Animal Health Board Project No. R-10708

Effectiveness of Epro Deer Repellent in Preventing Livestock from Eating Carrot and Cereal Baits

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Landcare Research
Manaaki Whenua

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DATE: August 2009

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Landcare Research Contract Report: LC0910/010

DOI: https://doi.org/ 10.7931/cgrr-ds41

Contents

Summary

Project and Client

Landcare Research conducted a series of trials for the Animal Health Board (AHB project R-10708) to assess the effectiveness of a proprietary deer repellent (Epro deer repellent; EDR) for reducing the incidental by-kill of sheep and cattle exposed inadvertently to bait during aerial possum 1080 poisoning operations using cereal or carrot. The trials were conducted between October 2008 and July 2009.

Objectives

To assess the repellency to cattle and sheep of non-toxic cereal and carrot bait treated with EDR.
To field-test the repellency to sheep of 1080 cereal and carrot baits treated with EDR.

Methods

Non-toxic bait types (EDR + cereal, EDR + carrot, and plain carrot) were weathered under natural climatic conditions for 2–4 weeks.
Coopworth sheep and Angus-cross and Hereford cattle were presented with weathered and fresh non-toxic baits (cereal and carrot), with and without EDR, in a 7-day choice test. From estimation of daily consumption of the different bait types EDR did not appear to repel cattle, so further testing of toxic bait was only carried out with sheep.
Cereal or carrot baits containing 0.15% 1080 were presented to merino sheep in four separate paddocks (2–3 ha; 30 sheep in each). The trial was an unreplicated 2×2 comparison of EDR-treated bait versus untreated bait, and clustered versus evenly spread (broadcast) bait. Sheep were exposed initially to cereal bait treatments for a total of 29 days, with carrot bait treatments also available in the paddocks over the last 14 days of this period.
Baits were analysed for 1080 content before application, after 14 days and at 29 days for cereal baits. Samples of rumen contents and muscle were collected from any sheep that died during the trial. The rumen samples were examined to identify presence and type of bait, and the muscle samples were analysed for 1080.

Results

In the non-toxic trial conducted with sheep, >95% of the fresh carrot bait, both with and without EDR, was eaten within 4 days. Weathered carrot was eaten more slowly than fresh carrot, and EDR weathered carrot was eaten more quickly than weathered carrot without EDR. The sheep did not eat any cereal bait treated with EDR (fresh or weathered) over 7 days, but did eat about a third of the cereal bait without EDR.
In the parallel trial where cattle were presented with non-toxic bait types, EDR did not have a deterrent effect. Cattle ate all bait types (weathered, fresh, carrot, cereal, with or without EDR) with c. 95% of bait eaten after 1 day, and all eaten by 3 days.
In the toxic bait trial conducted with sheep on rough pasture in Marlborough, no sheep died after 14 days of exposure to cereal 1080 baits with or without EDR. However, when the treatments were reapplied using carrot bait in the same paddocks for 14 days, sheep mortality occurred. None of the 60 sheep exposed to EDR carrot baits died, but seven (12%) of the 60 exposed to non-EDR carrot baits did. Of these, four were in the broadcast and three in the cluster treatment. Deaths occurred 2–13 days after carrot baits were applied.

Carrot bait was discernable in only one of the seven rumen samples collected from the dead sheep, but the muscle tissues for all seven had detectable 1080 concentrations (0.06–0.37 mg/kg), indicating they had eaten toxic bait.

Conclusions

Cattle do not appear to be repelled by EDR on non-toxic carrot or cereal bait, indicating that inclusion of the repellent would not significantly reduce the risk of cattle ingesting 1080 bait if they encounter it.

Sheep appeared to prefer non-toxic carrot over non-toxic cereal bait. Inclusion of EDR further reduced consumption of non-toxic cereal bait to nil.

In the toxic bait trial, sheep did not appear to eat any cereal 1080 baits, with or without EDR, in the first 2 weeks' exposure. This may have been because the sheep had no previous experience of cereal-based food, and alternative familiar food (pasture and hay) was available.

The 12% mortality of sheep after exposure to toxic carrot bait without EDR is consistent with the findings of the non-toxic-bait trial, suggesting that carrot is significantly more palatable than cereal bait to sheep. Some sheep may have ingested toxic cereal bait that was present during the time toxic carrot bait was also available, but the timing of the mortality (2–13 days after application of toxic carrot bait) and the presence of carrot in one of the rumens suggest that consumption of toxic carrot bait was more likely to have caused mortality.

Cluster sowing of 1080 baits was not more hazardous to sheep than broadcast sowing of baits but given the low levels of mortality (3/30 and 4/30 respectively) in the field trial, the power of the analysis was low.

Nil mortality in the sheep exposed to toxic carrot or cereal bait treated with EDR suggests repellency sufficient to substantially reduce the risk of accidental poisoning of sheep that encounter 1080 baits.

Recommendations

EDR-coated 1080 baits should be used if there is a significant risk that sheep will be exposed to toxic bait during aerial poisoning for possum control. Cereal pellet bait appears to be less palatable to sheep than carrot bait, so EDR-coated cereal bait should be used if a significant risk of sheep by-kill exists. Where carrot baits are used for possum control, inclusion of EDR is expected to reduce the likelihood of sheep consuming toxic quantities of carrot bait they encounter.

1. Introduction

Landcare Research conducted a series of trials for the Animal Health Board to assess the effectiveness of a proprietary deer repellent (Epro deer repellent; EDR) for reducing the incidental by-kill of sheep and cattle inadvertently exposed to bait during aerial possum poisoning operations using cereal or carrot baits containing sodium fluoroacetate (1080). The trials (AHB project R-10708) were conducted between October 2008 and July 2009.

2. Background

Sheep, cattle and domestic deer may eat toxic baits (chopped carrot or cereal pellets containing 0.15% 1080) applied aerially to control possum populations. Baits are therefore not sown near or over farmland, unless these areas are destocked for specified periods during and after poisoning. Despite this, livestock have been inadvertently killed when they encounter and consume toxic baits, for example through unintended access of livestock to baited areas, application of baits outside a specified area, or return of livestock to an area where toxic baits have not been sufficiently weathered (degraded) to become non-hazardous. These risks impose major constraints on where and when aerial application of possum baits can be used.

This project aims to determine the extent to which those risks can be reduced or eliminated by using a proprietary repellent (hereafter called EDR) known to deter deer from eating bait (Forsyth 2002, unpubl. Landcare Research Contract Report; Morriss 2007) to also deter sheep and cattle. This would reduce the frequency of livestock deaths, which contributes to poor public perception of 1080 and its aerial application, and increase opportunities to use the tool closer to farmland and in larger areas of rugged farmland where it is difficult to achieve a complete destocking ahead of bait application.

Concurrent research has shown application rates of aerial 1080 can be reduced by sowing bait in aggregated clusters rather than broadcasting it thinly and evenly (AHB Project R-10629-02 – Nugent et al. 2009; AHB Project R-10710 – Morriss & Nugent 2009). Some deer mortality was observed in the former project, leading to conjecture that larger animals may be more vulnerable to poisoning with cluster baiting (i.e. ingestion of a lethal dose in multiple baits before sickness behaviour stops feeding, compared with widely scattered bait where the onset of sickness behaviour may occur before enough bait has been found and ingested). This project therefore also determined whether sheep (as a relatively large animal) are at increased risk from cluster baiting compared with broadcast baiting.

3. Objectives

To assess the repellency to cattle and sheep of non-toxic cereal and carrot bait treated with EDR.
To field-test the repellency to sheep of 1080 cereal and carrot baits treated with EDR.

4. Methods

Testing was done in two stages: (1) determining the effect of EDR on the consumption of non-toxic carrot and cereal bait by farmed cattle and sheep on developed pasture near Lincoln, Canterbury, and (2) determining the effect of EDR in reducing sheep mortality following application of toxic bait in rough undeveloped farmland. The latter trial was intended to represent the context in which sheep are most likely to be at risk as a result of aerial baiting. Cattle were not included in a trial with toxic bait because we found little evidence of a repellent effect with EDR in the initial trial where cattle were presented with non-toxic bait.

4.1 Consumption of non-toxic bait by cattle and sheep

Bait preparation and weathering

Cinnamon-lured No. 7 non-toxic cereal bait (12 g) was sourced from Animal Control Products (ACP), Wanganui, and was surface-coated with EDR by Epro, Taupo. Fresh washed carrots were purchased from a wholesaler in Christchurch and cut to bait size (c. 10-g pieces) using a Gibson carrot cutter (provided by D. Hunter, Excell Pest Control). EDR solution was applied to batches of cut carrot bait on the same day.

Batches of EDR-treated cereal and carrot baits were weathered before being presented to sheep or cattle, to determine whether the freshness of EDR bait affected repellency. Freshly prepared baits were spread on the ground in wire mesh pens that excluded animals, and left exposed to the weather for 1 month. Rainfall and minimum and maximum temperatures were recorded daily during this period. A batch of untreated chopped carrot was weathered similarly for 2–3 weeks before being presented to sheep or cattle, to determine if weathering rather than EDR repellency produced any change in bait acceptance. Fresh cereal bait (both plain and surface-coated with EDR) was stored in a temperature-controlled room (20 ± 2 ºC) at the Landcare Animal Facility from the start of the weathering period until it was required for the trial. Fresh carrots were prepared by cutting to size on the day that the palatability trial commenced, and half of this cut carrot was coated with EDR. The resulting seven treatments were as follows:

1) Fresh plain 10-g chopped carrot baits (cut the day first presented)
2) Fresh 10-g chopped carrot surface-coated with EDR (cut the day first presented)
3) Fresh 12-g No. 7 Wanganui cereal baits surface-coated with EDR
4) Fresh 12-g No. 7 Wanganui cereal baits
5) Weathered (1 month) 12-g No. 7 Wanganui cereal baits surface-coated with EDR

6) Weathered (1 month) 10-g chopped carrot baits surface-coated with EDR
7) Weathered (2–3 weeks) 10-g chopped carrot baits

Consumption trials

One hundred and twenty Coopworth sheep (ewes and 3-month-old lambs) held on improved pasture at the Lincoln University Research Farm and a mixed group of Angus-cross and Hereford cattle (rising yearlings; $n = 37$) on improved pasture on a farm at Springston South were used for the trial.

Bait was placed in 70 troughs distributed across each of the two study paddocks in a randomised complete block design. There were 10 groups of seven troughs, with one of each treatment represented in each group (i.e. 10 troughs of each treatment). The seven troughs in each group were 2–3 m apart and clearly visible from each other to ensure that any visual attraction of the troughs was equal for all treatments.

Bait treatments were provided at 2 kg per trough except that desiccation of the two weathered carrot treatments meant that less of the weathered EDR carrot and weathered non-EDR carrot bait were available for both the sheep trial (0.5 and 0.7 kg per trough, respectively) and the cattle trial (1.0 and 0.85 kg per trough, respectively).

The bait remaining in each trough was weighed daily for 7 days or until all bait had been eaten. Four troughs of each treatment were placed in an unoccupied paddock as environmental controls to correct for weight change due to dehydration or exposure to moisture.

4.2 Mortality of sheep exposed to toxic 1080 bait

Cereal bait

To assess the effectiveness of EDR in reducing the risk to sheep during a simulated aerial baiting operation, a field site was selected in the Marlborough high country. This was adjacent to an area where an aerial 1080 operation was planned, and was representative of the type of country in which aerial 1080 poisoning could be used. The site was river terrace and easterly aspect toe-slope covered in scattered manuka, matagouri and native grasses. Four blocks (2–3 ha) were fenced using a combination of sheep netting and existing fences and included a natural water supply. Possums were present in and around the blocks, although some control using Feratox® cyanide pellets had been carried out in the vicinity of the blocks in the week prior to the trial commencing (c. 30 possums removed).

The sheep selected for the trial were mature unmated merino ewes, the sheep breed most likely to be exposed to 1080 possum baits in the South Island high country. The experimental design was an unreplicated 2×2 comparison of two factors – EDR vs non-EDR, and clustered vs broadcast (evenly spread) bait. The treatments used 12-g No. 7 Wanganui green-dyed cinnamon-lured 1080 (0.15%) cereal baits and were:

1) EDR-coated baits hand broadcast at 2–3 kg/ha
2) Standard baits hand broadcast at 2–3 kg/ha
3) EDR-coated baits cluster sown at 1 kg/ha
4) Standard baits cluster sown at 1 kg/ha

In the broadcast blocks bait was sown by walking a transect and scattering bait up to 50 m either side (Fig. 1). When the blocks were wider than 100 m, a second transect parallel to the first was also sown to ensure bait was evenly distributed across the blocks to simulate an aerial baiting swath of 100 m. In the cluster blocks, cereal baits were distributed in clusters of 36 baits (Fig. 2). The bait was sown by walking a transect and stopping every 50 m to distribute baits within a 10-m radius.

One hundred and twenty sheep were drenched and numbered with stock paint on each side, to assist in identifying individuals from a distance. Groups of 30 were selected randomly and put in each block. This stocking rate (10–14 sheep/ha) provided a worst-case scenario for testing bait acceptance by sheep as it was much higher than usually stocked (c.1.5 sheep/ha) on this type of farmland. As a result forage became depleted and supplementary feed (meadow hay) was provided starting 4 days into the trial when the farmer considered it necessary. Sheep were observed at least daily after baits were laid. An observer traversed the blocks and/or used binoculars from a vantage point to watch the sheep and look for any symptoms indicative of 1080 poisoning, i.e. lethargy and salivation (see Gooneratne et al. 2008). The sheep were left in the blocks for 2 weeks. As part of the animal ethics approval (09/04/02) for this trial, the following stopping points were in place:

If more than 8% (5/60) of the sheep exposed to EDR+1080 baits died of poisoning, the trial ceased;
If more than 33% (20/60) of the sheep exposed to standard 1080 baits died of poisoning then those treatments ceased, and the EDR treatments continued until either the trial end-point was reached or the stopping point of 8% mortality was exceeded.

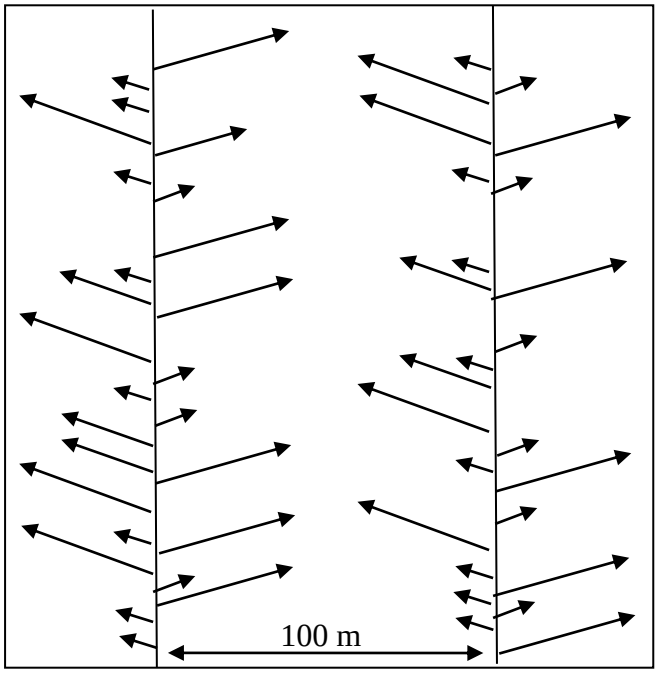

Fig. 1 Schematic representation of hand-broadcast baiting in the field trial blocks. The arrows represent where bait was thrown. Two blocks (2–3 ha) were sown with 12-g No. 7 Wanganui green-dyed cinnamon-lured 1080 (0.15%) cereal baits, one with baits coated with EDR and the other without EDR. A fortnight after cereal bait had been sown carrot baits (10-g green-dyed cinnamon-lured 1080 (0.15%) carrot baits with and without EDR) were sown in the same areas.

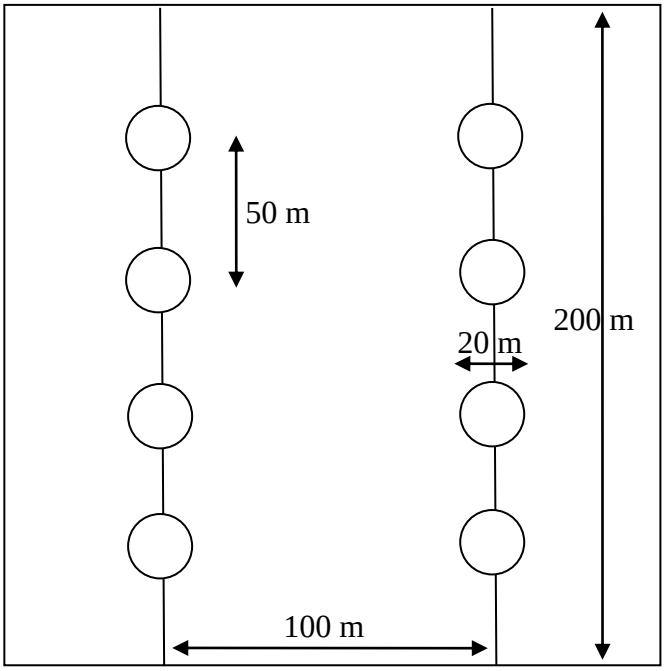

Fig. 2 Schematic representation of cluster-sown bait in the field trial blocks. The circles represent the area where bait was sown. Initially two 3-ha blocks were sown with 12-g No. 7 Wanganui green dyed cinnamon-lured 1080 (0.15%) cereal baits. The baits in one block were without EDR and in the other were coated with EDR. A fortnight after cereal bait had been sown carrot baits (10-g green-dyed cinnamon-lured 1080 (0.15%) carrot baits with and without EDR) were sown in the same areas. There were 36 cereal baits and 44 carrot baits in each cluster.

Repellency to sheep – carrot bait

After 14 days' exposure to toxic cereal baits there had been no mortality in any of the four treatments, so toxic carrot baits were distributed in the same blocks with the same sheep, following the same methodology used for the cereal bait. The treatments used 10-g green-dyed cinnamon-lured 1080 (0.15%) carrot baits and were:

1) EDR-coated baits hand-broadcast at 3 kg/ha
2) Plain baits hand-broadcast at 3 kg/ha
3) EDR-coated baits cluster sown at 1 kg/ha
4) Plain baits cluster sown at 1 kg/ ha

Carrot was manually cut to size before being surface-coated with a solution of 1080, cinnamon lure and green dye (formulated by the Landcare Toxicology Laboratory). The bait for the repellent blocks was then coated with repellent solution (provided by Epro) as per standard operating procedure (advised by Epro). Baits were distributed the same way as the cereal baits, except that 44 baits were put out in each cluster in the cluster blocks. At the end of the trial, the areas in which 10 clusters of bait had been sown (four in the non-EDR block and six in the EDR block) were searched to gauge disappearance rates of the bait.

Analysis

Samples of bait (20–30 g) were collected at application, after 14 days (cereal only) and when surviving sheep were removed from the blocks after 29 days (carrot had been distributed for

14 days at this stage). The 1080 concentration of the baits was determined using Toxicology Laboratory Method TLM 023 (with a method detection limit of 0.0002%) at the Landcare Research Toxicology Laboratory, to determine the level of continued toxicity. Rainfall during the trial period was recorded to assess the weathering of the baits.

The efficacy of the EDR was assessed by sheep mortality. Rear leg muscle samples (50 g) from dead sheep were analysed to determine 1080 concentration, using Toxicology Laboratory Method TLM 005 (with a method detection limit of 0.001 mg/kg) at the Landcare Research Toxicology Laboratory. Samples of rumen contents (1 litre) were collected and examined to identify bait present. Sheep were weighed at the completion of the trial or at death. The weights of surviving sheep and those which died during the trial were compared using a two-sample *t*-test. The mortality of sheep in EDR vs non-EDR treatments, and clustered vs broadcast bait treatments was compared using a Fisher's exact test (Crawley 2007).

5. Results

5.1 Consumption of non-toxic bait

Bait weathering

The average temperature during the period of bait weathering (2 October to 9 November 2008) was 12.2ºC (range -1.6ºC to 31.2ºC). There had been 27 mm of rain on the weathered baits presented to sheep and 33 mm of rain on those presented to cattle. The outer surface of the cereal baits coated with EDR was cracked due to the expansion and shrinking of the bait as it absorbed moisture or dried out, but it still appeared to have retained most of the original brown colour imparted by the EDR. Carrot baits weathered for 2–3 weeks (plain) or 1 month (EDR-coated) had lost 89.5% and 90.6% of their initial weight, respectively. There was little difference in the weight loss of the plain carrot weathered for 2 or 3 weeks (93% cf. 86%, respectively).

Repellency to sheep

Sheep did not eat any of the cereal bait treated with EDR (fresh or weathered), with the small reduction in weight shown in Fig. 3 probably resulting from compounding measurement error. However, sheep ate a third of the non-repellent cereal bait presented to them (Fig. 3).

EDR did not repel sheep fully from eating the carrot bait (Fig. 3). They ate all of the fresh non-EDR carrot within 3 days, but took 2 days longer to eat all the fresh EDR carrot (Fig. 3). They did not consume all of the weathered carrot, but ate more EDR weathered carrot than the non-EDR equivalent (Fig. 4).

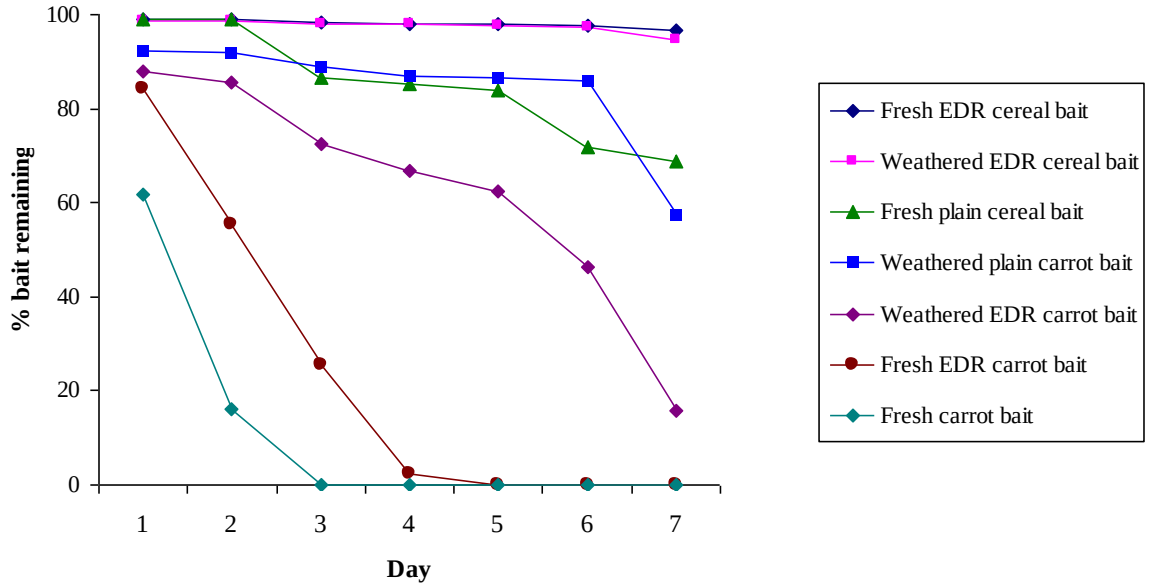

Fig. 3 Percentage of bait left by Coopworth ewes and lambs (*n* = 120) presented with 10 seven-trough groups. All weathered treatments had been weathered for 1 month with the exception of the weathered plain carrot bait, which had been weathered for 2 weeks.

Fig. 4 Lamb eating bait (non-toxic weathered EDR carrot bait).

Repellency to cattle

EDR did not deter cattle from eating cereal or carrot baits (Fig. 5). They ate all bait types very quickly, with most bait gone after 1 day and all gone by 3 days (Fig. 6). The only bait remaining in any quantity after the first day was fresh EDR carrot bait.

Fig. 5 Cow eating non-toxic EDR bait at a farm at Springston South.

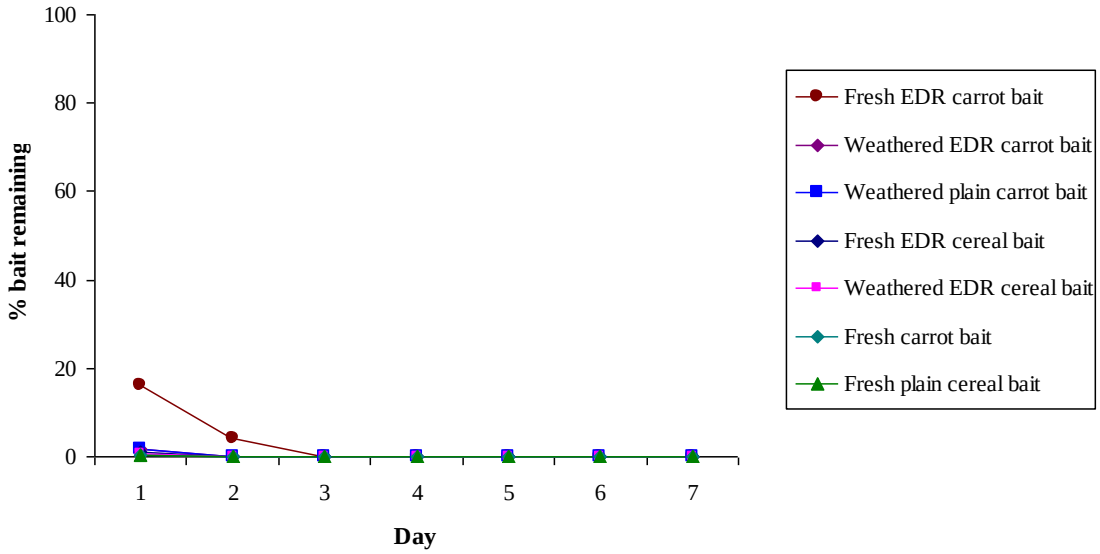

Fig. 6 Percentage of bait left by rising yearling cattle (*n* = 37) presented with 10 seven-trough groups.

5.2 Mortality of sheep exposed to 1080 bait

No sheep died or exhibited signs of sublethal poisoning during the first 14 days when they were exposed only to cereal 1080 baits. Seven sheep died 2–13 days after carrot baits were added to the trial blocks – 4/30 (13.3%) in the non-EDR broadcast block and 3/30 (10.0%) in the non-EDR cluster block.

Overall, the 12% mortality of sheep exposed to non-EDR carrot and cereal combined was significantly higher than the 0% mortality in EDR bait treatments (Fisher's exact test P = 0.01). Within the non-EDR treatments, the difference in the mortality in the broadcast-baited paddock (13.3%) and that in the cluster-baited paddock (10.0%) was not significant (Fisher's

exact test, $P = 1$). The mean weight of the sheep that died (41.4 kg) was not significantly different to that of the survivors (39.8 kg; $t_{117} = 0.8$, $P = 0.43$).

Analysis confirmed the presence of 1080 in muscle samples from all seven sheep that died (0.06–0.37 mg/kg, Table 1). Carrot was seen in one of the seven rumen samples; the remaining contents consisted mostly of hay. None of 60 sheep died during the 29 days they were exposed to EDR cereal or carrot baits.

Table 1 Concentration of 1080 in muscle samples from sheep that died following simulated aerial application of cereal and carrot 1080 (0.15%) baits. The method detection limit was 0.001 mg/kg

Block	ID	Muscle 1080 concentration (mg/kg)
Standard broadcast sown	43	0.32
	64	0.15
	88	0.11
	59	0.37
Standard cluster sown	1	0.06
	82	0.26
	97	0.17

Some baits were eaten by possums (two carcasses were found) but both bait types were still readily available in all the blocks at the end of the trial when the surviving sheep were removed. In the cluster-baited blocks an average of 29% and 43%, respectively, of the number of cereal and carrot baits known to have been sown per cluster in the non-EDR block and 29% and 67%, respectively, in the EDR block were re-located. Not all baits remaining would have been detected as some would have been hidden by vegetation or trampled by the sheep.

Bait toxicity

At the start of the trial, the 1080 concentration in all four bait types was close to the designated loading of 0.15%, but had declined by a third after 2 weeks, and by >75% after 4 weeks (Table 2).

Table 2 Concentration of 1080 present in carrot and cereal baits used in the field-testing of the repellency of EDR to sheep. At day 14 carrot baits were added to the blocks. Figures are % weight 1080

	Day 0	Day 14	Day 29
Standard cereal bait	0.15	0.09	0.023
EDR cereal bait	0.14	0.11	0.033
Standard carrot bait		0.14	0.004
EDR carrot bait		0.13	0.013

Cereal baits were exposed to 32 mm of precipitation (including 25-mm snow, and temperatures down to -11°C) during the 4 weeks and by the end were very soft but had retained their shape and colour. The carrot baits were exposed to 26 mm of rain during the final two weeks of the trial, and 1080 concentration declined more rapidly than in the cereal bait over this time (Table 2). Carrot baits had the same appearance at the end of the trial as when they were put out.

6. Conclusions

Although the trials were not replicated, the rapid consumption by cattle of non-toxic EDR baits (cereal and carrot) strongly indicates that at least some cattle are not repelled by EDR, such that the inclusion of EDR on toxic 1080 baits is unlikely to reduce risks of cattle eating bait and potentially being poisoned. In contrast, the field trial provided robust evidence that EDR reduced the kill of sheep.

Both trials suggest that cereal bait has lower palatability to sheep than carrot bait. Most of the non-toxic cereal bait without EDR was not eaten, and none of the bait with EDR, and there was no evidence in the toxic trial that sheep ate any cereal bait, with or without EDR. Cereal bait therefore appears to present a reduced hazard for sheep compared with carrot. Carrot bait appears to be more palatable, but the non-toxic trial suggested that EDR decreases the likelihood of sheep ingesting carrot bait. Because both cereal and carrot baits were present during the second half of the toxic-bait trial, we cannot be certain that the deaths were caused solely by eating non-EDR carrot bait. Some sheep may have overcame an initial avoidance of cereal baits and eaten them. However, given the declining toxicity of the cereal baits by the time carrot bait was applied, the apparent preference for carrot bait by sheep, and the presence of carrot in one of the killed sheep, we suggest that ingestion of toxic carrot bait was the cause of the sheep mortality observed here. The field trial clearly indicated that EDR reduced consumption of either bait type by sheep. The results from the toxic-bait trial suggest that merino sheep may not eat cereal bait even when pasture is limited. However, the merinos used in the trial had had no known experience of grain or pelleted feed supplements. Sheep that have had previous experience of grain supplements and feed pellets may be more inclined to eat 1080 cereal baits. This deserves to be tested.

Some previous observations support the suggestion that EDR lowers the risk of sheep consuming lethal quantities of 1080 bait compared with cattle. For example, EDR cereal 1080 baits were used for possum control at Mt Stalker, Otago, in July 2008, and two cattle were found dead in the operational area whereas numerous live feral sheep were observed in the block 3 months after the operation (B. Rohloff, Southern Pest Management, pers. comm.). Tissue analysis confirmed 1080 was present in the cattle.

Cluster sowing of 1080 baits was not more hazardous to sheep than broadcast sowing of baits but given the low levels of mortality (3/30 and 4/30 respectively) in the field trial, the power of the analysis was low.

The additional cost of using the repellent to reduce sheep mortality would need to be weighed against the cost of compensating farmers for 1080-killed livestock, welfare benefits of reduced sheep mortality, and the benefits to the overall Tb control strategy by being able to

apply an optimal possum control tool in areas where previously aerial 1080 use has been restricted.

7. Recommendation

EDR-coated 1080 baits should be used if there is a significant risk that sheep will be exposed to toxic bait during aerial poisoning for possum control. Cereal pellet bait appears to be less palatable to sheep than carrot bait, so EDR-coated cereal bait should be used if a significant risk of sheep by-kill exists. Where carrot baits are used for possum control, inclusion of EDR is expected to reduce the likelihood of sheep consuming toxic quantities of carrot bait they encounter.

8. Acknowledgements

This study was contracted research, carried out for the Animal Health Board. It was approved by the Landcare Research Animal Ethics Committee (09/04/02). Karen Washbourne, Mike Wehner, Sam Brown and Matt Campion provided technical support in the non-toxic trials. Thanks to Martin Ridgway at the Lincoln University Research Farm and Terry Lassen at Springston South who provided access to sheep and cattle for the non-toxic trials. Thanks to Roland and Jenny Mapp who provided the site and assisted with the running of the field trial. Thanks also to Ivor Yockney for review of this report, Christine Bezar for editing, and Cherie Wilson for final word processing.

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