was placed in the bait station or more bait stations were available. We recommend that further trials be undertaken to test the new bait with encapsulated cyanide, which has recently become available. This would offer a more humane and environmentally friendly alternative to warfarin.

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1. Introduction

Feral pigs (*Sus scrofa*) were introduced into New Zealand before the 1800s, and are now widely but patchily distributed in both indigenous and modified habitats. Pigs are regarded as a pest because they damage forest habitats essential for the survival of species such as kiwi and giant land snails (Nugent et al. 1996). Consequently pigs need to be controlled if these conservation values are to be protected. Most control is done by shooting using dogs to help locate pigs, but this is unacceptable in some areas where ground birds, such as kiwi and weka, are present (D. McKenzie pers. comm.), or in areas that are remote (e.g. the Auckland Islands). Also, hunting with dogs is generally only effective where pig numbers are low (Caley and Ottley 1995). An alternative option is poison baiting, which is more cost-effective, especially in areas where pigs numbers are high (Choquenot et al. 1996).

Substantial research has been conducted on poison baits and baiting strategies in Australia where feral pigs are also a major pest (Choquenot et al. 1996). Most of the trials have used baits containing the acute toxicant 1080 (sodium monofluoroacetate) or the anticoagulant warfarin (Hone and Kleba 1984). The results have shown that 1080 can cause vomiting, which reduces bait efficacy (O'Brien et al. 1986). However, trials using warfarin resulted in large reductions in pig numbers (McIlroy et al. 1989, Saunders et al. 1990, Clarke 1993). Warfarin is also less toxic than 1080 and has an antidote, vitamin K, which can be used if accidental poisoning occurs (Hackett et al. 1985).

Coumatetralyl has been considered as an alternative anticoagulant toxicant because it is potentially more effective than warfarin at killing pigs. However, pigs are able to detect coumatetralyl when incorporated into baits, which could potentially reduce bait efficacy (Henderson et al. 1993). An additional toxicant that has recently become available from Feral Control™ is macro-encapsulated cyanide. These capsules have been designed to kill pigs, deer (*Cervus elaphus*), goats (*Capra hircus*), and possums (*Trichosurus vulpecula)* (J. Kerr pers. comm.). This option has not yet been investigated, but it has the potential to be more humane and environmentally safe than warfarin. These issues are becoming more important because of an increase in awareness of the environmental and welfare effects of using toxicants for mammalian pest control (Eason and Warburton 1998).

Various strategies for applying pig bait have also been investigated. Aerial broadcasting is not suitable when using baits containing warfarin because of the high risk to non-target species (Clarke 1993). A safer method is to use buried baits, so non-target species do not have access to them (Saunders et al. 1990), or to feed them from an enclosed bait hopper or bait station (A.K. Rathore unpubl. report). However, both methods require a water-resistant bait so that baits remain fresh and palatable for extended periods especially when the baits are buried. This is more important in high rainfall areas where pigs are commonly found.

At present no bait is registered or available for pig control in New Zealand, which restricts the options available to agencies wanting to undertake pig control. Consequently four DOC conservancies (Northland, Wanganui, Marlborough, and Southland) have requested the development of a pig bait that is suitable for burying or using in a bait station. A pig bait, manufactured by Animal Control Products Ltd

(ACP), has been trialled for aerial application (Clarke 1993), but it is not known if this bait is suitable for burying or for use in a bait station. A previous trial (Henderson et al. 1993) identified bait ingredients, including paraffin wax that are palatable to pigs and which could form the basis of a prototype weather-resistant pig bait.

The objectives of the present research project were to develop improved baiting strategies for effective control of pigs by poisoning in threatened conservation areas, by:

- developing and producing a bait that can be buried or used in a bait station.
- undertaking a preliminary field trial to determine what proportion of pigs accept the baits when visiting a bait station and buried bait site.

2. Methods

2.1 DEVELOPMENT OF A PIG BAIT

2.1.1 Suitability of the ACP pig bait

The suitability of the ACP pig bait for burying and using in bait stations was determined by consulting the manufacturers and measuring the water-resistance of the bait. Water-resistance was measured by soaking a total of 20 baits in water at room temperature and recording whether the bait remained intact after 24 hours.

2.1.2 Formulation of the prototype bait

The bait ingredients identified by Henderson et al. (1993) were used for the bait base and wax was added to the bait to provide water protection.

The bait formulation and proportions used in the bait are as follows: Ground maize, 26%; RS5 possum bait mix, 10%; Paraffin wax, 18%; Mutton fat, 18%; Blood and bone, 17%; Powdered molasses, 7%; Fish oil, 4%.

The bait was made by first heating the wax and fat together at approximately 100¦C in a domestic deep-fryer until both had melted and mixed together. Then the remaining ingredients were added to the hot wax and fat and mixed until thoroughly blended. The mix was then spread onto trays to give a thickness of approximately 15 mm and allowed to cool and solidify. Once the mixture had hardened it was removed from the tray and broken into pieces weighing approximately 30 g each.

The water resistance of the prototype pig bait was measured by immersing 20 baits in water at room temperature and recording weights and condition of the baits before immersion and then 1 and 4 days after.

2.1.3 Palatability of the prototype bait

The palatability of the prototype pig bait and ACP pig bait was compared by offering 1 kg of each bait type at the same time for 10 minutes in large paired plastic trays to 12 collectively housed domestic pigs (Grote and Brown 1971). The pigs were allowed to feed from the trays for a 10-minute period. The amount of bait eaten was compared using a paired *t*-test to determine if there were any significant differences.

2.1.4 Efficacy of the prototype bait containing warfarin

Warfarin was added to the bait matrix at a concentration of 1% based on an LD_{90} for feral pigs of > 20 mg/kg (O'Brien et al. 1987).

A total of nine domestic pigs, weighing approximately 10 kg each, were used in the trial. These were collectively housed in a large open pen and allowed to acclimatise for 10 days. The pigs were then fed *ad libitum* for 1 hour on day 1 and day 5 with the prototype bait containing warfarin. The amount of bait eaten for each feeding period and the fate of the pigs were recorded. During these days pigs were fed their normal diet in addition to the prototype bait. Landcare Research Animal Ethics Committee approval was given to undertake this part of the study.

2.2 FIELD ACCEPTANCE OF THE PIG BAITS

The acceptance of the non-toxic prototype pig bait was tested in a preliminary field trial when buried, and when placed in a bait station. The study was conducted at Okuku, in North Canterbury. The site consisted of rough pasture adjacent to a riverbed that gave easy access for feral pigs. The baiting site was chosen where feral pigs had been observed a few days previously. A bait station, consisting of a 20-litre plastic bucket placed on its side, was attached to three metal standards using lacing wire. It was then filled daily over a period of 14 days (15/3/98 to 28/3/98) with approximately 5 kg of the prototype bait. In addition six buried bait sites were located around the bait station at approximately 10-m intervals, and 1 kg of bait was buried at a depth of approximately 10 cm at each site. These were checked daily and replaced when necessary during the 14-day baiting period. Before baiting, pre-feeding was undertaken for 5 days using fermented barley (Choquenot et al. 1996) to increase the likelihood of pigs revisiting the site.

Time-lapse video camera surveillance (Innes et al. 1994) was undertaken during the 14-day baiting period so that the activity of pigs that came within 50 m of the baiting site could be recorded. The video camera recorded an image every 5 seconds during daylight hours. In addition, a standard video camera was used for 5 days to record colour images of the pigs that would be suitable to use for demonstration purposes. At the end of the baiting period the tapes were viewed and the number of pigs visiting the site, the time they were at the site, the number using the bait station, the number digging up baits, and non-target species at the site were recorded.

3. Results

3.1 DEVELOPMENT OF A PIG BAIT

3.1.1 Suitability of the ACP pig bait

The ACP baits rapidly absorbed water and had completely disintegrated within 24 hours making them unsuitable for use as a buried bait. Consultation with the manufacturer confirmed that the bait was not suitable to use as a buried bait (W. Simmons pers. comm.).

3.1.2 Formulation of the prototype pig bait

The prototype pig bait was more water-resistant than the ACP pig bait. After 24 hours of water immersion the baits remained whole and had increased in weight by a mean of 8.9 ± 0.6% (95% CI). However by day 4 the baits had begun to disintegrate.

3.1.3 Palatability of the prototype bait

A total of 9.1 kg (62%) of the prototype pig bait was eaten by the 12 collectively housed domestic pigs compared to 5.7 kg (38%) of the ACP pig bait. The amounts were not significantly different ($t = 2.1$, $d.f. = 11$, $P = 0.052$). However, the amount of the prototype bait eaten was probably underestimated because five trays containing the prototype bait were completely emptied within the 10 minute feeding time whereas only one tray was emptied which contained the ACP bait.

3.1.4 Efficacy of the prototype bait containing warfarin

The prototype bait containing 1% warfarin killed two domestic pigs. On the first day of baiting the nine pigs ate a total of 6.5 kg of bait (mean 722 g per pig) and on the fifth day they ate 3.2 kg (mean 361 g per pig) giving a mean bait take per pig of 1083 g. This equated to a mean warfarin dose per pig of 100 mg/kg, sufficient to kill the pigs (O'Brien et al. 1987). The first clinical signs of poisoning were observed on days 5 and 6. These were bleeding from the mouth and anus, lameness, and shivering. By day 8 two pigs had died and another six were unable to walk. At this stage it was apparent that these six pigs were likely to die so it was decided that all seven pigs remaining alive should be euthanased to prevent unnecessary suffering.

3.2 FIELD ACCEPTANCE OF THE PIG BAITS

A total of 65 pig visits were recorded at the baiting site and these occurred on 6 of the 14 baiting days (43%). The number of pigs present at the site at any one time ranged from 1 to 8 (mean = 5). The mean duration the pigs spent at the site was 15 ± 3 minutes (range = 4–35 minutes).

During the visits all pigs located, dug up, and ate the buried baits. However, only 44% of the pigs used the bait station. The bait station may have been used more often if it was not emptied by the pigs that first used it. Also some pigs showed aggressive behaviour towards other pigs, which prevented them from using the bait station.

Non-target species observed at the baiting site were sheep, cattle, magpies, and a cat. It was not possible to determine whether they ate the bait, but the sheep were observed putting their heads into the empty bait station. No non-target species dug up the buried baits.

4. Conclusions and recommendations

From these trials we conclude that:

- The existing ACP pig bait was not suitable for use as a buried bait or for use in bait stations because it rapidly absorbed water and disintegrated.
- The water-resistant non-toxic prototype pig bait we developed was equally palatable to penned pigs as the existing ACP pig bait.
- The toxic prototype bait killed pigs when warfarin was added to the formulation.
- Buried non-toxic prototype bait was located, dug up, and eaten by all feral pigs that visited the baiting site.
- When placed in a bait station, the prototype bait was eaten by only 44% of feral pigs visiting the baiting site. However, more pigs may have eaten the bait if the bait station was not emptied or guarded by the pigs that first used it or more bait stations were available.
- No non-target species were observed digging up the baits, but sheep were observed putting their heads into the empty bait station.

We recommend that:

- Pen trials should be conducted to test the efficacy of the prototype bait containing encapsulated cyanide. If successful this would offer a more humane and environmentally safer alternative to warfarin.
- An experimental use permit should be obtained to test a toxic version of the prototype bait containing warfarin and / or cyanide in the field.
- Suitable companies to manufacture the bait should be considered. Kiwicare Corporation (J. O'Brien pers. comm.) and ACP (W. Simmons pers. comm.) have shown interest in manufacturing the bait.
- A baiting strategy using buried baits and / or bait stations should be developed for the habitats where feral pigs are a problem.
- Because of humaneness concerns warfarin should only be used in a bait when other methods are not suitable, e.g. where hunting dogs may threaten ground birds or in remote locations where hunting is not feasible.

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