Appendix 1 - Fly Control Manual

FLY CONTROL IN LAYER SHEDS - AN INTEGRATED APPROACH

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Integrated Control of Flies in Layer Sheds

Overview

Manure associated with layer facilities provides an abundant food source and ideal habitat for fly breeding. Controlling flies on poultry farms has always been a concern, but these concerns have grown in recent years because:

- Increasing urban encroachment into areas where poultry farms have traditionally been located has increased the likelihood of neighbour complaints. This can result in poor community relations and, in severe instances, may lead to actions under public health laws. Unfortunately, as urbanisation and non-farm rural living increases pressure on intensive livestock facilities to reduce fly populations will also increase.

- Flies can transmit or act as a reservoir for more than 100 animal and human disease organisms. These include viruses, bacteria, protozoa, fungi and the eggs of worm parasites. The propensity of flies to disperse amongst farms makes them a significant and frequently overlooked biosecurity risk. Pathogens that may be carried by flies include agents of health and food safety concern such as *Salmonella spp.*, *Campylobacter spp.* and *E. coli,* and poultry diseases such as Newcastle disease, Avian influenza and poultry tapeworms.

- Flies in layer houses cause annoyance to workers and fly spot contamination of buildings, lighting, equipment and eggs. Occupational health and safety issues can arise where continued use of pesticides is required for control. Anecdotal reports suggest that flies may annoy poultry, making them irritable and leading to an increase in feather pecking and cannibalism.

In the past control of flies in poultry houses has relied heavily on the use of pesticides. Now, with the development of resistance to many pesticides and a general increase in sensitivity to the use of chemicals there is growing adoption of integrated (IPM) methods of control. An IPM approach recognises that flies cannot be eliminated and uses a combination of physical, cultural, biological and chemical methods to reduce numbers of flies to an acceptable level. The level of flies that is ‘acceptable’ will vary between farms and will be influenced in particular by proximity to residential areas or other businesses.

The elements of a good IPM program are outlined below and described in more detail in further fact sheets in this series. It will not be possible or even appropriate to incorporate all elements into a fly control program on every property. Programs will need to be tailored to fit the particular circumstances and production requirements of each individual farm.

Elements of an IPM programme

Monitoring fly numbers

- Monitor fly numbers at least weekly and keep records of population counts
- White spot cards, sticky tapes, fly traps or a visual scoring system should be used

Moisture control

- Regularly check for and repair broken waterers and leaking pipes
- Provide maximum ventilation over manure to aid rapid drying

- Divert surface water and provide proper grading and drainage from manure accumulation areas

Manure management

- Clean out manure in low fly periods, if possible
- At cleanout leave a pad of manure to preserve predators and parasites, aid drying of new manure and avoid eroding floors to below the surrounding ground level
- Prevent flies breeding in manure after cleanout – both in temporary storage areas and when manure is applied to soil as a fertiliser

Enhance populations of natural biocontrol agents

- Keep manure dry (see above)
- Avoid killing predators and parasites by inappropriate spraying
- At cleanout leave a pad of manure as a reservoir for predators and parasites

Sanitation

- Clean up spilled feed
- Remove broken eggs and dead birds daily
- Clear vegetation from around houses to facilitate airflow and remove fly resting sites

Use insecticides selectively

Adulticides to kill flies

- Use surface sprays when monitoring indicates fly numbers are building or at times of the year when flies regularly become a problem
- Treat surfaces where large numbers of flies rest
- Rotate insecticide groups
- An ongoing baiting program can help suppress flies
- Use fogging or misting for rapid knock down of high fly populations

Larvicides to treat manure

- Use only products containing cyromazine (Neporex®, Larvadex®)
- If problem sites with high maggot numbers can be identified, use a spot treatment
- Strategically time manure treatments for problem periods
- Use feed additives (Larvadex®) for periods of 4-6 weeks and then discontinue use for a similar period, or until maggots are again seen in manure
- Avoid spraying or contaminating manure with other chemicals

A more detailed discussion of the different components of a well structured program and the biology of the problem flies are contained in further fact sheets in this series.

Flies that breed on egg farms

Well structured IPM programs attempt to identify the key factors that regulate fly populations and to manipulate them to keep fly numbers low. A good understanding of the biology of the flies is key to the development of sound programs. This fact sheet describes the life cycle of the main problem flies that breed in layer sheds and discusses the factors that determine abundance.

Figure 1: The main problem species of flies breeding in layer sheds in Australia

***Muscina stabulans*,**
(False stable fly)

Musca domestica
(Housefly)

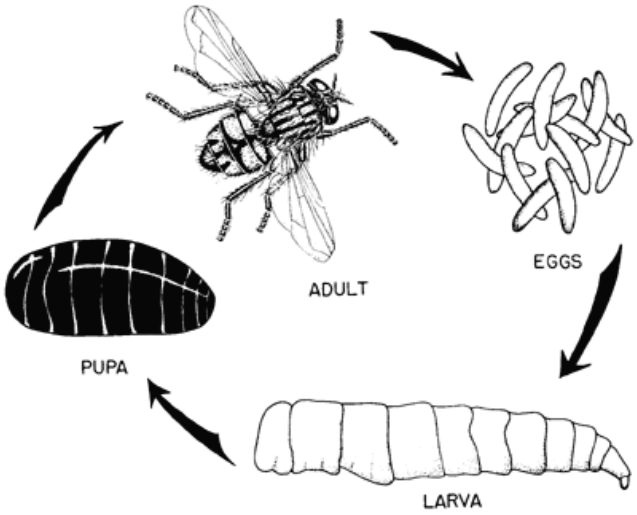
Fannia canicularis
(Little housefly)

The life history of flies

The three species of flies that are of main concern in Australian poultry facilities are the little housefly, (*Fannia canicularis*) the common housefly (*Musca domestica*) and the false stable fly (*Muscina stabulans*). Other species also breed in poultry manure and may occasionally reach significant numbers but are generally not a problem. Knowing which fly species are present is important when determining control strategies. The major species of concern overseas is the housefly, but in Australia studies suggest that in many areas the little housefly and false stable fly are more important.

The life cycles of the three main problem species are similar. All undergo four stages – egg, maggot, pupa and adult. The female fly deposits her eggs in cracks and crevices in the surface of the manure. These hatch to maggots or larvae, which feed in areas of the manure with a suitable moisture content. The larvae undergo three moults and when fully developed, seek a drier site and begin to form the toughened outer puparium (cocoon). The adult fly develops within the puparium and hatches after a period of time determined mainly by temperature and the species of fly. The life cycle of the housefly is shown in Figure 2 as an example. The other species are considered in more detail below.

Figure 2. Life cycle of the housefly



Housefly (*Musca domestica*)

By far the most studied of flies breeding on poultry farms is the housefly. This is the major pest associated with poultry farms overseas, and probably in some parts of Australia. In the southern states of Australia houseflies are most numerous in the period from mid-summer to autumn, whereas in Queensland they may be the most abundant species year round. The life cycle of the fly is shown above. Development from egg to adult can take as little as 7 days at 35°C or up to 22 days at 20°C.

Eggs – The fly mates and begins laying eggs 1-2 days after emergence. The eggs are deposited in masses of 75-200 with the number of eggs depending on the size of the fly. Each egg is about 1 mm long, white and 'sausage shaped'. Given suitable conditions, most eggs hatch in 8 to 24 hours.

Larvae – Maggots of the housefly are white and cylindrical with the rear end broad and flattened and tapering to a point towards the front (Figure 2). On the blunt back end there is a pair of spiracles or breathing apertures. These are characteristic in form and can be used to identify the larvae (Figure 7). The larvae have three stages, which can be completed in as little as 3 to 4 days at 35°C but can take up to 25 days at 15°C. The third stage larvae grow to approximately 12mm in length.

Pupae – Late third stage maggots usually migrate into lighter and drier areas to pupate. The pupae are cylindrical, dark reddish-brown and 6-8mm long (Figure 2). The adult fly may hatch from the pupa in as little as 3 days at 35°C but can take up to 21 days at 15°C. The larvae will not pupate at temperatures below 10°C.

Adult – The adult housefly is 6-7mm long, grey in colour with four longitudinal stripes on the thorax (section behind the head) (Figure 1). Houseflies have a number of characteristics that make them excellent disease vectors. They have sponging mouthparts and feed by regurgitating saliva to moisten and liquefy food and then sucking up the food and saliva mixture. The lighter coloured 'fly spots' left by flies result from regurgitation during feeding or while resting whereas the darker coloured spots are faecal spots. Disease organisms are

spread to food or resting surfaces during feeding or defaecation. Pathogens can also be spread physically on fly mouthparts, leg and body hairs, or on the sticky pads of flies' feet.

Adult flies live an average of 3 to 4 weeks, but can live up to twice this long. During this period they deposit up to 6 batches of eggs. They are most active at temperatures of 30-35°C and become inactive when temperatures fall, for example, at night. At these times they rest on walls, posts, ceilings or any other convenient surface. Preferred resting spots can often be detected by an accumulation of fly spots and these places are often good sites for the application of surface sprays. Most flies remain within 1-3 km of their place of origin throughout their life, but some can move much further and dispersal distances of 15-30 km have been recorded.

Houseflies produce a sex and aggregation pheromone called (z)-9-tricosene or muscalure, which is used as an attractant in many chemical fly baits. This attractant works mainly with houseflies and baits containing it do not work as well with other fly species.

Little house fly (*Fannia cannicularis*)

Fannia is a slightly smaller, lighter bodied fly than the common house fly (5-6mm long), dark grey in colour with three indistinct stripes on the thorax (Figures 1, 3). *Fannia cannicularis* is by far the main species, but two other species of *Fannia*, *F. scalaris* and *F. femoralis* can occur from time to time. The main characteristic that makes *Fannia* instantly recognisable is the tendency for the male flies to hover or fly slowly in small circles in poultry sheds or in shaded and protected areas outside of the sheds. The females are less active and are more often found near the manure or other breeding sites. When at rest the *Fannia* overlap their wings giving a more 'V' shaped wing outline than houseflies (Figure 1)

Figure 3 – Fannia, side view

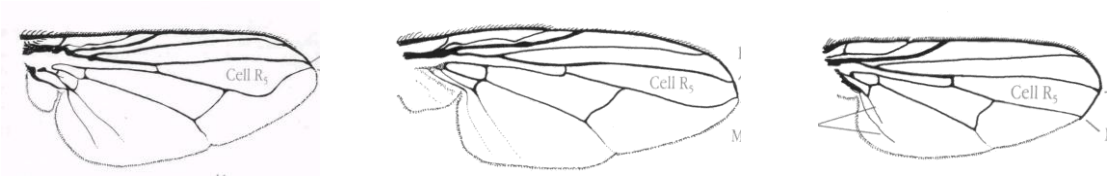
Fannia tend to be more common at cooler temperatures than the housefly and are most likely to reach high numbers in spring and early summer. However *Fannia* breed throughout the winter in many areas and the winter breeding population forms the base for the spring fly explosion. Larval development is inhibited at temperatures above 27-30°C and numbers of *Fannia* usually fall during midsummer.

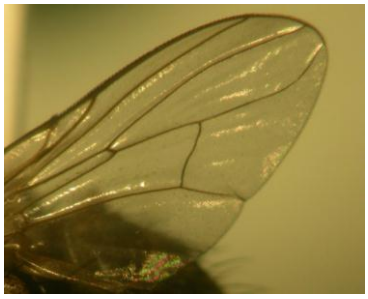
Fannia is able to breed in drier manure than houseflies. Whereas houseflies prefer a moisture content of 60-75%, *Fannia* will oviposit in manure with moisture content of 55-60% and larvae can complete development with moisture content of less than 50%. The lifecycle generally takes longer to complete than the housefly, and development from egg to adult typically takes 18- 22 days, but may take 30-40 days in cool conditions.

Figure 4. *Fannia* maggots above and *Muscina* larva below.

Fannia eggs are about 2 mm in length, white, slightly flattened and with wing-like processes. The larvae are very different in appearance to those of the housefly with a somewhat flattened form with spiny processes on the sides and back (Figure 4). The first instar larvae are about 1.5 mm long and white, the second instar about 3 mm long with a little more black coloration and the mature larvae 5-8 mm long with a light brown body and black head. They are very difficult to see in the manure and can easily be missed. The pupae resemble the third stage larvae in appearance, with similar spiny processes, but are darker in colour with toughened outer skin.

Figure 5: Wing venation in housefly (left), *Muscina* (middle) and *Fannia* (right) with a photograph of a Muscina wing below. The vein below Cell R5 has a strong bend in houseflies, is slightly bent in *Muscin*a and is not at all in *Fannia*





False stable fly (*Muscina stabulans*)

Muscina is larger and more robust than the common housefly but is also dark grey in colour with four dark stripes on the thorax. However, the rear lobe of the thorax is tan in colour and the legs are orange or cinnamon coloured whereas those of the housefly are dark or almost black (Figure 6). The three species of flies can also be distinguished be the pattern of veins near the tip of the wings (Figure 5).

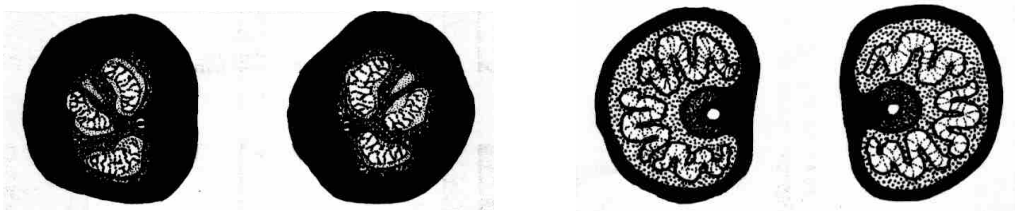
Figure 6: *Muscina stabulans* showing tan colour of rear lobe of thorax.

Eggs of *Muscina* take 11-18 hours to hatch and the larvae, although similar in shape to the housefly, are larger. Maggots can grow up to 14mm and can be distinguished from housefly larvae by the shape of the rear spiracles (Figure 7).

Third stage *Muscina* larvae will sometimes feed on the larvae of the other fly species. However, this predation is limited and probably does not have a significant effect on the numbers of other flies. The pupal stage of *Muscina* takes about 14 days.

Muscina also breeds in cooler conditions than the houseflies and takes longer to complete its life cycle. The time for development from egg to adult ranges from about to 13 days at 26°C to 40 days at 16°C. As with *Fannia*, larval development seems to be inhibited at temperatures above 27°C-30°C and numbers drop during summer. In studies in NSW *Muscina* was the main problem species on poultry farms during peak fly numbers in spring.

Figure 7: Location of spiracles (above) and appearance of spiracles when examined under a microscope (below). (*Muscina* left and housefly right)



Muscina **Housefly**

Other species

A number of other species can be found in poultry sheds from time to time, but generally do not reach high numbers in Australia. These include:

Black carrion or garbage flies (*Hydrotaea spp*.) and these are shiny black and about two thirds the size of a housefly, but with similar breeding habits. Occasionally numbers of this species reach problem levels.

American Soldier Fly (*Hermetia illucens*). This fly is blue black, about 2 cm long and distinctively different in appearance from the other common flies. Large numbers of soldier fly maggots can cause manure to liquefy and cones to collapse.

Stable flies (*Stomoxys calcitrans*). These flies are similar in appearance to houseflies except that they have very obvious biting mouthparts that protrude forward when they are resting and they have a pattern of dark spots on their abdomen. They can impart a painful bite and cause significant annoyance to both humans and animals. Stable flies do not often breed in poultry sheds in Australia. However, they have caused severe problems in Western Australia by breeding in poultry litter from broiler sheds applied as a fertiliser for horticultural crops and turf production.

Blowflies: (Mainly *Calliphor*a, *Lucilia* or *Chrysomya* spp.). These are large brownish or metallic green or blue flies, which usually breed in carcases of dead birds, or in areas where there are accumulations of broken eggs

Small dung flies (mainly in the family Sphaeroceridae). These are very small black or brown flies only a few mm long that are nearly always present near the manure but which do not disperse far and are not of any concern.

Factors affecting abundance

Flies have a relatively short lifespan and can quickly build to high numbers. For example, given ideal conditions one housefly could multiply to more than 25 billion within 8 weeks. This rate of multiplication is seldom realised because of environmental and biological factors that suppress fly breeding.

Factors that influence fly abundance include:

Moisture: One of the major factors determining suitability of the manure for fly breeding is moisture content. Fresh poultry manure usually has moisture content of 75%-80%. House flies prefer moisture contents of 60%-75% whereas the little housefly will oviposit in manure somewhat drier than this. If the manure to dries out rapidly and is kept dry it will form peaked cones and only a relatively small amount of freshly deposited manure will be suitable for fly breeding. If however the manure is very moist, or is kept wet by leaking waterers, broken pipes, drainage water from outside or wet droppings there will be a much greater mass of manure suitable for fly breeding and fly numbers will reach high levels.

Temperature: Temperature affects the rate at which flies can complete their life cycle and the rate at which fly numbers increase. Decomposing organic matter generates its own heat and the manure in which the flies are breeding may actually be much warmer than

ambient temperature. Houseflies do best at high temperature whereas *Fannia* and *Muscina* prefer more moderate Spring and Autumn temperatures.

Season: The major peaks of fly breeding in southern Australia seem to be in Spring and, to a lesser extent, Autumn. These are the times when favourable temperatures and high moisture conditions coincide. However, conditions may become suitable and fly numbers can build to high numbers at any time of the year. Different species prefer different conditions and tend to be most active at different times. *Fannia* will breed more efficiently during cooler periods than the other species and is usually the main species responsible for high fly numbers in winter. *Muscina* seems to be most abundant in Spring whereas in southern Australia the greatest numbers of house flies occur during the summer and autumn. In subtropical areas houseflies may be the most important species year round.

Presence of other breeding media: Broken eggs, feed spills and dead birds also provide rich substrates for fly breeding. They should be prevented or cleaned up promptly when they occur.

Predators and parasites: There is a whole fauna of insects and mites that breed in poultry manure and utilise the manure dwelling stages of flies as a food source. Various species of mites and beetles feed on fly eggs and maggots. Very small parasitic wasps deposit their eggs in fly pupae where the growing wasp larvae feed on and eventually kill the developing fly. Predators and parasites can have a significant effect in regulating fly numbers and mass releases of artificially reared parasitoids are used as part of integrated control programs on some overseas poultry farms. Part of the reason that fly numbers often reach high levels 4-6 weeks after manure clean out is that the flies repopulate the manure more quickly than the beneficial organisms and can breed freely until the predators and parasites "catch up".

Integrated pest management programs aim to manipulate the factors that regulate fly numbers so that, together with the strategic use of chemical controls, fly numbers are kept to acceptable levels. Further fact sheets in this series discuss the elements of IPM programs for layer sheds.

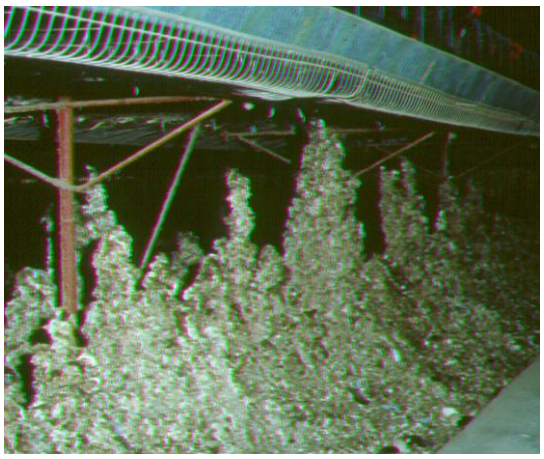
Physical and Cultural Fly Controls for Egg Farms

Many locations in layer houses provide ideal conditions for fly breeding. These include moist manure, sites of spilled feed, broken eggs and dead birds. Areas where manure is piled temporarily outside of sheds following cleanout can also breed large numbers of flies.

The three major aims of cultural controls are to:

- keep the manure dry,
- remove breeding sites
- provide optimal conditions for fly predators and parasitoids.

Figure 1: If the manure is kept dry it will form peaked cones (below) with minimal amounts of manure suitable for fly breeding



A well structured fly control program should contain the following elements:

1. Prevent wetting of manure

- *Regularly inspect the manure for any wet or damp patches and ascertain the source of moisture*. Manure drying systems will be rendered ineffective if the dried manure is continually re-wetted.

- *Regularly check for and fix leaking waterers and broken pipes.* This should be done daily. Leaking waterers are a major reason for wet manure and even a small leak will provide enough moisture to create a large fly breeding zone

- *Ensure that leaking roofs or gutters do not channel water into the shed*

- *Install and maintain appropriate drains and banks to divert surface runoff.* Manure accumulations inside the house and temporary manure storage areas outside should be protected. Diverting drainage water will be particularly important where repeated manure cleanouts have made the floor lower than surrounding areas. It may be necessary to add filler to an eroded floor to raise it above the outside level and prevent the accumulation of water.

- *Ensure adequate ventilation in bird housing areas* to remove the large amounts of moisture generated by the birds

- *Avoid wet droppings.* Production of wet droppings by layers will increase suitability for fly breeding as well as cause dirty eggs and cages and result in other shed-related hygiene issues. For a discussion of causes and solutions to the problem of wet droppings see AECL report UNE-55A (http://www.aecl.org/r&d/reports/index.html)

2. Promote rapid drying of manure:

Moist manure is highly attractive to adult flies, provides ideal conditions for egg laying and maggot growth and is the principal site of fly breeding. Keeping the manure as dry as possible reduces suitability for flies while providing optimal conditions for fly predators and parasites. Fresh poultry manure usually has moisture content of 75%-80%. If moisture in the manure beneath cages can be kept below 50%, fly build up will be minimised. When dry conditions are maintained the manure will form cone shaped peaks and only the recently deposited droppings will be suitable for fly breeding.

To maximise the rate of manure drying ensure maximum airflow over the manure:

- *Clear or mow vegetation around sheds* to allow unimpeded airflow. This also removes resting places for the flies
- *Check manure deflectors, scrapers and drying systems regularly* to ensure that they are operating efficiently
- *At cleanout leave a pad of old manure.* This enhances drying by providing an absorbent base and exposing newly deposited manure to airflow
- *Fans in manure accumulation areas can increase the rate of drying*
- *In shed composting* is used in some large overseas poultry sheds. The manure is mechanically turned twice weekly to aerate and dry. Although this can successfully prevent fly breeding it is labour intensive, can produce high concentrations of ammonia. Because beneficial insects are killed, it can also result in fly outbreaks if regular manure turning is stopped.

3. Remove fly breeding sites

- *Check for sites of manure accumulation and rectify where possible*. Pockets of manure can contribute significantly to fly numbers. Some common sites include on the top of rafters, on cage supports, on manure deflectors, and in areas missed by scrapers or other mechanical manure removal systems.

- *Prevent accumulations of broken eggs.* These can be rich sources of fly breeding. Place trays, bins or other collection receptacles at sites under egg collectors and in egg rooms where broken eggs accumulate and empty them regularly.

- *Prevent and promptly remove spilled feed.* Feed spills can be a significant source of fly breeding, especially if they become wet.

- *Promptly remove dead birds and exposed garbage or food scraps.* These can provide protein for fly egg laying and a focus for disease spread. Dead birds should be placed in fly proof bins, burned or composted.

Figure 2: Accumulations of broken eggs under egg collectors or at other sites as pictured below provide highly favourable conditions for fly breeding

4. Structured manure cleanout

Two extremes of manure management exist in layer sheds – frequent or daily removal with some automated systems and long-term accumulation of manure with periodic removal, usually at 12 month or longer intervals. With the first, the aim is to completely remove breeding media, whereas in the second and more common situation a management program must be instituted to control fly breeding.

Interestingly, studies have shown that when manure is allowed to accumulate there is an inverse relationship between the amount of manure present and fly numbers. Over time a fauna of predators and parasites that feed on the immature stages of flies build up in the manure and act to keep fly numbers down. Very often major fly outbreaks occur in the 2-8 week period after manure clean out. This is partly because the flies can breed more quickly than most of the predators and parasites and fly numbers increase until the predators and parasites can 'catch up'.

Often manure clean out coincides with the introduction of new birds. New birds can have wetter droppings, which also contributes to the problem.

To prevent high fly numbers following clean out the following points should be observed:

- *Leave a pad of dry manure at cleanout* - Leaving a pad of manure has four effects:
    - *Promotes rapid drying* by elevating newly deposited manure and exposing it to air movement. This benefit is most marked in summer
    - *Leaves a dry base which absorbs moisture* from freshly deposited manure
    - *Retains predators and parasitoids* that can feed on freshly deposited fly eggs and newly hatched maggots.
    - *Prevents erosion of the shed floor*. Continual complete cleanout can gradually wear away the floor so that it is lower than the surrounding area. Water will

accumulate keeping the manure wet and providing ideal conditions for fly breeding.

- *Schedule manure clean out for times of low fly numbers*. The best time will depend on location. It may be in mid winter when it is too cold for flies, or in mid-summer in regions where the summers are hot and dry.

5. Prevent fly breeding in temporary manure storage and disposal areas

Manure is sometimes temporarily stored outside of layer sheds or spread as fertiliser for pastures and crops. This manure can also be a significant source of flies. Methods to reduce fly breeding in manure piles and spread manure include:

- *Choose a well drained site and divert surface drainage away from manure piles*
- *Protect from wetting by rain*
- *Cover manure piles with black plastic.* This will keep the manure dry, cause temperatures to become too high for fly breeding and reduce access to the flies. Bricks or lengths of poly pipe filled with sand can be used to hold black plastic in place.
- *Composting.* If there is a ready market for composted manure and a ready carbon source for mixing with the manure, composting may be an option. Composting raises the temperature of the manure to levels lethal to flies, reduces moisture below levels where flies can breed and reduces nutritional suitability of the manure for fly breeding.
- *Spread the manure during periods when drying occurs quickly or when fly numbers are low*. Studies in the US have shown that poultry manure used as fertiliser can continue to be a source of flies, even when the manure has been cultivated into the soil. Use of poultry litter as fertiliser for vegetable and turf production was responsible for epidemic levels of house flies and stable flies on the Swan coastal plain in Western Australia.

6. Design new facilities with fly control in mind:

- *Locate new facilities on well drained sites and away from residential and commercial areas*
- *Facilitate maximum airflow over accumulated manure*
- *Elevate the shed floor above the surrounding ground surface and grade to facilitate drainage away from the house*
- *Consider the installations of scrapers, manure driers and automated manure removal systems*
- *A concrete base in manure areas prevents erosion of floors, facilitates drainage and aids clean out*

- *Fans that draw air over the manure pit will facilitate drying*

- *Be aware of local council regulations and bylaws*

6. Fly traps

There are a number of designs of fly traps on the market that contain fly attractants and feeding stimulants mixed with toxic baits. These traps are discussed in the fact sheet on chemical controls. A number of non-chemical means are also available. These include electrocuting black light traps, sticky traps and traps where the flies are killed by drowning, dehydration or solar heating. Fly tapes and sticky ribbons can also be considered a form of trap. Traps can catch significant numbers of flies and assist in keeping fly numbers down when good manure management practices are in place. However, under fly outbreak conditions they will seldom have a significant effect. Placement of traps is extremely important in determining the number of flies that are caught.

Biological control of flies in layer sheds

Accumulations of manure support a complex fauna of insects and mites in addition to the immature stages of flies. Fly eggs and maggots are used as food by a variety of beneficial organisms. Given favourable conditions predators and parasites can eliminate up to 50%-80% of the fly population and play a key role in keeping fly numbers under control. Biocontrol is an extremely important part of any integrated fly control program. Although it is possible to augment natural populations by release of artificially reared predators and parasites, in most Australian layer sheds, biocontrol will consist primarily of enhancing naturally occurring populations. Fortunately, the conditions that favour the beneficial organisms are also the ones that are most unfavourable for fly breeding

Fly predators

A number of beetles and mites feed on fly eggs and small newly hatched maggots.

Carcinops pumilio, also known as the hister beetle, is a small black beetle, approx 3 mm long, which can reach high numbers in undisturbed accumulations of manure. The adult stages of this beetle can consume 13 – 24 fly eggs per day and will also feed on newly hatched maggots. *Carcinops* larvae also eat 2-3 eggs per day. The life cycle of *Carcinops* is relatively slow and it can take 12-16 weeks after manure clean out to rebuild to maximum levels. However, after this time, high numbers of beetles will persist and the beetle will play an important part in controlling fly numbers until the next manure clean out.

Figure 1: The hister beetle, *Carcinops pumilio*. This beetle feeds on fly eggs and young maggots

There are also number of species of mites in the families Macrochelidae, Parasitidae and Uropidae that will feed on fly eggs and larvae. Each mite can consume up to 20 eggs per day. These mites are small, generally reddish brown in colour and the later stages and adults have eight legs. They can become extremely numerous in the manure and have a significant effect in regulating fly numbers.

The different species of mites have different life histories, different feeding habits and often reach peak breeding numbers after different periods of time. Some species feed predominantly on eggs and are most numerous in the outermost layers of the manure where the fly eggs are deposited. Other species feed mainly on the larvae and are found slightly deeper down in the manure. Manure breeding mites are often seen attached to beetles or flies. These mites are phoretic or simply 'hitching a ride' to a new breeding site.

Figure 2: Predacious mites that feed on fly eggs and young maggots

Mites that feed on fly eggs and larvae are completely different to the northern fowl mites and poultry red mites that infest hens. Manure breeding mites will not infest hens and northern fowl mites and red mites are seldom found in manure.

There are also a number of other species of fly predators, including other types of beetles, spiders, earwigs and minute pirate bugs. Certain species of fly maggots also feed on nuisance fly larvae. However, *Carcinops* beetles and predacious mites are by far the most important in most circumstances.

Fly parasites

A number of species of very small parasitic wasps lay their eggs in the fly pupae. These wasps are generally very small, about the 2-3mm long, stingless and should be distinguished from the much larger European wasp and other groups of stinging and nest building wasps. They are specific to nuisance flies and do not attack other insects. The main genera of pupal parasites that are active in poultry sheds are *Spalangia*, *Muscidifurax*, *Pachycrepoideus* and *Nasonia*.

The female wasps search out fly pupae in the manure, pierce the outer toughened layer of the pupal case and lay their eggs in the developing pupa. (Figure 3) Some species are quite specific in laying only one egg per pupae whereas others will lay up to eight. The wasp eggs hatch within the puparium and go through 3 stages, feeding on the tissue of the host fly and killing it in the process. After they have finished feeding the adult cuts its way out of the pupal case and hatches as an adult wasp. The wasps also puncture the pupal case to feed. This damages the pupa and most pupae damaged by wasp feeding also fail to develop into adult flies. Parasitism rates of up to 40% have been noted under extremely favourable conditions.

Figure 3: A female wasp laying her eggs in a fly pupa (left) and parasitised fly pupae showing holes where the young wasps have emerged (right). No flies will hatch from these pupae.

One species of parasitoid (*Tachineaphagus*) lays its eggs in late stage maggots rather than in the pupa. Parasitised fly maggots are not immediately killed but continue to develop into pupae. The parasite then feeds on the pupal tissues, killing the fly in the process and hatches in a similar way to the pupal parasitoids described above. This species appears to be most active at cool times of the year and has been found in high density during winter on some southern Australian egg farms.

Preserving and enhancing native predators and parasites

Achieving good biocontrol in Australian poultry sheds consists primarily of providing the most favourable conditions to enable the beneficial organisms to exert their effect. Ways to enhance the activity of beneficial insects and mites include:

- *Keep the manure dry:* Well managed dry manure, characterised by coned peaks, is most favourable for the beneficial insects and mites. If the manure is too wet parasitoids have difficulty in finding and ovipositing in fly pupae or larvae.

- *Leave a pad of manure at clean out*. Complete clean out will also remove all of the predators and parasites. As the flies breed up more quickly, complete clean out is typically followed by a fly outbreak 4-6 weeks later. Leaving a 10-20 cm pad of manure will preserve a portion of the beneficial organisms as well as facilitating drying of the newly deposited droppings.

- *Avoid chemical treatment of the manure.* Most (but not all) pesticides that kill flies will also kill predators and parasites. As the flies breed more quickly than the predators and parasites, a chemical spray that kills the beneficial insects and mites is often followed by a fly outbreak some weeks later. In addition, high volume sprays, necessary for good insecticide penetration add moisture to the manure. If problem areas for fly breeding can be identified use a spot spray of problem sites rather than treating all of the manure.

- *If a manure treatment is necessary, use cyromazine* (Neporex® or Larvadex®). These chemicals kill flies but have little effect on the beneficial organisms.

- *When using surface treatments avoid wetting the manure*: Use a course droplet spray or paint on residual treatments. Course droplets are less likely to drift onto the

manure, unintentionally killing predators and parasites. Sprays or baits applied to walkways can contaminate the manure and kill beneficial organisms.

Augmenting natural populations of predators and parasites

Large numbers of *Carcinops* beetles can often be collected using black lights with pitfall traps positioned beneath them. The beetles are attracted to the lights, fall into the traps and can later be released to recently cleaned out sheds to assist rapid build up in predator beetle numbers. As *Carcinops* can carry several poultry diseases, beetles should not be transferred between farms or from sheds with known disease problems.

Fly parasitoids are available commercially overseas and artificial releases of biocontrol agents are used as part of control programs on many commercial egg farms. The main genera reared commercially for this use are *Spalangia* and *Muscidifurax*. Released parasites must be adapted to local conditions to gain good effect. Most recommendations stress the importance of using cultural methods to keep the manure dry in order to obtain maximum benefit from the released parasitoids. At the moment there are no commercial facilities in Australia providing these organisms, although a number of companies are currently assessing the likely market.

Monitoring fly numbers - an essential part of a fly control program

A structured monitoring and recording system is an essential part of any good fly control program on egg farms. A uniform consistent method of monitoring, carried out regularly through the fly season will provide a measure of changes in fly numbers that is far superior to subjective, often misleading impressions.

Regular monitoring allows a producer to promptly detect rising fly numbers and to spray or institute other control procedures before flies reach problem levels. A written record of monitoring results is critical to planning the most efficient program and may be important in providing documentation of fly numbers when responding to complaints.

Good monitoring records will:

- *Enable early treatment of increasing fly populations*. This will:
    - *Give better control* - Once high numbers of adult flies are seen there will also be a large number of developing flies present in the manure as eggs, maggots and pupae . Early treatment will reduce the chance of flies numbers increasing above tolerable levels and decrease the number of sprays required to bring the problem under control.
    - *Prevent trouble with neighbours* – spraying on the farm may have little effect on fly numbers on surrounding properties for a number of weeks if flies have already dispersed. This appears to be particularly so where *Fannia* is the main problem.
- *Assist farm managers to build up a good knowledge of the seasonal pattern of fly numbers* on their property so that they can be particularly vigilant during high risk periods.
- *Provide evaluation of the control practices being used*. This will give early warning if resistance has developed and a product or method is not working.
- *Avoid the application of unnecessary and uneconomic treatments*. This saves unnecessary cost but also reduces selection for pesticide resistance and unnecessary exposure of workers to chemicals.

Monitoring systems

A number of different systems of monitoring are available. These include sticky tapes, white spot counts, traps, subjective scores, resting fly counts and grid counts. Whichever systems is used there are a number of key points that should be observed:

- Monitoring stations must be located at the same sites on each occasion to allow comparison of counts from different times. If tapes, cards or traps are used, set monitoring sites should be established. If fly counts or scores are used they should be carried out at the same place on each occasion.

- Tapes, traps and cards must be put out and scores or fly counts carried out at the same time of day to get accurate results. It is also critical that tapes, cards are traps remain in place for the same period of time on each occasion.

- Results should be recorded and assessed regularly. Records are preferably by an entry on a graph so that the pattern of fly numbers is immediately apparent. Records may also be an entry in the day record book or a book kept specially for the purpose. Whatever method is used it is essential that the results are assessed promptly so that controls can be put in place early.

- A greater number of measurements on each occasion will give increased accuracy, but also means more work. Each farm will need to establish a balance between the degree of accuracy required and the amount of time spent.

Spot cards

Spot cards are white 125mm X 75mm index cards which are fastened flush to the sides of sheds, rafters or support beams, centre poles or any convenient surfaces where flies are seen to rest. Suitable cards can be purchased at any stationary or office supply store. The best positions are usually at head height or above. Flies leave yellowish regurgitation spots or darker faecal spots (fly spots) when resting. An index of fly activity is gained by counting the number of spots present on a card over a set sampling period. Usually the number of spots is counted at intervals of 3 days to a week (but always the same period!). Remember to write the date on the cards before you put them out or as you collect them

Figure 1: Spot card mounted on a support beam with a cut piece of poster holder for easy collection and replacement

The main advantage of the cards is that they are easy to count, easily labelled and can be stored for future reference. However, the species of flies causing the problem cannot be determined from the card.

Spot cards have been shown to work best with house fly, which is not the major problem species in much of Australia. However, results have shown that they also give useful results at sites where *Fannia* and *Muscina* are the main species. Growers will need to establish suitable thresholds to suit their particular circumstance.

Sticky tapes or ribbons

Fly tapes or sticky fly ribbons are commercially available from most hardware or rural retail stores. The main advantages of tapes are that they can be left in place and therefore give a sample over a period of days, they allow assessment of the species of flies present and they appear to be the most accurate method when *Fannia* is the main problem species. A sample

collected over a period is usually more accurate than a spot count or score, and knowing the main problem species can be important when determining treatment methods.

The main disadvantages are that the tapes are sticky and messy to handle and may be less effective in dusty conditions. Laying the tapes on gladwrap and folding the wrap over the tape so that flies can be easily counted is a convenient way of overcoming this problem and of storing the tapes for future reference (Fig – collecting fly tapes).

Tapes are usually hung in housing areas from the rafters, or from supports on the side or end of the house. It is usually a good idea to place wire hooks in suitable positions to hang the tapes. Good positions are in areas where flies are seen to congregate, but away from feed dispensing or mixing areas where the tapes can rapidly become covered in dust. Positions where the tapes will become wet from misters should also be avoided if possible.

Four tapes per shed will give good results, but even two tapes per shed is better than no monitoring at all. When fly numbers are low it is probably easiest to just count all flies on the tape. However, when fly numbers get higher a length of a third or quarter of the tape can be marked off and counted. Remember to multiply to obtain a total tape count if only part of the tape is counted.

Usually tapes should not be left in place for more than 1- 3 days for accurate results. If left longer than 3 days they can become dry or coated with dust and less effective in trapping flies or, during high fly periods, may become clogged with flies and give inaccurate counts.

Figure 2: Fixed sticky tapes (a and b) and walkthrough tape (c)

Walkthrough tapes

A convenient alternative to fixed tapes is to use ‘walkthrough tapes’. Walkthroughs are done walking in a fixed pattern through the shed holding a sticky tape out in front (figure 2c above). Walkthrough tapes have the disadvantage that they provide a measure of fly numbers

at a fixed point in time and can be strongly influenced by the prevailing temperature and environmental conditions. However a good assessment of fly numbers can be obtained if walkthroughs are done regularly at short time intervals, for example daily or every second day. For best results it is critical that walkthroughs be done at the same time on each occasion and that exactly the same walking path be followed. Because walkthrough tapes catch many fewer flies than fixed tape it is very important that flies on the tapes are counted and recorded immediately on finishing the walkthrough or that tapes be wrapped in cling wrap or sealed in a container immediately after the walk is finished to avoid inaccuracies from flies becoming caught on tapes after the walkthrough is finished.

Baited traps

Fly traps and bait trays are an efficient means of monitoring fly numbers where the major problem species is house fly. However, experience has shown that they are less efficient where *Fannia* is the main species.

The major design of trap used in the US is the baited jug trap. This consists of a 4 litre 'jug' with four 5 cm diameter access holes (Figure 3) often hung from rafters or supports in the shed using wire attached though the screw top. Flies enter the holes, feed on the bait and die in the trap. Traps can be made by using large juice or milk containers or similar plastic containers purchased direct from packaging supply houses.

Figure 3: Baited jug trap

Traps are baited with approximately 25g of commercial fly baits, which contain sugar, insecticide and an attractant. Most commercial baits contain a housefly pheromone attractant (z-9-tricosene) and are not very efficient with other species of flies. Our studies suggest that the attractiveness of the traps to *Fannia* can be enhanced by addition of Port wine

Traps should be positioned where flies congregate and a number of traps should be used in each house to ensure accurate results. It is important that traps be placed in the same location on each occasion that the flies are collected and the baits renewed at least weekly.

Traps have the advantage that because results are obtained over a number of days, they are less subject to the error inherent in spot assessments or counts. In addition, the species of flies caught can be identified. The disadvantages are that traps do not work well with all species and counting flies necessitates some handling of insecticidal baits.

Resting counts, grid counts and subjective assessment

Results from these methods can be misleading for a number of reasons. All provide an estimate of fly numbers over a very short span of time and results can vary greatly depending on the time of the day and weather conditions. In addition, they do not provide a ready estimate of the species of flies present. However, a structured and regular system of subjective scoring is preferable to no monitoring at all. If a subjective method is used it is imperative that assessments are made at the same time each day, by the same method, at the same location and desirably, by the same observer.

Resting counts: Predesignated areas are chosen (and marked) in fly resting areas. These could be on walls, ceiling, posts or any other convenient resting surface. The number of flies at rest within these sites is counted at designated times. A number of sites in each shed should be counted.

Grid counts: are similar to resting counts, except that a fly grid is placed at a number of preselected sites in each shed and the number of flies resting on it counted after a set period of time.

Visual scoring: One method is to walk through each shed and give a score of 0 = no flies, 2= moderate level of flies and 4 = flies above nuisance levels with scores 1 and 3 intermediate between these. It is critical to retain a written record of each days results.

Monitoring manure conditions

In addition, to monitoring adult fly populations, the manure pit should be observed and waterers and pipes checked for leaks daily. The source of any wet spots should be identified and rectified immediately. A leaking waterer can provide excellent conditions for fly breeding and even a small wet spot can breed large numbers of flies.

If wet spots are detected and high numbers of maggots are found a spot manure treatment may be required. Only products based on the chemical cyromazine (Neporex®) should be used for manure spraying. Other chemicals will kill fly predators and parasites (see fact sheet on chemical controls).

Recording monitoring records

Ideally, each spot count, fly count or score should be plotted on a graph either on graph paper or in a computer-graphing package such as Excel. This gives an immediate visual record of fly numbers, trends in fly numbers and seasonal patterns. Alternatively records of the counts or scores for each date should be written in a note book or on a special sheet in the folder kept for other farm records. Good records give an early indication of trends in fly numbers, such as when fly numbers begin to rise in spring. Treatments can then be applied early when they are likely to be most effective. Collection of records over a number of years will establish a seasonal pattern for each farm and allow the development of a fly program that targets the problem periods.

Establishing treatment thresholds

Thresholds of 50 spots per card per week and 40 flies per tape per day have been suggested for cards and fixed tapes respectively. However, the appropriate threshold will depend on things such as placement of tapes, time of collections and a number of other factors and a suitable threshold may be much lower or much higher than those mentioned above. In situations close to residential areas chemical treatments will probably be needed at lower thresholds than where there are few close neighbours. Each producer will need to determine, over a period of time, what is an appropriate treatment threshold to meet his or her own particular circumstances.

Chemical control of flies on egg farms

Chemical treatments are an important part of any fly control program. However, excessive reliance chemical methods without sufficient attention to the other means of control can be costly and is likely to rapidly lead to problems. Control of flies on poultry farms should consist of an integrated program that includes physical, biological and chemical elements.

Flies have managed to develop resistance to nearly every group of chemicals used against them. However, on any one farm it is unlikely that that flies will be resistant to all pesticides and usually effective chemical treatments can be found. Generally resistance declines if flies are not continually exposed to the same pesticide group, but rapidly reappears when that chemical is used again. It is important to use a mix of pesticides and application methods to counter the development of resistance and to gain best control of flies.

Most pesticides will kill the fly predators and parasites that breed in the manure if they come into contact with them. Predators and parasites play an important part in regulating fly numbers. As flies breed more quickly than the beneficial insects and mites, a spray that kills beneficial organisms is often followed by fly outbreaks. Heavy and unplanned use of chemicals can also cause environmental contamination, residues in meat and eggs and increase occupational health and safety risks.

For these reasons, and to minimise costs, it is important to design a chemical application program that uses chemicals efficiently and avoids killing predators and parasites, but which gives maximum effect against flies.

When planning a chemical program, there are three main decisions to be made:

- When to apply treatments
- What application method or mix of methods to use
- Which chemicals or products to use.

Whatever method is used it is essential to handle pesticides carefully and wear appropriate protective clothing. **Read the label closely and follow all directions exactly.**

Timing of treatments

A structured monitoring program should be instituted to ensure most efficient use of chemicals. In the southern parts of Australia fly populations tend to be relatively low during winter, increase to peak numbers during spring and early summer and then fall as conditions become hot and dry in mid and late summer. However, there are regional and local differences in fly patterns and given the right conditions, fly numbers can reach high levels at most times of the year. A monitoring system will assist timing chemical applications to give best effect, avoid unnecessary and costly treatments and enable evaluation of the effectiveness of the methods used. For a full discussion of monitoring systems see the fact sheet on monitoring in this series.

Methods of application

The main methods of applying pesticides for fly control are:

Surface treatments

Surface treatments are insecticides sprayed or painted onto fly resting surfaces inside and outside of poultry sheds to give long lasting toxic effect against flies. Some surface treatments incorporate a fly attractant and feeding stimulant. The period of residual effect varies between about 2 and 16 weeks depending on the product, thoroughness of application, environmental conditions and whether or not there is resistance to the pesticide used. Residual treatments should be applied at times of the year when experience shows that fly numbers are likely to increase, or when monitoring indicates that fly numbers are building towards problem levels.

For best effect, residual sprays should be applied to all surfaces where flies are seen to rest in high numbers. Preferred resting spots can be identified by accumulation of fly spots. Very often different surfaces will be favoured at different times of the day. Favoured areas include walls, ceilings, rafters and support poles. Flies also rest in high numbers on external walls and other convenient surfaces outside of the shed. Under roof overhangs are a favoured place. If possible these surfaces should also be treated with a residual spray. Cutting or removing grass and vegetation around sheds, removes resting places for flies, and increases the effect of surface sprays.

Surface sprays should NOT be applied directly to the manure. Manure applications of most pesticides will kill biocontrol agents and may be responsible for later explosions in fly numbers.

Surface sprays should be applied as coarse droplets to minimise drift and avoid unintentional effects on beneficial predators and parasites. Hand held back packs or motorised sprayers can be used. Avoid spraying the birds, eggs, feed or drinking water. Feed and water troughs and egg collectors should be covered during spraying if possible. Read the label for directions carefully to determine if the pesticide can be used while birds are present. Appropriate protective clothing should be worn during spraying.

Resistance is a particular risk with residual treatments because of their persistent effect. It is important not to use a product from the same chemical group over long periods of time.

Larvicides applied to the manure

Most pesticides kill fly predators and parasites when applied directly to the manure. However, one pesticide, cyromazine, registered for application to manure, kills maggots but does not affect predators and parasites. Cyromazine, is an insect growth regulator that interferes with the normal moulting and pupation processes of the maggots. It can be purchased for direct application to manure as a spray or granular formation (Neporex®) or as a feed additive (Larvadex®). When incorporated as a feed additive, cyromazine moves through the birds' digestive system and is passed into the manure in an essentially unaltered state. Cyromazine will not kill adult flies and should not be used as a surface spray for shed walls or other fly resting areas.

It should be noted that because cyromazine does not kill the maggots or pupae immediately and has no effect against adult flies it may be 2 weeks after first application of cyromazine before a reduction in adult fly numbers is seen.

Manure sprays: When sprayed onto manure a coarse spray of high volume is required to give maximum penetration. However, the advantage of high volume must be balanced against the disadvantage of increasing the moisture content of the manure. The most satisfactory compromise is to spot-treat problem locations in the manure or sites where high maggot numbers are seen.

Feed additives. When used as a feed additive, cyromazine should be used for 4-6 weeks and then use discontinued for a similar period of time, or until maggots are noted in the manure. Some producers only use feed-through pesticides during high risk times, for example for the 4-6 week periods following manure cleanout or during periods when experience has shown that high fly numbers can be expected. Continual year round use of cyromazine without sufficient consideration to other control methods is expensive and has caused high levels of resistance on some egg farms in the USA. Strategic use of feed additives saves money and reduces selection for resistance.

To avoid illegal residues, Larvadex® must be removed from layers diet at least 3 days before birds are sent for slaughter. Heavy applications of cyromazine treated poultry manure to soil in which food crops will be grown can result in residues in produce. To avoid illegal residues follow the label instructions.

Fly baits

Commercial fly baits usually consist of a granular formulation of pesticide, sugar and a fly attractant. Flies are attracted to the bait, feed on the sugar and are killed. Ongoing fly baiting, used as part of an integrated fly control program, will assist in keeping fly numbers low.

Fly baits can be placed at set stations, either in bait trays, or sometimes in traps such as the jug trap shown in Figure 1. These may also used be for monitoring fly numbers (see fact sheet on monitoring). Sometimes bait formulations are also sprinkled on walkways, the ground or floor in areas of high fly numbers. However, indiscriminately sprinkling baits increases the chance of non-target effects and environmental contamination and the use of set bait stations is to be preferred. Bait should not be sprinkled directly onto the manure or in areas where it can fall onto the manure because of the risk of killing predators and parasites. Baits should never be used in areas where they could become mixed in feed or there is a risk of them being ingested by birds, other livestock, pets or children

Figure 1: A jug trap made from a milk container

The attractant used in most commercial baits is muscalure (z-9-tricosene). This is a house fly pheromone and is not attractive to most other species of flies. In particular, bait formulations designed for use against houseflies generally have little effect on fly numbers when the main problem species is *Fannia*.

Misting or fogging

When fly numbers reach very high levels and an immediate action is required to prevent difficulties with neighbours, sometimes it may be necessary to mist or fog with insecticide inside and outside of sheds to give an immediate kill of adult flies. Misting and fogging gives a rapid knock down in fly numbers, but has little residual effect. Misting should only be done with a low toxicity, low residual effect product registered specifically for the purpose. Surface sprays or other chemicals not registered for this method of application should not be used.

Misting is best done early in the morning when flies are likely to be resting on walls and other surfaces and when ventilation systems can be closed or turned off without causing a significant rise in shed temperatures. Misting outside of sheds should only be carried out in calm conditions. Misting in windy conditions will give poor effect and allows unacceptable spray drift.

Misting may need to be repeated on a number of occasions if fly numbers are high. A manure treatment and surface sprays may also be necessary to obtain a more long lasting effect. It is important to use full protective clothing, including a respirator when misting. Read the product label for detailed directions.

Choice of pesticides

Choosing the right mix of products for optimum control is a complex process. Factors that need to be taken into account include resistance management, effect on beneficial insects and mites, period of residual effect and human and animal toxicity. As noted above most chemicals that kill flies will also kill predators and parasitoids. Cyromazine is currently the only chemical on the market that can be applied to manure without killing beneficial organisms.

As a general principal, chemicals from different groups should be rotated to slow the development of resistance. This is particularly important with surface treatments. Note that different products often contain the same active constituent and or active constituents from the same group. Prolonged use of one will confer resistance to the other and rotating products containing chemicals from the same group will have no effect in preventing resistance. Products registered for use in poultry sheds are listed within their chemical groups in Table 1. However, there are continual additions and deletions of registered products and the latest information should be sought.

Table 1: Chemicals registered for fly control in layer sheds

Application Method	Product	Active Ingredient	Chemical Class	Insecticide Resistance Group
Surface Spray	Alfacron 10 Plus	Azamethiphos	Organophosphate	1B
	Alfacron 500	Azamethiphos	Organophosphate	1B
	Dipterex 500 SL	Trichlorfon	Organophosphate	1B
	Coopex Residual Insecticide	Permethrin	Pyrethroid	3A
	Agita 100 Plus Fly Paint-on	Thiamethoxam	Neonicotinoid	4A
	Tempo	Betacyfluthrin	Pyrethroid	3A
	Tugon 100 WP fly & litter beetle insecticide	Cyfluthrin	Pyrethroid	3A
Bait	Tugon Plus	Methomyl	Carbamate	1A
	Snip Fly Bait	Azamethiphos	Organophosphate	1B
	Agita 10 flybait	Thiamethoxam	Neonicotinoid	4A
	Dy-Fly Plus	Methomyl	Carbamate	1A
Larvicide Feed additive	Larvadex 1% Feed Premix	Cyromazine	Insect growth regulator	18A
	Larvadex 10% Feed Premix	Cyromazine	Insect growth regulator	18A
Larvicide Manure spray	Neporex 2 GR	Cyromazine	Insect growth regulator	18A
	Baycidal 250	Triflumuron	Insect growth regulator	15A
	Barmac Dichlorvos 500	Dichlorvos	Organophosphate	1B
	ChemAg Dichlorvos	Dichlorvos	Organophosphate	1B
Fog or Mist	Rudchem PY Spray	Pyrethrins	Pyrethrin	3A
	Rudchem PY 40-Formula 40	Pyrethrins	Pyrethrin	3A
	Rudchem PY Fog	Pyrethrins	Pyrethrin	3A
	Rudchem PY Mist	Pyrethrins	Pyrethrin	3A

Disclaimer: The above list contains as far as we are aware all of the products registered for use for fly control in layer sheds at the time of preparation. However there is a wide range of products registered for the control of flies in a variety of other circumstances and continuing additions of new fly control products and lapses in registration of others and we cannot guarantee that all possible products are listed. In addition, other registered products can be used for spraying external walls or areas outside of bird housing areas. Some products can be used for more than one of the applications listed above, but have only been listed under one type of application. It is extremely important to check the label to ensure the product is registered for its intended use.