Fly-traps

Lucitrap® and LuciLure® improvements

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Summary

Lucitrap® is a selective trapping system for the Australian sheep blowfly, Lucilia cuprina. *Improvements have been made to Lucilure®, the synthetic attractant used in the trap, and Lucitrap®. The shelf life of Lucilure® was extended from four months to two years by separating two reacting components to produce a new, 3-bottle Lucilure®. The concentrations of all components in the new Lucilure® were >97 per cent of the original concentrations after 56 days at 50°C. The new Lucilure® was as effective as the original lure in catching* L. cuprina *(mean catch 56 and 63 flies per trap and period respectively, no significant difference). The Lucitrap® with a new, more transparent bucket caught more* L. cuprina *(mean per trap and period 55) than with the original trap bucket (mean 49, difference not significant). These improvements make the Lucitrap® an even more attractive component of any control strategy for sheep blowflies.*

Keywords

Lucitrap®, Lucilure®, *Lucilia cuprina*, blowfly strike, sheep, trapping

Introduction

Lucitrap®, which has been available commercially since 1995, is a selective trapping system for the Australian sheep blowfly, *Lucilia cuprina*. Lucitrap® consists of a transparent plastic bucket with a yellow top containing multiple cones for fly entry. Inside the trap is an attractant, Lucilure®, in plastic bottles with wick dispensers, which provide a uniform evaporation of the attractant over three months (ie. the optimum lifetime of the current lures). The evaporation rate of the attractant is regulated by adjusting the length of the wick to match prevailing climatic conditions. Flies having entered the trap find it difficult to leave through the specifically designed entry cones. No insecticide is required to retain the blowflies. Lucilure® is registered with the National Registration Authority for Agricultural and Veterinary Chemicals (NRA Approval No. 51198/0101).

Lucitrap® has been shown to reduce the populations of *L. cuprina* when used at 1 trap per 100 sheep (Urech *et al*, 1998). Field trials investigating the correlation between Lucitrap® and the incidence of flystrike and the use of insecticides are currently ongoing in Australia and South Africa (Scholz *et al*, 2000) and the findings from these studies are reported in other papers presented at this conference.

Recent research and development work on Lucitrap® and Lucilure® was focussed on two points where improvements were sought:

- An increase in the shelf life of Lucilure® from four months to at least two years.
- Optimization of the trapping efficacy of Lucitrap® by increasing light transparency of the trap bucket.

The shelf life of Lucilure® was limited to four months because of a slow reaction between two components of Lucilure® B, 2-mercaptoethanol (2-me) and butyric acid, which reduced the attractancy of the mixture for *L. cuprina*. The short shelf life necessitated the production of small batches and their frequent replacement, so increasing production and transport costs. A solution was required where this reaction was either prevented or reduced to a negligible rate so that the mixture could be stored for two years at ambient temperature with no loss of attractancy.

Research on completely clear Lucitrap® buckets had indicated that traps fitted with such buckets caught more flies than the standard, semi-transparent buckets. When black buckets were used, the trap catch was much smaller compared to the standard trap. Thus, trap efficacy appeared to be correlated with the amount of light entering the bucket. However, the clear buckets were not inert either to UV light or to the attractant chemicals. A trap bucket with maximum light transmission and stability to UV light and chemicals was required.

The results from the research on the modifications to Lucilure® and on the material used for manufacturing the Lucitrap® bucket and the assessment of the efficacy of the new system are reported in this paper.

Methods

Accelerated stability study

An accelerated stability study was carried out with Lucilure®s stored in an incubator held at 50±1°C. At day 56 the lures were removed from the incubator and an aliquot (500 ul) of each Lucilure® removed and stored in the freezer until analysed. The analyses were carried out on a gas chromatograph (GC) fitted with a flame ionisation detector (FID).

Sample preparation

Samples and standards (15ul) were dissolved in acetone (0.5 ml), transferred to a volumetric flask (10 ml), filled to the mark with hexane containing 1-hexanol (3 mmol/L, internal standard (IS)) and well mixed.

GC/FID analysis

Analysis was carried out on a HP5890 GC fitted with a capillary column (J&W, DB5, length 30 m, ID 0.25 mm, film thickness 0.25 um; carrier gas was hydrogen, 10 psi head pressure). Temperature program was 40°C for 2 min., 20°C/min. to 240°C with a final time of 3 min. Sample injection (1 ul, split 1:50) was achieved via automatic sampler HP 7673A and detection was by FID. Detector output was processed by a HP 3392A integrator. Area under peaks was used for calculations of concentrations. The retention times for 2-mercaptoethanol, butyric acid, 1-hexanol (IS) and indole were 3.8, 4.4, 5.3 and 9.5 min respectively.

Calculation of concentrations

The ratios of area under peak of each component over IS were calculated. The concentration of each component was derived from its ratio in the sample and the corresponding ratio in the standard.

Field assessments

Field assessments of Lucilure® and Lucitrap® were carried out in Brisbane and south-western Queensland. The experimental design was a duplicated 4x4 Latin square with 8 sites, 4 periods and 4 treatments (Perry, 1980). The lengths of the periods were 24 h in Brisbane and 48 to 84 h in the rural trials. Fly counts were transformed (square root) and analysed by ANOVA (95 per cent confidence limits). Back-transformed mean catches (per trap and period) are reported, to provide a realistic mean fly catch.

Results

Replacing one of the two reacting components in the attractant mixture by a functional substitute, which was assumed not to react with the other component, led in all cases to unacceptable losses in attractancy for *L. cuprina*.

The addition of various components to the attractant mixture did not reduce the reaction to an acceptable rate. Components added included chelating agents, diluents and pH buffers.

Physical separation of 2-me and butyric acid in Lucilure® B seemed the only way of preventing the reaction causing the loss in attractancy. The production of one bottle with two compartments appeared not to be feasible for technical and economic reasons. Thus it was necessary to package the new Lucilure® in three bottles.

The third component contained in the original Lucilure® B, indole, could be mixed with either of the two other components. The results from an accelerated stability study of the two possible new combinations and the original Lucilure® B at 50°C are given in Table 1.

Table 1. Composition of Lucilure® mixtures after heating to 50°C for 56 days.

Mixture	Composition (% of original concentration)		
	2-Mercaptoethanol	Butyric acid	Indole
Lucilure® B (original)	73%	67%	97%
2-Me/indole	98%	--	97%
Butyric acid/indole	--	98%	79%

Both two-component mixtures had better stability than the original, three-component Lucilure® B. The concentrations of both components in the 2-me/indole mixture stayed constant throughout the study, whereas the indole concentration was reduced by about 20 per cent in the butyric acid/indole mixture. Thus, indole is added to 2-me to form the new Lucilure® B and Lucilure® C is neat butyric acid.

Lucilure® A remained unchanged in the original 55 ml bottle. The new Lucilure® B and C were packaged in two 30 ml plastic bottles. The new bottles used the same wicks, inserts and lids as the original bottles. Different coloured lids and stripes on the labels were used to facilitate the distinction between Lucilure® B and C.

The three-bottle Lucilure® had to be compatible with the original Lucitrap®. For this purpose, a plastic bridge is provided with Lucilure®. The bridge is attached to the Lucitrap® top using two bottles (one of them being Lucilure® A) and it holds the third bottle next to, and at the same level as, the other bottles underneath the rain protected area of the trap (see Figure 1).

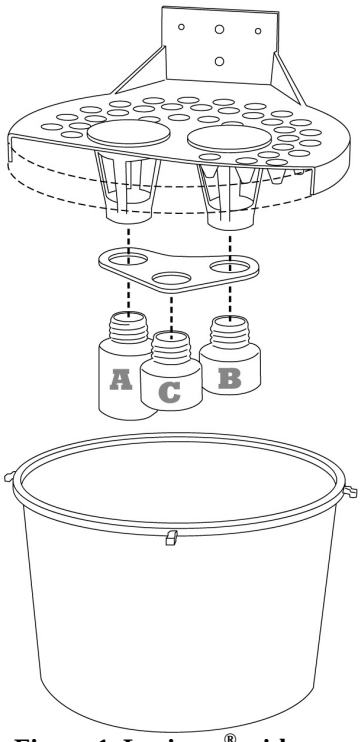

Figure 1. Lucitrap® with new Lucilure® dispensing system.

The efficacy of the original 2-bottle and the new 3-bottle Lucilure® were assessed in six separate duplicate 4x4 Latin square experiments, carried out in different climatic conditions and with wicks set at levels to provide equal total evaporation from both systems. The mean catches for the original and new Lucilure® systems were 63 and 56 *L. cuprina* per trap and period respectively over the six experiments, with no experiment showing a significant difference ($P>0.05$) between the two systems.

The original Lucitrap® bucket is produced from polypropylene incorporating an UV stabiliser. None of the plastic materials that could be used to manufacture a clear plastic bucket was a suitable replacement material because of their instability to the Lucilure® chemicals and/or UV light. A modified polypropylene polymer, which provides a more transparent bucket, was selected for the production of the new Lucitrap®. In a direct comparison experiment, the clearer bucket caught a mean (per trap and period) of 55 *L. cuprina* versus 49 flies for the original trap bucket (difference not significant, $P>0.05$).

Discussion

A physical separation of the two reacting components, 2-me and butyric acid, was required to eliminate the reaction which took place in the original Lucilure® B causing a loss in attractancy. The resulting 3-bottle system is more expensive to produce, uses somewhat more space and potentially

provides more opportunity for making errors when placing Lucilure® bottles in the trap. These disadvantages are compensated for by the preservation of Lucilure's® attractancy, a long shelf life and the opportunity for handling larger batches in the manufacture and transport of Lucilure®. The long shelf-life makes it possible to market Lucitrap® and Lucilure® via stock and station agents, which are reluctant to trade goods with a shelf life of four months. The use of larger batches in the manufacture and transport of Lucilure® will lower the costs of these processes, which may well more than compensate for the cost increases associated with the change to three bottles. The possibility for making errors when placing the lures in the traps has been minimised by clear colour-coding of lids and labels on the two small Lucilure® B and C bottles and unambiguous reference to these in the directions for use. It is imperative that one bottle each of Lucilure® A, B and C are placed in the Lucitrap® for it to be effective.

The reaction between 2-me and butyric acid at ambient temperature was not anticipated. It was even more surprising that the reaction lead to an appreciable loss in attractancy. Such reactions are known but usually only occur in the presence of a catalyst, such as mineral acid, enzyme, and/or at higher temperatures (>80^{o}C). Attempts to suppress any resident catalytic activity (such as from an impurity) with chelating agents, buffers and polar diluents failed to slow the reaction to an acceptable rate. The most likely explanation for this reaction is the particular chemical structure of 2-me (ie two functional groups on adjacent carbons).

The new Lucilures® B and C contain somewhat more attractant mixture (60 ml) in two smaller bottles compared to the original single bottle (55 ml) to compensate for the retention of mixture in the wicks. The amount of lure, which will evaporate at constant rate (which happens as long as there is some liquid in the bottle), is the same in the original and new systems. As the evaporation takes place from two wicks in the new system, the wicks are set at a lower height to achieve the same evaporation rate as in the original system. This is an advantage for colder areas, as it became sometimes difficult to achieve complete evaporation of bottle contents within three months. We have previously demonstrated that trap efficacy increases with increasing evaporation rate (Urech *et al.*, 1993).

Initially, the plastic Lucilure® bottles were packaged in cardboard boxes. To avoid residual smell from the package and to complement the two-year shelf life, Lucilure® bottles are now packaged in metal cans, which completely seal their contents.

Previous research had indicated that the *L. cuprina* catch in Lucitrap® was correlated with the amount of light inside the bucket. Presumably, the flies were more likely to progress through the entry cones into a brighter rather than a darker environment. The requirement for material stability towards the lure chemicals and UV light and commercial considerations ruled out plastic materials which could be used to produce clear buckets (ie PVC, perspex, polycarbonate). A modified polypropylene polymer became available which allowed the production of a bucket that had the same chemical and physical characteristics as the original bucket, but a higher light transmission. Although the new bucket is still not clear, it caught more *L. cuprina* than the original bucket, and checking the trap for flies and other objects, without having to remove the bucket, is facilitated.

Conclusion

Improvements to the Lucilure® and Lucitrap® have been made. They include a new 3-bottle Lucilure® with an extended shelf life of two years, odour-free packaging in metal cans and a new Lucitrap® bucket with increased light transparency. The new 3-bottle Lucilure®, which is registered by the NRA, is compatible with previously purchased traps. These improvements make this selective trapping system for the Australian sheep blowfly an even more attractive component of any control strategy for sheep blowflies.

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