Symposium: Use and Control of Pesticides and Antibiotics in Milk Production and Manufacturing. Federal Recommendations

USES OF INSECTICIDES IN THE PRODUCTION OF MILK

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Every minute of every day insects are making their insidious attacks on man, his crops, timber, gardens, homes, mills, warehouses, and livestock. Competition with man is keen and constant. Estimates of losses in dollars and cents are difficult to arrive at, but in the aggregate, insects cause losses of approximately $4 billion annually in the United States, to food and fiber crops, livestock, forests, buildings, stored products, and clothing. Many serious livestock and plant diseases are transmitted by some of these pests. For example, cattle fever, anaplasmosis, encephalitis, anthrax, and filariasis are transmitted by ticks, flies, and mosquitoes. Forage plant diseases transmitted by insects include alfalfa mosaic, witches'-broom of alfalfa, and alfalfa dwarf, and numerous others, which are either proved or suspected of being carried by insects. In addition, there are the filth insects, such as house flies, blow flies, and cockroaches, which contaminate food and also transmit human and livestock diseases. The dairy industry is adversely affected by many of these pests in several stages of milk production. They feed on the farmer's forage and pasture, attack his livestock, contaminate his food, and are nuisances in the barns and milk rooms as well as in processing plants.

Scientists have conducted much research on ways to control these pests. Many methods of control are employed, including use of biological agents, cultural practices, mechanical devices, draining and filling of breeding areas, and chemicals. The use of insecticides is the most widely applied single method, because they generally provide highly effective control at comparatively low cost.

RESIDUES AND THE PROBLEMS THEY CREATE

In recent years, several problems have been encountered in connection with the use of insecticides that are now commonly recommended. Perhaps the most serious trouble is that of insecticide residues which may appear in raw agricultural products or in processed foods.

Various government agencies and industry, representing many scientific disciplines, have long recognized that in connection with the use of chemicals to produce agricultural commodities the public must have assurance that foods do not contain harmful residues. After much study, the Miller Amendment to the Federal Food, Drug, and Cosmetic Act of 1938 was passed, on July 22, 1954. This new law, Public Law 518, is designed to increase protection to the public from harmful residues, and provides procedures for establishing tolerances of pesticides on raw agricultural products. It also recognizes that insecticides are necessary to assure a continuing supply of high-quality foods.

The importance of the residue problem has been recognized ever since pesticides came into use. Prior to the enactment of legislation, research on the development of recommendations for the control of insects had emphasized the prevention or minimizing of insecticide residues in plant and animal products. Many research data had been obtained by state, federal, and industry workers which guided officials responsible for issuing control recommendations. Officials of the Pesticide Regulation Section of our Department, and those of the Food and Drug Administration, were consulted by federal and state entomologists relative to proposed recommendations. However, following the recent, more stringent legislation, research has been intensified to determine more precisely the nature and extent of residues which appear in foods following the use of various pesticides. It has been found that several of the effective materials, including malathion, Diazinon, toxaphene, and Perthane, and spray formulations of methoxychlor, can not be used on dairy animals because minute amounts of residues occur in the milk. No tolerances have been established for insecticide residues in milk. Regulatory officials and others recognize the necessity for keeping milk free of any harmful residues, because it is the major item in the diet of infants, the aged, and the sick.

Obtaining data on the residues of insecticides on or in crops, or the accumulation of residues in meat and milk, involves a great deal of complex and painstaking research. Entomologists, veterinarians, and chemists have developed various techniques for applying insecticides on crops, and for taking samples for residue determinations. Methods have also been developed for feeding livestock measured...
amounts of insecticides in their diet and for the surgical removal of fat samples from animals at various intervals after treatment, so that more precise information can be obtained. Similar procedures are used in studying residues in animals sprayed with insecticides. The chemists have devised various highly sensitive methods of analyses of numerous insecticides and their break-down products in animal and plant tissues and in milk. Their problems have been concerned with the extraction, clean-up procedures, and sensitivity measurement of residue levels as low as 0.1 p.p.m. or less in tissues. Studies on each insecticide that has broad and extensive usage requires the analysis of thousands of samples of meat, milk, organ tissues, and plants.

In experiments designed to determine residues in livestock, the expenses particularly are great. To determine to what extent, if any, an insecticide is secreted in the milk following the feeding of treated forage, cows are carefully selected so as to be similar in age, milk production, period of lactation, and breed. They must, of course, be free initially from any insecticide contamination. There are usually two to four cows for each of four to six levels of insecticide feeding. Milk samples are taken and analyzed two or three times a week during the feeding period, which is usually 3 to 4 wk. in length, and sampling is continued for several weeks after the feeding of insecticide-treated forage is stopped. Determining residues in meat and milk following application of sprays to animals must be studied in a similar manner. Thus, obtaining residue data in livestock requires long periods of time, as well as being costly.

It has been said in some quarters that insecticides have been foisted on the public without adequate study. This is not true, since immense amounts of effort and money have gone into experimental work to determine how insecticides may be used safely. Effort and costs are shared by industry, state, and federal agencies, but the ultimate cost is borne by the taxpayer and consumer.

In addition to studying residues of established insecticides, entomologists and chemists are continuing the search for new and safer compounds. Many thousands of chemicals are being evaluated each year to determine their effectiveness against different insects. Those having promise in preliminary tests are further evaluated in field experiments. Entomologists are also investigating ways to minimize residues by developing new application techniques and new formulations of the insecticides.

INSECTS ON FORAGE AND PASTURE

Of the 75 or more species of insects and mites that are economic pests of forage crops, the most important are the alfalfa weevil, the pea aphid, the spotted alfalfa aphid, the potato leafhopper, the European corn borer, and the corn earworm. These pests are prevalent in most of the billion acres devoted to producing forage in the United States. Since forage and pasture crops constitute the major source of feed for dairy cattle, it is mandatory to control insects on these crops. The development of insecticides that will provide effective and economical insect control, and will not leave undesirable residues on the plants and subsequently in milk, has been exceedingly difficult.

The alfalfa weevil is present in most of the States from Nebraska to the West, and has recently spread along the Atlantic coast from South Carolina to Massachusetts. In the West, heptachlor at 4 oz. per acre is recommended when plants are less than 2 in. tall will control the adult insects and prevent egg-laying. In the East, heptachlor at the same dosage is recommended when the plants are 10–12 in. tall. Stubble treatment after the first cutting is also necessary sometimes. After forage is treated with heptachlor, seven days must elapse before harvest, for the residues to dissipate to the required tolerance.

The pea aphid is damaging to alfalfa, clover, and other legumes in many parts of the United States. Malathion is recommended at 10 oz. per acre and gives good control. A period of seven days must elapse between treatment and feeding of the forage. Parathion at 4 oz. per acre is also recommended, with a 15-day waiting period before feeding.

The spotted alfalfa aphid, a recent pest in this country, now is known to occur in 31 states. Demeton, parathion, and malathion are recommended for control of this pest, but the costs are high. Waiting periods of 21, 15, and seven days, respectively, must elapse between treatment and feeding, to prevent any residues in milk.

Spittlebugs, which are serious pests of alfalfa, clover, and other legumes, occur from Illinois east to the Atlantic coast and south into Kentucky. Heptachlor and methoxychlor are recommended as sprays about 1 wk. after the eggs hatch. A seven-day waiting period before pasturing or feeding is necessary to prevent residues.

Potato leafhoppers are damaging to alfalfa in the eastern half of the United States. Methoxychlor at 8 oz. per acre applied when the crop is half-grown controls these pests. A seven-day waiting period before feeding to livestock is again necessary.

The use of the chlorinated hydrocarbons, especially DDT, for control of the European corn borer and corn earworm on sweet corn, are major developments in controlling these important pests, but again, their use creates a serious residue problem in milk from animals feeding on the silage and forage. The present requirement is that forage from corn treated with DDT emulsion can not be fed to dairy animals. Substitute insecticides, such as ryania and parathion, have been developed for the control of the corn borer. Although these...
materials are not as effective as DDT, they do not leave objectionable residues on the fodder at harvest. No satisfactory substitute for DDT has been found for corn earworm control. Since, in most areas, it is impossible to produce marketable sweet corn without applying DDT for corn earworm control, producers are losing the use of a valuable by-product, and the dairy farmers are losing the source of a valuable and economical feed because the contaminated fodder cannot be fed to animals. These losses, and consequent increased costs from the necessity of using other feeds are, in the end, passed on to the consumer.

**INSECTS ATTACKING DAIRY CATTLE**

Numerous kinds of insects attack cattle in all parts of the United States. Biting flies, such as the stable flies, horn flies, horse and deer flies, and mosquitoes, plague livestock during the warm season of the year. To protect themselves against these pests, cattle will run, fight the insects, and will not feed properly. According to the limited experimental evidence available, biting flies reduce weight gains and milk yields up to 20%. Under moderate-to-severe infestations, dairy cattle are not contented animals or producing to the highest capacity. Furthermore, the quality of milk may be adversely affected. Studies are needed to determine what effect biting flies may have on the quality of milk, as well as other edible tissues. Frequently, cattle are frightened and under severe stress when insect infestations are heavy. Fright and stress very likely produce physiological reactions that may affect milk quality.

Horn flies spend their entire adult life on the animal, leaving only momentarily to oviposit in the droppings or as a result of the animal's fighting the flies. The only known economical method of controlling these flies is by the use of insecticide sprays on animals. Because of minute residues in milk, amounting to about 0.15 p.p.m. for three-four days after treatment, methoxychlor sprays are not recommended on dairy cattle. Malathion, also effective against horn flies, shows a residue of about 0.17 p.p.m. in the milk for the first few hours, but none a day or two later. Several other effective insecticides leave similar residues. Therefore, we are limited in our recommendations for insect control on dairy cattle.

Current recommendations include the sprinkling of 1 tablespoonful of a 50% methoxychlor dust on the back and neck of each animal at 3-wk. intervals. This treatment, while effective in controlling horn flies, will not control lice or other biting flies. Methoxychlor sprays should not be used, because of residues.

Pyrethrum synergized with either piperonyl butoxide or MGK 264 will control horn flies, stable flies, and mosquitoes, but sprays must be applied every one to five days, depending upon the locality and pressure of insect attack. Thanite and Lethane have been used for about 25 yr. in oil-mist sprays applied at a rate of an ounce or two per animal, and are currently recommended. They are usually not so effective as pyrethrums preparations and must be applied daily. No other insecticides or repellents for fly control are recommended by our Department for use on dairy cattle.

Only two materials are recommended for control of lice on dairy animals. These are synergized pyrethrums emulsions containing 0.035% of pyrethrins applied as a spray, and rotenone prepared by adding 1 lb. of 5% dust to 100 gal. of water. From 2 to 4 qt. sprayed thoroughly over the entire animal is usually necessary. Two treatments should be made about 2 wk. apart, in the late fall or winter.

The same insecticides, but at higher concentrations, can be used for the control of ticks, but are not nearly so effective as toxaphene or malathion which, of course, can not be used on milk animals.

Rotenone is the only material that can be recommended for the control of cattle grubs on dairy animals. The spray is prepared by using 7 1/2 lb. of a 5% rotenone powder to 100 gal. of water. It should be applied to the backs of cattle with a power sprayer or scrubbed on with a brush. Treatments should be made two or three times at 30-day intervals, after the grubs appear in the back.

**FILTH INSECTS IN MILK BARNs AND PROCESSING PLANTS**

House flies are the most important filth pests in and around animal shelters, milk barns, milk rooms, and bottling and processing plants. They breed in moist, decaying organic matter, including manure, straw, grass clippings, and garbage. These pests do not distinguish between filth and cleanliness, walking or resting indiscriminately on any surface. Utensils, processing equipment, and the milk itself, therefore, are subject to contamination during the several warm months of the year when flies are prevalent. Sanitation is the first line of defense against these insects. Breeding materials should be destroyed or removed from premises.

After DDT became available, in about 1946, nearly perfect house fly control was easily accomplished by spraying the walls, ceilings, and other fly-resting places at intervals of 6–12 wk. It was soon learned, however, that DDT tended to flake off treated ceilings and walls and contaminate feed, water, utensils, and milk. DDT and other long-lasting materials were subsequently withdrawn from recommendations for use in dairy barns and other places where they were likely to contaminate foods. However, they can be used in other farm buildings and outdoor situations.

During the early 1950's, house flies became resistant to DDT and other chlorinated hydro-
carbon insecticides, and their control became almost impossible. Research at our Orlando, Florida, laboratory and by industry and states showed that some of the organic phosphorus insecticides provided fair-to-good control, but that treatments had to be made more frequently than with the chlorinated hydrocarbons. Early in 1954, the Orlando researchers announced the development of poison baits containing sugar or other sweet substances plus 1 to 2% of malathion, Diazinon, or Bayer L 13/59. One type of bait is prepared in dry form and can be scattered in barns and other places where flies congregate. Another type is liquid and is dispensed over floors with a sprinkling can. These baits are highly effective against house flies in most situations and, in addition, are economical in cost and time required for application. They are exceedingly safe to use.

As was to be expected, house flies gradually became resistant to the organic phosphorus materials, and last year trouble was experienced in obtaining control in some parts of the country. Researchers are now seeking substitute materials.

In dairy barns house flies can also be controlled with fine mist sprays containing synergized pyrethrum. Applications should be made once or twice a day, or as frequently as needed to knock down the flies. These sprays, while expensive, have the advantage of complete safety and also of killing stable flies, against which the poison baits are not effective. Pyrethrum sprays are widely used in dairy barns and other places where contamination of food is likely to occur.

Cockroaches and blow flies are filth insects, but usually not so prevalent in dairy barns as are house flies. However, a barn may be heavily infested with cockroaches without the owner’s knowledge, because these pests come out of hiding only at night. Current recommendations for the control of cockroaches in dairy barns include spraying with malathion or Diazinon or floors, walls up to about 3 or 4 ft., baseboards, under and around feed troughs or cabinets, and any other places where they may hide.

Combating insects in and around bottling and processing plants requires close attention to cleanliness, including the prevention of waste food materials in which insects can breed or feed. Control should place emphasis on the exclusion of insects from the buildings. Windows should have tight-fitting screens, and doors should be tight, strong, fast-acting, and double-swinging. Vestibules are very useful in trapping flying insects when personnel enter or leave a building. Entrance vestibules usually have doors at both ends. Some of them are equipped with automatic spray devices that discharge small amounts of insecticides to kill insects before they gain admittance to the plant.

Conveyor openings are frequently fitted with air blowers overhead, which prevent insects from entering during transfer of materials to and from the building. The air blower must be of sufficient size and located so that a curtain of air is driven at a high speed over the opening.

When flying insects get into the plant, aerosol bombs containing synergized pyrethrum are highly effective and safe to use. The insecticide should not be directed towards food and equipment, or allowed to settle thereon.

If it becomes necessary to apply a residual insecticide, such as malathion, to the interior of a building for control of flies, food products and equipment should be covered with paper, cloth, or plastic sheets. Special brush-type applicators reduce the hazard of sprays falling or drifting over food and equipment.

Cockroaches are frequently abundant in dairy plants, even though a program of cleanliness is in effect, because they come into buildings as stowaways in boxes of supplies. Favorite cockroach harbors are switch boxes, cracks in tile and other wall surfaces, in and between cabinets and work benches, and behind insulated pipes adjacent to walls or ceilings. Malathion and Diazinon as wet sprays or dusts applied to these hiding places will reduce cockroach populations. Care must be taken not to blow the dust and spray around the plant.

**SUMMARY**

Insects and their near relatives are among man’s most serious enemies. The dairy industry is affected by many of these pests in several stages of milk production. They feed on the farmer’s forage and pastures, attack his livestock, and are nuisances in barns and milk rooms as well as in processing plants. Several highly effective insecticides for application to forage, directly on dairy cattle, and in barns can not be recommended because small amounts of residues are stored in the milk. To determine to what degree insecticides contaminate forage, meat, and milk, extensive and costly studies have been completed. The cost of this work is shared by industry, state, and federal agencies, but ultimately must be borne by the tax-payer and consumer. Research is needed to develop safe and effective insecticides for use by the dairy industry in providing high-quality milk at low costs. Many of the currently recommended materials and methods are costly and not as effective as desired.