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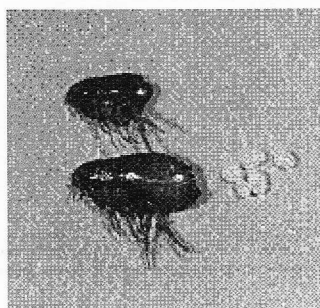
Companion Animals

MSD Animal Health

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Part 1: Investigation skills:

- Global perspective: same flea species (*Ctenocephalides felis*) infest dogs and cats all over the world; we all use the same products.
- Most common reasons why we may perceive that flea products have failed are a lack of understanding of product performance attributes such as true speed of kill, duration of activity, and misconceptions concerning repellency. In addition most users of ectoparasiticides are poorly informed about flea biology & epidemiology. They simply don't know what they don't know.
- Distinguishing fleas that have been on the animal's coat for <24 hours or >24 hours indicates whether the product being applied is working as an adulticidal. Fleas that have been on a host for >24 hours are reproductively active and visibly different (larger, lighter orange-coloured abdomens); this means that fleas that are not actively reproducing on the pet have a different appearance and thus give us information regarding how long they have been present on the pet's coat!

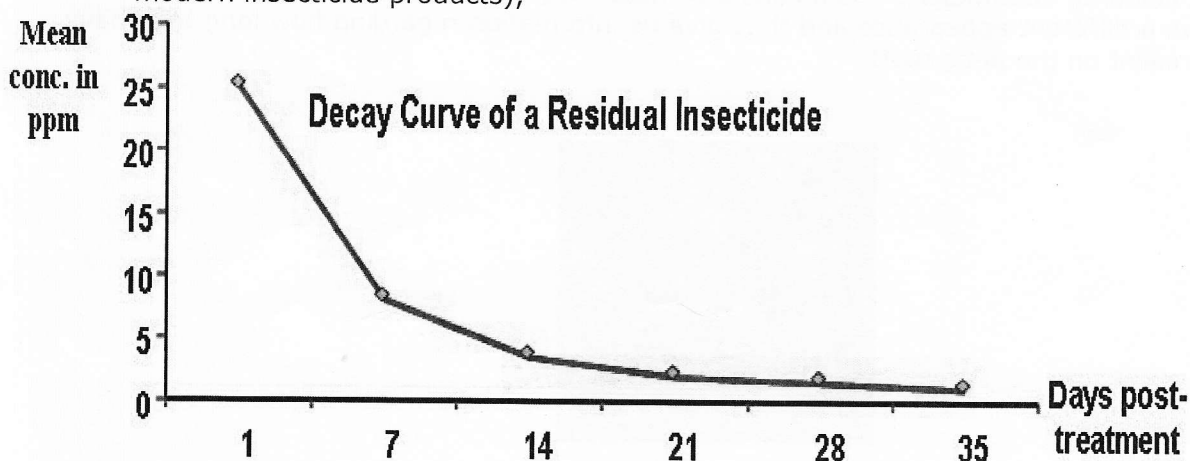


Part 2: We need to gain an understanding of the biologic and epidemiologic factors responsible for persistent flea infestations:

- For a pet to have "Fleas" there must be eggs, larvae, pupae and emerging fleas somewhere in the property. That means we need to go back in time, at least 2 months when the 1st generation of fleas began to breed and multiply.
- Pets do not acquire fleas directly from another flea infested dog/cat. Since the adult cat flea is a permanent external parasite, metabolically dependent upon a constant host relationship, direct flea transfer between pets is a rare occurrence. Fleas we see on our pets and in our homes came from flea eggs laid 3-8 weeks previously. Those initial few fleas came from flea eggs deposited by neighbor's pets, feral dogs & cats or possibly flea infested wild mammals.

Those eggs deposited in the outdoor premises developed to the adult stage and jumped on their dog/cat or even occasionally the pet owner/humans on the same premises.

- Most of us never see the first 2 - 3 fleas our pets acquire. What we actually react to is often the 2nd or 3rd generation. Those initial few fleas (trickle infestation), mate within a few hours and females start laying eggs within 24 hours and in a few days are producing up to 40 - 50 eggs/day/flea.
- Fleas deposit their eggs into the coat of the pet with the eggs then falling out of the coat into the premises where they ultimately develop in a few weeks to the adult flea. By the time we as pet owners react and take our pet(s) to the veterinarian there are already flea eggs, larvae, pupae and emerging fleas in the home and protected outdoor source points ("environmental hotspots"), which is why it may take several weeks to get adequate flea control and rarely complete elimination.
- The commonly used residual adult-killing flea compounds (fipronil, imidacloprid, selamectin, and pyrethroids) are all contact insecticides.
- They do not kill instantaneously and while some pyrethroids such as permethrin may have a rapid neurotoxic effect that may be perceived as "clinical repellency", the repellent and antifeeding effect against fleas may be poor and may even be non-existent if the fleas are pyrethroid resistant. While a few fleas may die within minutes, most will actually feed prior to dieing often many hours later. Therefore when we see a few fleas on our pets 1 - 3 weeks after treatment we should not incorrectly assume that the product is failing. Due to the contact neurotoxic action of these compounds newly acquired fleas often are only killed after 18 - 48 hours, depending on the product being used.
- Close scrutiny of treated pets in an infested environment will almost always result in fleas being observed for up to 8 weeks and occasionally longer.
- While these newer residual adulticides do not kill instantly they do kill most newly acquired fleas before egg production is initiated (24 hours). However, some level of flea survival and reproduction does occur prior to next application. This occurs 1) because the speed of flea kill slows during 3rd and 4th week after application due to decreased insecticide levels (with all modern insecticide products),



2) incorrect application of the product results in under-dosing - a very common example is the products packed in plastic ampoules, requiring that one squeezes the contents out, however, once the pressure is released it creates a suction force and some of the liquid is sucked back into the ampoule; a survey conducted in recent years in Australia and USA found that 40% of ampoule users were under-dosing in this way 3) Frequent bathing/swimming

can reduce insecticide levels and 4) Genetic variability of flea isolates resulting in differences in insecticide susceptibility (this refers to the classic "bell-curve" of population dynamics).

- Those factors that result in <100% residual flea kill and allow for limited egg production from surviving fleas have been recognized for almost a decade. This continued reproduction must be halted in order to prevent persistent flea infestations and selection for resistant fleas. Therefore the use of Integrated Flea Control (IFC) utilizing Insect Growth Regulators (IGRs) that render flea eggs nonviable can add greatly to a flea control program (topical or systemic IGRs). The aim of the treatment is to prevent eggs from developing into normal adult fleas. Research suggests that the egg killing activity of topically applied IGRs is also due to exposure of the adults to IGRs with eggs being nonviable before even being laid. The use of topical or systemic IGRs provides for prolonged residual ovicidal activity, interrupting future flea development, even after residual activity of an insecticide is diminished.

Part 3: Facts contributing to persistent flea infestations

- *The flea life cycle does not stop during winter and the flea eggs laid during winter (even 6 – 12 months ago) contribute to the environmental burden we battle with in summer!*
- *By the time fleas are seen and identified as a problem, the infestation has been present for at least 2 months!*
- *Fleas visible on our pets are only 5% of the flea population, while the other 95% is in the surrounding environment.*
- *Pupae wrapped in protective cocoons in the environment cannot be killed by any insecticide known to man, and are only susceptible upon hatching.*
- *Young adult fleas jumping onto your pet are unavoidable because we are treating only 5% of the population when we treat our pets.*
- *Products are not repellant, and will only kill fleas after they have been in contact with the insecticide and on the pet's coat for 18 – 24 hours.*
- *Similarly, ticks will only die after 24- 48 hours contact time.*
- *The pet's coat must be 100% dry at the time of the spot-on application.*
- *With severe environmental infestations, monthly product application in conjunction with a registered environmental treatment remedy/product for at least 4-6 months is recommended!*
- *Continuous reinfestation of the environment can occur through untreated animals (neighbour's pets, rodents, stray cats, wild birds and animals, etc.) as well as foreign environments your pets have access to (local parks, infested micro-environments in the house, neighbour's garden, etc.)*

Investigations into ectoparasiticide inefficacy worldwide as well as locally have yielded the following reasons for perceived product inefficacy:

- *Non Compliance (59%)*
 - *Incorrect application (underdosing, incorrect product, applying the product on wet coat, using hands to distribute the liquid)*
 - *Not all pets are treated*
 - *Infrequent treatment (most products are recommended every 4 weeks)*
 - *No concurrent environmental treatment employed in severe infestations*
- *Unrealistic expectations (30%)*
 - *Expecting repellency.*
 - *Expecting fleas and ticks to die in less than 18 – 24 hours.*
- *Other skin conditions (11%) e.g. Skin allergies (especially in spring and summer)*

Dr. Michael Dryden (the flea guru), Professor of Veterinary Parasitology, Kansas State University, Manhattan KS, USA

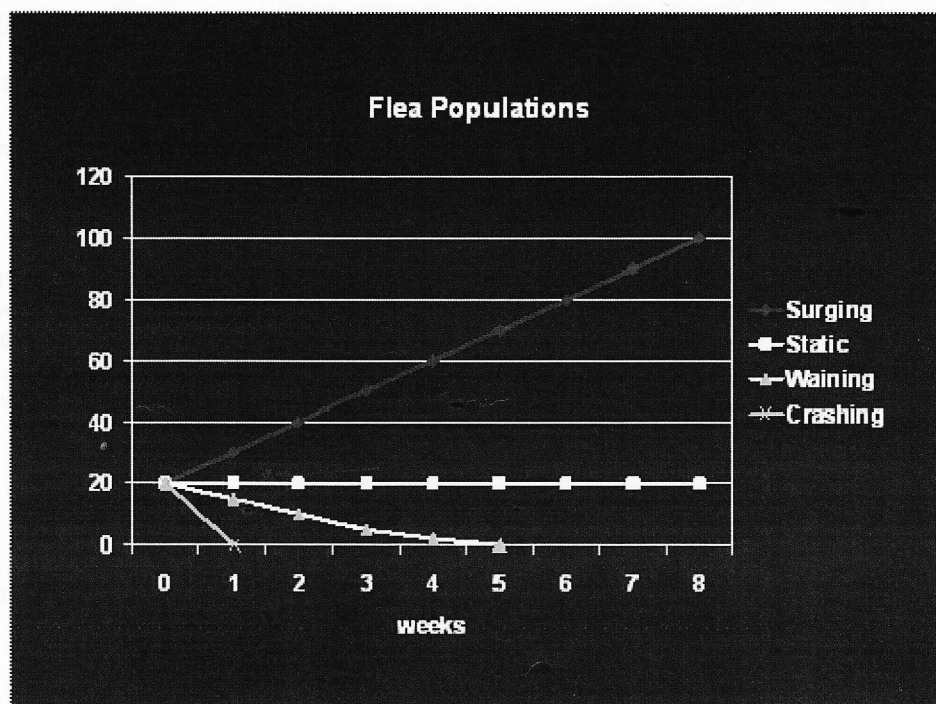
"While differences in susceptibility to modern insecticides does occur in various flea strains, there is no documented resistance in field collected flea isolates to the modern adulticides. Since resistance selection is a possibility in fleas likely the best strategy to prevent resistance in the future is integrated flea control".

Part 4: Expectations of modern flea control products.

When a flea infested pet is identified, there are 3 goals that must be achieved:

(a) Relieving pet of its current discomfort - kill fleas A.S.A.P. on the pet(s); I personally find that using a topical spray formulation immediately is most effective; use the spray as directed and use latex gloves to part the hair so that the active ingredients can reach the skin. Then follow-up on that treatment with a registered spot-on (ExSpot, Ecto-Spot, Proticall Plus, Advantage, Advantix, Revolution, Frontline, Promeris, Prac-Tic, Pulvex, etc.) in 3 days time, and maintain treatments at least every 4 weeks. Remember that some of these products are safe enough to use every 2 weeks if required initially, to allow us to gain control of a flea burden faster - check with the manufacturer if the product you wish to use can be applied more often than 4 weeks initially. Dips and insecticidal shampoos may also be used but they do not last as long as the spot-ons, and they are much more labour-intensive because the dogs need to be restrained during the process.

(b) Eliminate the premise infestation - eliminate immature life stages and emerging fleas,



The crashing flea population will control itself no matter what product you use, and you will see results within 1-7 days. Biologically speaking, no product can ever do that even if it was to be used under the ideal conditions of a laboratory. That means that the only explanation why such a thing would happen, is that the population was in the process of dying out naturally anyway.

Waning and static flea populations take substantially longer to control and you will still see fleas on your pets but at the expected amounts of 1-3 fleas at any given time. If the 1-3 fleas are sometimes and sometimes not, then we are dealing with a waning flea population. Treating your pets when experiencing the effects of a waning flea population, results will be seen within 1-5 weeks.

If the pets always have 1-3 fleas visible on their coat at any given time, then we are dealing with a static flea population. Treating pets in this scenario may take up to 8 weeks to achieve low levels of infestations that are either not easily visible nor irritant to the coat of the animals (no scratching is seen).

The hardest flea infestations to control will be when we have a surging flea population and the number of fleas hatching in the environment and subsequently jumping onto our pets is far greater than what we can kill with our spot-on and spray products. These infestations can sometimes require continuous, diligent and timeous treatments for the next 4-6 months and often require the change of season to assist in slowing down the reproduction of the fleas in the environment. Although the reproduction of the fleas in the environment will slow down it will rarely stop in South Africa (except in isolated areas of the country where climatic conditions may force relative humidity to drop below 50% and temperatures below 10 degrees Celcius). The rest of South Africa will still experience mild to moderate flea infestations throughout the year, especially in areas along the coast where the humidity is higher than 50% throughout the course of the year.

Control of premise life stages can be achieved without direct treatment of the premises (in most cases; rarely direct treatment of premises is indicated) through a combination of residual adulticidal activity (killing newly acquired fleas) and ovicidal activity (rendering eggs of surviving fleas nonviable). The latter will only occur if the product chosen contains an adulticidal compound (fipronil, imidacloprid, selamectin, and pyrethroids) as well as an Insect Growth Regulator compound (methoprene, pyriproxifen and fenoxycarb). If not, then direct treatment of the environment is absolutely essential. This well established concept of Integrated Flea Control (IFC) is also termed "Breaking the life cycle at the host level". This approach essentially turns the treated dog or cat into a "living flea vacuum". Over the next 3 - 8 weeks (occasionally longer) the flea eggs already in the premise develop into larvae, then into pupae and finally into adult fleas. As fleas emerge and jump on treated pets most are killed by the residual adulticide and if a few survive and lay eggs, those eggs are killed by the ovicidal activity. The population is driven to "extinction" through elimination of reproduction. This time period from treatment until control is achieved (elimination of all premises life stages) is called the "Development Window".

In addition destroy refuge areas for fleas - they like shaded/covered and sanded areas (exposed soil). Remove or burn tall grass, brush piles, and weeds between runs and fences and along buildings; the latter allows for sunlight penetration to cause desiccation of remaining immature flea life stages - larvae and nymphs especially. Pupae remain resistant and will probably only be destroyed by fire.

I would personally avoid fumigation and pesticide services as toxic compounds inevitably land up on plates and bowls of pets which subsequently contributes to acute poisonings and gastrointestinal disease.

Environmental Treatments for controlling flea infestations

The level of infestation would have to be extremely high in order to consider treating your property with some form of environmental treatment. The most common form of treatment

involves the practice of fumigation, which means that the property needs to be evacuated by people and pets and poses a logistical issue at the best of times. Over the past 20 years environmental treatment at this grand scale have fallen out of favour so and they have been replaced by more convenient and modern methods and products. The author does not recommend environmental treatment for the following reasons:

1. Based on the majority of products used by companies that offer fumigating and similar other services, as well as testimonials from pet owners that have actually applied environmental treatments on their property, the general consensus seems to be that the treatment either works for too short a period of time (does not have the lasting effect that is required to control the excessive flea infestation) or does not work at all.
2. Once again, based on testimonials as well as the author's private practice clinical experience, although the animals are removed from the property during the actual treatment process, there are often secondary exposures to the insecticides used with resultant poisoning in the animals once they have been taken back to the property.
3. The same basic principles of treating flea infestations still need to be applied even if we decide to use environmental treatments i.e. we need to do it repeatedly, using insecticides that kills adult fleas as well as the immature life stages (Insect Growth Regulators). This is the very same reason that makes environmental treatments less effective than anticipated, but also logistically and financially prohibitive.
4. No matter what product is used for environmental treatments, the immature stage of the flea life cycle called "pupae" (the stage immediately before adults) which is enclosed within an impenetrable cocoon will not be killed. There is no substance known to man that will penetrate the protective cocoon of this parasite and kill it. The cocoon allows the parasite to survive such harsh treatments and environmental conditions, and hatch when the conditions are favourable again. Pupae can survive within their cocoons within the environment for up to 1 year.
5. A lot of emphasis has been placed on vacuum cleaners over the past few years and the author is of the opinion that we should not rely on vacuum cleaners that heavily when it comes to controlling flea infestations. If the purpose of the vacuum cleaner is to collect flea eggs that might have dropped off our infected pets, then it may have a role to play only if we insert an egg-killing or larvicidal insecticide within the vacuum cleaner's receptacle. However, if we have been applying the concepts of Integrated Flea Control already, we would have been using an Insect Growth Regulator on our pets, which means the eggs produced by the dying fleas will not hatch anyway. If the vacuum cleaner is used to get rid of larvae and pupae (the other two immature stages in the flea life cycle), it will not be effective at all because larvae burrow very deep within carpets before developing into pupae.

Alternative forms of applying environmental treatment:

1. Dog and cat spot-on products that contain both adulticide and Insect Growth Regulator insecticides. The adulticide component kills adult fleas before they start producing eggs. The Insect Growth Regulator component is then used to address those fleas that have managed to lay eggs before dying, by rendering their eggs non-viable (they will not hatch) and thereby reducing the environmental load.
2. In addition to spot-on formulations, we can employ the services of environmental sprays containing Insect Growth Regulators (e.g. methoprene and pyriproxifen). These sprays are then used to treat what we call "environmental hot-spots" within our property. Environmental hot-spots are usually areas that are shaded, have soil and shielded from the environment e.g. shaded ground below thick bushes, soil below raised decks and kennels, wooden crevices, etc. but also all the "favourite" areas that our pets spent a lot of time

sitting and resting - that can be a certain couch, a certain part of the room which is carpeted, a room with wooden floors and crevices, etc. Two products that the author is aware of are "Flego Aerosol" made by Novartis, and "Fleegard Environmental Spray" made by Bayer which your local veterinarian should be able to order in on your behalf.

3. Excessive soil deposits (sand brought in for building purposes) within a property should be removed as immature fleas (especially larvae) continue their development within soil and continue with their life cycle, which ultimately increases environmental loads.

(c) Prevention - provide for long term flea control preventing recurrence of an infestation simply by following the manufacturer's recommendations on IFC. The latter usually means monthly treatment all year round!

Part 5: Understand product performance limitations, regarding tick control

3 tick killing active ingredients provide the best protection: Amitraz (Preventic impregnated collar; not for cats), Fipronil (Frontline/Ultram spray and spot-on formulations) and pyrethroids such as Permethrin (ExSpot) and Deltramethrin (not for cats). For cats Fipronil spot-on is highly effective.

It is crucially important to understand that there are a very large number of tick species (at least 12 species) that attack our beloved pets and all products have been tested only against a small number of those tick species - usually the tick species that are deemed most important for transmitting diseases such as biliary and Ehrlichiosis. When we find ticks on our dogs and cats we should identify them and check whether our choice of spot-on will offer us protection (Ask the manufacturers). If the product has never been tested against the species of tick in question, we cannot expect any great results. If it so happens that the product is effective against that species, we can consider that as a bonus.

What constitutes a "repellent" is not always clear - technically, there is no such thing currently on the market, as all available insecticides are contact-insecticides! That means that the parasite must come in contact with the parasiticide in order to be killed.

Understanding the extent of natural tick reservoirs is absolutely critical

Since tick products do not kill or repel all ticks instantly, so we shouldn't get the impression that the products are not performing as well as expected. In these situations, consider additional tick-control measures. Destroy refuge areas for ticks and tick wildlife hosts. Removing or burning tall grass, brush piles, and weeds between runs and fences and along buildings can kill some ticks outright, allows for sunlight penetration to cause desiccation or remaining ticks and can reduce harborage for wildlife tick hosts.

We have absolutely minimal control over tick populations in the environment. The majority of ticks (99, 99%) are on alternative hosts and in the environment, and not on pets. This is due in large part to the multitude of wildlife hosts and immature ticks in the environment.

Understand the differences between flea and tick control. (These three factors i.e. "repellency", multiple host species including multi-host species, and tick visibility, cause most real and perceived product failures.)

There is also a major difference in perception between a few fleas on a dog and a few ticks. Most of us never see the first 2-3 fleas to infest a dog, while almost all pet owners see the first 2-3 ticks, simply because of their larger size (especially when fully engorged after a blood meal). A perception on efficacy is formed on what is visible, even though the product may be >95% effective.

The same level of efficacy can give completely different perceptions of flea and tick control. What is often forgotten is that when you see a couple ticks on the dog it is likely that numerous other ticks were killed. Therefore seeing one or a few ticks does not mean product failure but may simply mean the ticks are recently encountered and not yet killed, and/or the residual activity of product is no longer 100% and the pet is moving through heavily tick infested environments.