# House flies and the avian influenza threat

*by Dr Kai Sievert, Dr Roberta Alvarez, Raul Cortada and Dr Martin Valks, Novartis Animal Health Inc, Basel, Switzerland.*

House flies are a huge economic and sanitary problem. In modern poultry production flies can cause immense damage to birds since they transmit various diseases. One of the most threatening diseases, not only for birds but also for man, is avian influenza (AI). From an sanitary standpoint the house fly Musca domestica is definitively one of the most critical insects. Millions of humans and countless animals are suffering from diseases transmitted by flies.

Their continuous flight between nutrition and faeces, feedstuff and waste, poultry, livestock and carcases connects clean and hygienic areas with contaminated and highly contagious ones. This is the way flies become mechanical vectors for several infectious viral, fungal and bacterial diseases.

Among these diseases are salmonellosis, campylobacteriosis and diarrhoea caused by E. coli O157:H7, cholera, foot and mouth disease and approximately 100 other diseases. Even the eggs of some parasitic worms (hookworms, roundworms) may be transmitted by flies.

Of major concern today is avian influenza (AI), a disease causing the death of millions of wild birds and chickens. It has a huge impact on the economic situation of poultry farmers and can even threaten their health.

Recently, in the EU a budget of €1.9 billion has been allocated for the containment of the disease.

## Outbreaks of avian influenza

The strain (H5N1) currently spreading from Asia to Europe is not only highly pathogenic for poultry, but has the potential to infect humans and a number of fatal cases linked

to backyard poultry have been reported. The virus was first identified in 1996 in China. Since then millions of birds and 86 people have died. Independent from this serious H5N1 epidemic several outbreaks of AI occurred in the past. Between 1959 and 2001, a total of 18 primary outbreaks of highly pathogenic AI in poultry were recorded.

Millions of birds were killed each time to stop the spread of this virus – resulting in immense economic losses for the farmers and the national economy.

The connection between the AI virus and houseflies as transmitter is reported in various scientific literature:

- Wilson et al. (1986) presented data that house flies seem to be one of the predominant vectors that can transmit AI in poultry farms. An outbreak of AI (H5N2) in Lancaster County, Pennsylvania, USA in 1983/84 led to the death of countless birds. Up to 90% of the flocks died.

Transmission of the AI virus was suspected to occur in several ways. Apart from the direct contact between the birds and by contaminated mechanical vectors, such as man, one of the major transmission routes seemed to be insects, especially house flies.

Fifteen different insect species were collected in 324 samples – each containing members of only one species. Among them were 72 samples only with Musca domestica as the dominant insect.

– **Flies (121 samples of three species):** In more than one third of the adult Musca samples, the virus of avian influenza could be identified. Also one third of samples of less abundant fly species (Ophyra and Coproica) were positive.

– **Beetles and other insects:** In the remaining 203 species specific samples, only two other insect samples (one of litter beetles Alphitobius diaperinus and one of hide beetles Dermestes maculates) were positive. In no additional species pool was AI virus isolated.

- Sasaki et al. (2004) reported that an H5N1 bird flu strain was found in flies caught in 2003 near a poultry farm in Kyoto in western Japan that had seen an outbreak of the virus in the previous months.
- Bean et al. (1985) reported that the AI virus was isolated from house flies in chicken houses.

These results show the potential of flies in general and Musca domestica in particular to carry avian influenza viruses! However, trials testing infection of poultry with flies contaminated with the AI virus have not been carried out to date.

## Integrated programme

An integrated farm fly control programme should always be an important tool to reduce the threat of AI in poultry farms and to avoid the economic disaster caused by such outbreaks.

It is part of the general recommendations to prevent the spread and introduction of avian influenza virus.

Based on the three key principles of biosecurity – isolation, traffic control and sanitation – a series of recommendations can be made to prevent the spread of AI between poultry premises by flies:

- **Isolation.** Prevent mechanical transmission of AI by anything that can walk, crawl, or fly from farm to farm. Be aware that flies can easily fly distances of 3km.
- **Traffic control.** The spread of AI follows the movement of people and equipment. Flies can be present in feed trucks, during transport of poultry from the hatchery or to the slaughterhouse and on and in cars of visitors. In this way, flies can be easily transported from one farm to the other.
- **Sanitation.** Remove manure as this destroys the breeding sites of the flies. Scrape the sides of the buildings to remove

*Continued on page 9*

*Continued from page 7*
all residual organic material that might harbour virus.

To understand the problem you need to imagine the fly population is like an iceberg. The visible part, the adult flies, are the top representing an estimate of 20% of the total present population. They are the part of the population causing the problems. But the bigger 80% part of the population (eggs, larvae, pupae) is hidden in the manure, dung, spoiled fodder and other suitable places for development of the larvae. This causes a continuous supply of new flies (see Fig. 1).

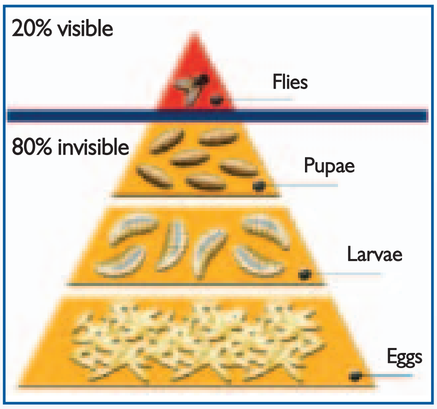


***Fig. 1. The fly population.***

The exclusive control of the adult flies addresses only a small part of the problem. It is essential to start the fight by using larvicides in conjunction with an adulticide treatment scheme.

## Integrated farm fly concept

Modern anti farm fly control products are specific and selective. The use of these products, when applied correctly, is also safe for humans and animals.

An integrated anti farm fly programme concept is based on two major elements – larvicides and adulticides.

Larvicides target the hidden majority of the fly population. They usually interfere with the hormone system of the insect larvae (for example methoprene) or with the chitin synthesis (for example cyromazine).

This ensures the selectivity of the larvicides. Compounds like cyromazine (for example Neporex) are even more selective since they kill only the larvae of flies. Neither mites, parasitic wasps or beetles are affected.

These modes of action lead not to an immediate death of the larvae but kills the larvae at the moulting stage or when they develop into adults at the pupal stage.

Larvicides have no direct effect on adult flies and are thus summarised as 'Insect Growth Regulators' or IGRs.

Larvicides are used either in granular form, as a spray or poured on the manure. The products have to be applied to the breeding sites of the fly larvae. This includes spillage areas under feeding troughs, moist areas beneath drinking troughs, around pillars and posts. Edges and anywhere else where manure accumulates should not be forgotten.

Adulticides are applied to control the adult flies. Most of the insecticides in current use against flies act on molecular targets in the insect nervous system. There are several well established compounds out of different chemical classes (for example organophosphates, pyrethroids, neo-nicotinoids and spinosyns).

The main targets are nicotinic acetylcholine receptors, GABA receptors, glutamate receptors, cholinesterases and sodium channels.

The adulticides are available in different forms:

- Baits consist of an insecticide mixed with some attractive substances, such as sugar, the fly sexual attractant tricosene and a yellow or red dye. The products act as ready to use 'attract and kill' granular bait. The flies are attracted by colour and tricosene, are forced to eat the sugar and die after consumption.
- These baits can also be dissolved in water to be painted on pillars, posts, window frames or as spots on the walls where flies normally tend to congregate.
- Surface sprays provide a long lasting toxic surface and are applied where the flies congregate, for example walls, posts and ceilings. The products act as contact poison.

## Resistance

One very important issue has always to be considered when using chemical measures – the great potential of flies to develop resistance.

Rotation management in a monthly or two monthly manner is recommended, which involves the routine switch to products with different insecticidal classes and different modes of action to prevent the development of resistance (Table 1).

In addition, the parallel use of adulticides and larvicides is of utmost importance. Larvicides always have different molecular targets than adulticides and act on different life stages in the insect's life. This also helps to prevent the development of resistance. ■

***Table 1. Treatment schedule (northern hemisphere) with monthly rotation, beginning early in the season when flies start to develop.***

| | March | April | May etc. | |
|---|---|---|---|---|
| Adulticide | Product A | Product B | Product A | Continue until the end of the fly season – normally October/November |
| Larvicide | Product L | Product M | Product L | |