CONTROL OF BLOWFLIES IN WHEELIE BINS USING ENVIROBLOX INSECTICIDAL BLOCKS

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DISCLAIMER

This report is not an endorsement or recommendation for the use of any of the products tested.
SYNOPSIS

In April 1992 the Darwin City Council approached the Medical Entomology Branch, Department of Health & Community Services to conduct a trial to determine the efficacy of Enviroblox insecticidal blocks against blowflies and their larvae in wheelie bins. These blocks consisted largely of napthalene with 2% permethrin. Initial trials indicated that the insecticidal activity of the blocks was not adequate for effective control (especially of larvae). A second batch of Enviroblox insecticidal blocks containing 10% dichlorvos with napthalene were tested against blowflies and their larvae. Under the trial conditions these blocks killed blowflies within half an hour and larvae within six hours. Shelltox Ministrips which contain 18.6% dichlorvos were found to kill blowflies and larvae as effectively as the insecticidal blocks. Larvae feeding on organic matter within plastic bags may be protected from the insecticide vapour in the bin air space. However once larvae escape from the bags to search for pupation sites or more food they are likely to come into contact with a lethal dose of insecticide. The report concludes that a trial of the blocks in household wheelie-bins in part of Darwin should be undertaken to confirm the trial results reported here.
1.0 BACKGROUND

The Medical Entomology Branch informed the Darwin City Council in 1991 that the Nambour Council was investigating the use of an insecticidal block in wheelie bins. The Darwin City Council followed this up with the Nambour Council.

In April 1992 the Darwin City Council (DCC) received some communication from Barry Lazarus of Enviroblox Pty Ltd regarding insecticidal blocks for the control of flies and maggots in wheelie bins. The Insecticidal blocks were to be placed in perforated holders heat-welded to the lid of the wheelie bin. Insecticide from the blocks evaporates into the bin space. The DCC subsequently had discussions with the Medical Entomology Branch (MEB) of the Department of Health & Community Services regarding the use of these blocks. The MEB recommended that the blocks should be tested under local conditions. The DCC requested the MEB to conduct tests on the efficacy of the insecticidal blocks.

The need to consider insecticidal blocks for fly and maggot control in wheelie bins has arisen because of some public concern that the level of blowflies present in the Darwin urban environment is too high. Some public opinion attributes an increase in the level of blowflies present in Darwin to the introduction of wheelie bins. The MEB in a report completed in November 1991 (Logan 1991) confirmed that wheelie bins can produce very large numbers of blowflies given suitable food waste that is inadequately packaged. This report details the trial work on the insecticidal blocks (hereafter referred to simply as blocks) carried out by the MEB in May and July 1992. The latter trial assessed the blocks in comparison with another commercially available preparation (Shelltox ministrip) that was thought to have a similar action.

2.0 AREA OF STUDY

Trials were carried out in a suburban backyard in Leanyer.

3.0 AIM OF STUDY

The trial work had as its single objective to test the efficacy of the blocks in killing blowfly larvae and adults in wheelie bins.

4.0 INVESTIGATION METHODS

4.1. Blowfly Culture

In order to have access to large numbers of larvae and adults of known species and age for trial work it was necessary to set up a culture of blowflies. Blowflies were captured in suburban Karama by using fly traps baited with Efekto fly trap bait. The flies captured were knocked down by cold and two species separated out. These species were the big blue blowfly Chrysomya megacephala and the smaller green blowfly Lucilia cuprina. Both species were selected because they are very common in the Darwin urban environment and readily breed in refuse in wheelie bins. From 200 to 250 blowflies of the same species but mixed sexes were put in cages measuring 30 cms x 30 cms x 30 cms. Blowflies were provided with sugar solution (10 - 20%) and mince meat to feed and lay eggs on. Two cages of L.cuprina and one of C.megacephala were maintained. The mince meat in each cage was checked twice daily for eggs which were removed and either reared or destroyed dependent on the need for larvae or...
adults for trials. If larvae were needed for trial work they were reared on mince. If adult flies were needed larvae were allowed to pupate in sand. The pupae were subsequently removed by sieving the sand and placed in containers ready for adult emergence.

4.2 First Formulation Block Trial Design

4.2.1 Block Characteristics

Enviroblox Pty Ltd initially provided four blocks to the DCC who subsequently passed them to the MEB. These blocks initially weighed approximately 50 grams and were made of 2% permethrin, 97% naphthalene and 1% synergists and releasing agents. Correspondence from Enviroblox Pty Ltd indicated that these blocks had shown an average knock-down time for both maggots and flies of twelve minutes. Later correspondence however stated that flies were killed within a thirty minute period but that maggots took up to twenty-four hours to be killed.

4.2.2 Block Weight Loss

Block weight loss was monitored by weighing each of four blocks kept in separate wheelie bins, at 1.00 pm each day for thirty-five consecutive days. Temperature in one bin was monitored by thermohygrograph.

4.2.3 Larval Trial I

Eight new wheelie bins were used in the larval trial. The bins were arranged in two lines of four approximately one metre apart from each other. Four of these bins had blocks placed in holders attached to their lids. The other four bins did not have blocks (control bins). Each bin was empty apart from a bucket containing 10 litres of moist soil. The soil was a platform for a single 400 ml plastic container with a gauze covering (to prevent larvae escaping). Within each container was a petri dish lid with 5 g of mince and twenty-five C. megacephala 2nd instar larvae. The containers were placed in bins at staggered intervals of approximately four minutes. This enabled the larvae to be checked thoroughly for mortality. Mortality in larvae was recorded as having occurred if they were not moving at all or moving very weakly.

Each container was exposed for six consecutive half hour periods with starting times ranging from 2.00pm - 2.30pm. Containers were checked again sixteen hours later. Temperature was monitored externally and in one of the bins by using thermohygrographs.

4.2.4 Adult Trial I

Four wheelie bins were used for the adult trial. Two of these bins contained the blacks in holders attached to the bin lids. The other two bins did not have blocks (control bins). A cage measuring 30cms x 30cms x 30cms containing 30 two day-old adult C. megacephala was placed in each bin at staggered intervals of approximately four minutes. Starting time for the trial was 2.00pm - 2.15pm. Each cage of adults was exposed for nine consecutive fifteen minute periods followed by two consecutive one hour periods. Between each period mortality was checked. Mortality was recorded as having occurred when no movement in adults was noticeable. Temperature was monitored in the two bins containing blocks by using thermohygrographs.
4.3 Second Formulation Block Trial Design

4.3.1 Block Characteristics

Following unpromising trial results with the first blacks trials were redesigned to allow longer exposure time. These designs were made superfluous because a second batch of blocks was formulated by Enviroblox Pty Ltd's chemical manufacturers. These blocks initially weighed approximately 50 grams and consisted of 10% dichlorvos, 88% napthalene and 2% synergists and releasing agents. Two batches of eight blocks were received by MEB.

4.3.2 Larval Trial II

Nine wheelie bins were used. Three bins had holders containing blocks of the second formulation, three bins contained a Shelltox Ministrip attached to the bin wall and three bins contained no insecticidal treatment (control bins). Bins were organised in three groups of three with approximately half a metre between each bin. Each bin contained a ten litre bucket of moist soil. In each bin was placed, at staggered intervals of approximately four minutes, two gauze-covered 400ml plastic containers. Both containers held a petri dish lid with five grams of mince. In one container there were 25 second instar L.cuprina larvae. In the other container there were 25 second instar C.megacephala larvae. The trial started between 8.20am and 8.52am. The containers in each bin were checked at two-hourly intervals until all larvae in the bins containing insecticide treatments were dead. Mortality was recorded as having occurred when larvae were no longer moving or moving very weakly. Temperatures in the bins were monitored by using multi-channel Squirrel data-loggers and thermohygrographs.

4.3.3 Adult Trial II

The design for the adult trial using a second formulation block was based on the larval trial design. There were three groups of three bins each with either a block in the lid, a Shelltox Ministrip or no insecticidal treatment (control bins). Into each bin at staggered intervals of approximately 3 minutes were placed gauze covered 400ml plastic containers with either 2-4 day-old C.megacephala adults or 2-3 day-old L.cuprina adults. Each container held about 25 adult flies. All bins contained two containers of L.cuprina and either one or two containers of C.megacephala. Containers in each bin were checked at half hour intervals until all adults in the bins with insecticide treatments were dead. Mortality was recorded as having occurred when adults showed no noticeable movement. The trial commenced between 10.20am - 10.45am when all bins were in full sun. Temperatures in the bins were monitored with multi-channel Squirrel data-loggers and the thermohygrographs.

4.3.4 Packaging Trial - Effect on Larval Mortality

Three bins were used to determine what impact packaging had on the rate of larval mortality. Each bin had either a block in the lid, a Shelltox Ministrip or no insecticidal treatment (control-bins). Two gauze covered 400ml containers of 25 third instar C.megacephala larvae were introduced to each of the three bins. Larvae were provided with 1.0 grams of mince on a petri dish lid within the container. One of each pair of containers was placed in a four-litre plastic ice-cream container and covered with...
roughly 35cms of loosely compacted grass cuttings. This container (without a lid) was put into a plastic supermarket bag tied by the handles as per household refuse disposal. Some gaps could be seen at the top of the bag.

The containers in each bin were checked for three consecutive two-hour periods after introduction around 10.30am. The containers were checked again after fifteen and a half hours. Mortality was recorded as having occurred according to criteria used in the previous larval trials described. Temperature was monitored by using a multichannel Squirrel data-logger.

5.0 RESULTS

5.1 First Formulation Block Trials

5.1.1 Block Weight Loss

Weight loss per twenty-four hour period in wheelie bins was monitored for four blocks for 35 consecutive days. Weight loss per day for one of the four blocks together with daily maximum and minimum temperatures recorded by thermohygrograph in the bin is given in figure 1. Weight loss for the remaining three blocks is not given because temperatures in the holding bins were not measured. Initial block weight varied by almost four grams. Differences in weight loss at the end of the 35 day period varied by up to 7.32 grams between blocks. No statistical analysis of differences in weight loss between blocks was carried out because of the lack of coincident temperature data. The initial ten days of weight loss measurement gave the most variable results with the mean coefficient of variation (C.V.) for this period being 32.2%. Weight loss from the 4 blocks over the next 10 days by contrast had a mean C.V. of 17.4%. The trend to more uniform weight loss per day can be seen in figure 1. According to these weight loss measurements, when bins were opened twice for very brief periods, blocks would last from 80-120 days. This period will vary dependent on temperature and frequency of bin use.

5.1.2 Larval Trial I

No mortality was recorded until larvae had been exposed for two and a half hours. A single dead larva was found in once control bin and in one of the bins containing a block. No further mortality was recorded until bins were checked sixteen hours after larvae had been introduced when one more larval in a bin containing a block was found dead. These results are given in table 1. Temperature was monitored in one of the bins containing a block using a thermohygrograph.

5.1.3 Adult Trial I

Mortality results for the bins containing blocks are given in figure 2. Mortality occurred in only one of the two bins with blocks. No mortality occurred in the control-bins throughout the period of the trial. Temperatures were measured in the bins with blocks by using thermohygrographs. Figure 2 indicates that temperatures in the bin in which mortality occurred were up to 10°C higher, during some periods of time, than in the second bin. According to figure 2, temperatures above 38°C are needed in the bin before the insecticide (permethrin) has reached a lethal concentration.
5.2 Second Formulation Block Trials

5.2.1 Larval Trial II

Results for the larval trial of the second formulation blocks are summarised in table 2. After two hours exposure to either the block or the Shelltox Ministrip, mortality of second instar *L. cuprina* larvae varied from around 50% to 100% in different bins. Mortality of second instar *C. megacephala* larvae also varied considerably between bins but was generally less than that of *L. cuprina* larvae in the same bin. Variability in mortality may have been partly a result of size differences between second instar larvae of both species. *C. megacephala* larvae were approximately 7mm in length whereas *L. cuprina* larvae were from 4mm -5mm in length. Variability in mortality may also have been contributed to by temperature differences between bins and by differences in larval activity between containers. Larvae searching for food, expose themselves to a much greater extent than feeding larvae, which usually are well buried in the food matter. There is probably inadequate replication to detect any statistically significant differences between block efficacy and Ministrip efficacy after two hours of exposure. After four hours of exposure most groups of larvae had suffered 100% mortality. Those few larvae surviving were dead by six hours of exposure. In the control bins there was no mortality until six hours. At this point a single *C. megacephala* larva was found dead.

5.2.2 Adult Trial II

Results for this trial are summarised in table 3. The rate of mortality was rapid with all flies exposed to either the blocks or Ministrip treatment dying within half an hour. There was a single mortality in one container of *C. megacephala* in a control bin. The percentage mortality in the control treatment in this trial of around 2% is of the same order as mortality in control treatments in other trials reported here.

5.2.3 Packaging Trial - Effect on Larval Mortality

The results of this trial, which was a supplement to the adult and larval trials, are given in table 4. Larval mortality in containers that sat exposed, as in the previous larval trials described, reached 100% after 6 hours of exposure. Although temperatures recorded in the bins reached high levels than in the larval trial of the second formulation block mortality of larvae after two and four hours was much lower in this trial. The difference might be attributed to the greater physiological age of larvae used in this trial. Table 4 indicates that the larvae in containers beneath a layer of damp grass cuttings and inside a plastic bag are not greatly affected by otherwise lethal concentrations of dichlorvos in the air space of the bin receptacle.

6.0 DISCUSSION

While the first formulation blocks were not tested extensively the trials indicated that the insecticidal activity of the blocks against adults and larvae was probably not great enough to prevent breeding within bins. In Adult trial I not all blowflies were killed and in Larval trial I mortality did not exceed 2%. If not all adults are killed some may lay eggs in wheelie-bin garbage. Any resulting larvae or larvae introduced to the bin with kitchen scraps will survive and may escape from the bin to produce further generations of adult flies. The initial results of
this test was conveyed to the DCC and Envirobloks. Envirobloks advised that they would redesign the blocks to rectify the observed inadequacies. By comparison with the first formulation blocks which contained permethrin, the second formulation blocks which contained dichlorvos were very effective. Under the trial conditions adults were killed within half an hour and larvae within six hours.

Shelltox Ministrips also killed within the same time frame. On the basis of these trial results it is not possible to determine any real difference in efficacy between the second formulation blocks and the Ministrips. It is important to note here that Shelltox Ministrips may not be registered for use in wheelie bins.

Dichlorvos, the insecticide present in both the Ministrips and the second formulation blocks is much more toxic than permethrin which was used in the first formulation blocks. For example the acute oral LD50 for rats is about 50 mg/kg for dichlorvos whereas it is 430 - >4000 mg/kg for permethrin. Some concern therefore could be raised regarding the effect on householders if the blocks are used in wheelie-bins. The dose of dichlorvos received when disposing of rubbish during an average day is however not likely to exceed the acceptable daily intake (Mike Thompson pers. comm.). Testing of dichlorvos concentrations at open bin lids may be needed to confirm this.

Once either blocks or ministrips are placed in bins, the vapour concentration of dichlorvos reaches a saturation point when vapour density and pressure no longer increase. At this point the concentration of insecticide in the bin air parcel will be at its greatest and probably most effective. Losses of dichlorvos vapour will occur from the top layers of the bin air parcel by diffusion when the bin lid is closed. (There is a perceptible odour near the bin when the lid is shut although this is not strong and does not deter flies from landing on the bin lid). Greater gas losses will occur if the bin lid is opened and air movement is created by introducing rubbish. The air parcel in the bin will become saturated with dichlorvos again some time after the bin lid is shut. The speed at which the saturation point is reached again is dependent on temperatures within the bin. The higher the temperature the shorter will be the period before saturation is reached. This means that best results from both blocks and mini-strips are likely to be obtained when wheelie bins receive the maximum amount of full sun per day. Provided that the bin lid is shut overnight, there should be minimal loss of vapour from the bin. This means that a lethal concentration of dichlorvos will remain in the bin overnight.

Dichlorvos is soluble in water at the rate of 10g per litre. This rate of solubility may provide some insecticidal activity when dichlorvos is absorbed in moist organic material. Dichlorvos vapour in the bin air space however is likely to provide the most insecticidal activity.

One concern regarding the efficacy of the second formulation blocks was how much protection packaging will afford larvae introduced to the bin. The amount of protection against insecticidal vapour will vary according to the porosity of the packaging material. In the small trial conducted as a preliminary test of the impact of packaging it appears that, at least, over 22.5 hours, plastic bags containing some organic matter protect larvae from the insecticide quite effectively. Once larvae reach the wandering stage however they are likely to be exposed to lethal doses of dichlorvos when escaping from the plastic bags.

These trials show that Shelltox ministrips and the second Envirobloxs insecticidal blocks are effective at killing blowflies and their larvae. However these results should be confirmed by running a trial in a section of suburban Darwin. This trial should involve introducing blocks to bins in a suburb such as Karama, where some data on blowfly incidence is available, and
checking for larvae in bins over a number of weeks. At the same time there should be a check of bins in an adjacent suburban area to act as a control.

7.0 SUMMARY

1. Enviroblox Insecticidal blocks of the First formulation containing permethrin were inadequate to prevent fly breeding within wheelie bins. The blocks failed to kill significant numbers of larvae.

2. A second batch of blocks containing dichlorvos, called Second formulation blocks, were much more effective at killing adult blowflies and larvae than the first formulation blocks. Shelltox Ministrips, which were used as a comparison, were equally as effective as the second formulation blocks against adult blowflies and larvae.

3. When larvae are enclosed in moist organic material within plastic bags they are protected from the lethal concentration of insecticide vapour in the bin airspace at least for about 1 day. However when larvae escape to search for a pupation site or for more food they are likely to expose themselves to lethal levels of insecticide vapour.

4. The best results from blacks or ministrips will be obtained if the wheelie bin receives full sun during the day. Full sun increases the temperatures within the wheelie bin which in turn results in greater vapour production from blocks and ministrips.

5. To confirm these results a trial in part of Darwin should be considered. This should involve introducing blocks to a certain area and checking for larvae over a number of weeks. A check should be made for larvae in bins without blocks to act as a control.

8.0 REFERENCES


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