CONTROL ORGANIZATION RESPONSIBILITIES

Whether the responsibility of city or county health organizations, public-works programs or independent taxing districts, mosquito- and vector-control programs exist primarily to protect the public from organisms that cause discomfort or transmit disease agents. Federal, state and municipal regulations provide the essential guidelines for achieving these objectives, but how the task is done varies from place to place. This chapter deals with many of the interrelated factors that shape the organizational structure, effectiveness and public perception of these programs.

I. ORGANIZATION AND PRINCIPLES

Comprehensive control programs are carefully planned and executed operations aimed at ensuring effective and continuous control of mosquitoes or other **vectors** in a given area. They follow an integrated approach using combinations of methods designed to give maximum control with minimal impact on **nontarget** organisms, the environment and the general public. Such programs must consider cost/benefit ratio estimates and be economically realistic.

Established programs are routinely in a state of readiness in order to manage the normal course of events and to respond to the unexpected. Throughout the U.S. there is continual threat of introduction of exotic public-health pests and disease organisms. Detection of introduced pests is usually difficult and delayed, thus reducing the likelihood of eradication and leading to a policy of containment to prevent or slow further spread.

Under normal situations, control of public-health pests is a three-step process: data collection, data analysis and appropriate action. Data collections are performed routinely, and it is important that, before any control procedures are initiated, an assessment be made of the overall problem. The objective of the collection and analysis of surveillance data is to provide information regarding the identity, density and stage of development of the problem pests, as well as identification of the specific problem areas. This information provides the basis for prioritizing needs and developing strategies to initiate plans of action for control.

Planning

Routine operations. Experience has shown that when proper consideration is given during the initial planning stages, it is usually possible either to prevent problems from mosquitoes and other public-health pests or to minimize the control measures required. To be successful, a comprehensive control plan should include all of the practical control options for the local situation. Such planning requires attention to many issues: demonstrating the existence and identifying the source of the problem; analysis of remedial options; development of a realistic budget; securing funding, trained personnel, equipment and materials; and providing relevant public information and education.

Planning for a successful program starts long before the mosquito season and includes the confirmation or identification of the responsible elected officials. Specific individuals are assigned to oversee the effort and conduct the program, provide technical guidance, maintain equipment, procure insecticide, set application criteria and evaluate the results. Other planning aspects may include preparation for the use of specialized control techniques, new materials, insecticide resistance monitoring, disease monitoring, etc. It is very important that these matters be resolved at the outset.

Community-wide control operations are best conducted as continuing programs with a stable source of funds, financed by any of several different methods that are dictated by local conditions. These may include dedicated millage, fixed charges added to each household water-meter account, local sales tax or the general revenue fund. Whatever the source, a budget is established each year based on projected needs. The budget is a major planning tool. It is also used to evaluate progress at various intervals throughout the fiscal year and to adjust expenditures as required. The budget further serves to explain and justify the costs for the various phases of the operations. It should reflect the program's projected expenditures for personnel (by categories), contractual services, public relations, supplies and materials, equipment, and security measures for pesticides and application devices. It should indicate where these items will be used within the program. Because of the unpredictability of natural weather-related events, funding mechanisms should provide for contingency needs, such as allowing carry-over of a fixed amount of unused insecticide funds from one year to the next.

State and federally managed lands. Programs often need to consider the impact of state or federally managed lands that produce public-health pests, but are not under local jurisdiction. Often these pests can migrate considerable distances from their breeding sites and then impact residents. Therefore, many states require written operational guidelines and/or agreements that spell out what can be done on public lands to reduce the problem. Some public-land managers prefer to allow no public-health pest control except during periods of serious disease outbreak. These situations require advance planning and agreement to avoid a failure to respond when the need occurs, which is usually on very short notice.

Continuous Surveillance

Surveillance is the backbone of any mosquito-control program. Without adequate surveillance it is inappropriate to apply pesticides for the control of many public-health pests in most states. Control agencies may be required by law to demonstrate and record increased pest population levels before the application of **adulticides**, and it may be necessary to maintain this documentation for an extended period (three years in some states). Inspections should become routine once a sustained mosquito-control project is under way. Historical information from these observations also can be used to assess and evaluate the progress of the control operations.

Data from surveys are commonly correlated with reported disease prevalence or complaint calls. It is only after reviewing all of this information that the health office or control supervisor can make an intelligent decision as to the need to activate the type of control operations that will be most effective and economical. Although immature-stage pest density is often a bit more difficult to correlate with pest problems or disease hazards than adult pest density, larval surveys reveal the specific sources of pest production and enable application of effective larvicides at the right places and times. Data collected over a period of time may also serve to justify the use of permanent source-reduction measures.

Control

Permanent control is accomplished by source reduction (physical habitat manipulation). Initially, costs may be high, so cost/benefit ratio estimates should be determined before investing in a source-reduction project. Breeding areas that don't cause persistent problems or that can be economically controlled by larviciding in an environmentally safe manner may not justify the expense of source-reduction measures. For example, the collection or propagation and release of local strains of larvae-feeding minnows, such as *Gambusia affinis,* may be effective where water management practices provide continuous mosquito breeding habitat, making expensive physical habitat manipulation unnecessary.

Temporary control with insecticides, exclusion, removal with attractants, etc., requires continuous effort and repetitive budget allocation. Commonly, the overriding factor in temporary control is to make applications at the stage in the life cycle or seasonal biology that requires the least amount of insecticide in the smallest practical area. For example, treatment of mosquito larval habitat limits application to a much smaller total area than would treatment of adults after their emergence and dispersal. Furthermore, larval control reduces human exposure to pesticides and the probability of adverse public reaction in most instances. The reader is reminded that the Environmental Protection Agency does not consider registered public-health pesticides to pose unreasonable risks to the public when applied according to the label. Nevertheless, reducing public and environmental exposure is good stewardship, which should be practiced whenever feasible.

Special Circumstances

Storm water retention. Occasionally, local circumstances intensify public-health problems. For example, in most communities the control of storm water drainage is not the responsibility of public-health pest control agencies. Inevitably, however, storm water retention areas and reconstructed wetlands that have been designed without guidance from public-health pest control agencies tend to become significant sources of pestiferous insects. When control agencies are invited to share in the planning, problems can be avoided at the onset, and the resulting budgetary commitments to such breeding sources can be minimized.

Catch basins. Catch basin breeding also requires the attention of control agencies. The design of these urban devices often overlooks their great potential as breeding sites for production of large numbers of disease vectors in residential and commercial areas. In many communities, attention to catch basins represents a full-time commitment in order to prevent mosquito-related problems.

Water management issues. Mosquitoes, biting flies and biting midges propagate quite successfully in a variety of aquatic habitats created by commercial interests. These include, but are not limited to, irrigated crop lands, package sewage treatment plants, municipal water treatment plants, spray fields for industrial waste, and holding ponds and lagoons for animal waste. Public-health and mosquito-control agencies are often required to work out corrective measures to mitigate the problems generated by these activities and facilities.

Public domain. In most states and communities, the public does not have the right to produce or harbor public-health pests. When a business or homeowner fails to correct a breeding problem, the local control agency usually has the authority to enter the property and inspect the situation. If the agency deems that the situation impacts on other residents in the area, it can take action to enforce compliance or to mitigate the problem. Improper waste-tire disposal frequently requires such intervention.

Vector control at schools. Many states have regulations that control the use of pesticides on school grounds and inside school buildings. These rules not only regulate the type of control activity that may be conducted, but may also require the applicator to provide extended prior notice to the school administration and/or parents of attending children. In many areas these restrictions are waived for governmental agencies that use insecticides for public-health services. Applicators must be aware of the state and local ordinances in this regard.

Chemical drift and chemically sensitive individuals. Public-health insecticides, when used according to the label in public and residential areas, do not normally pose an unreasonable health risk to the public. However, there are individuals who have unusually adverse reactions from exposure to certain chemicals. Throughout the country, mosquito-control and public-health agencies recognize the need to provide special notice to people who have identified themselves as chemically sensitive. Some agencies call ahead to the residences of such individuals to provide advance notification of a pending application. Some agencies turn off the insecticide generator when passing such residences. This may appease the individual but realistically does not prevent the property from insecticide drift because the aerosols are designed to move with air currents in order to maximize their effectiveness. Momentarily stopping the output while the vehicle passes will not ensure that the property is not treated.

Beneficial insects. Beneficial insects may be sensitive to public-health pesticides. Honey bee colonies, for example, can be impacted by either ground or aerial application of mosquito **adulticides**. Product labels may include a statement relating to avoiding exposure of honey bees. Many agencies elect to spray after dark, which protects honey bees because they do not commonly forage in darkness (but may forage on bright moonlit nights). Others notify beekeepers of the pending application so that hives can be covered or closed. This is not, however, always successful, as the colonies may be in remote locations and beekeepers may be somewhat reluctant either to register their hives or to notify authorities of the specific locations. Thus, control agencies often are not aware of the presence of hives even though most municipalities require beekeepers to register.

Requirements for Records

In most states, applicators are required to keep records on both restricted- and nonrestricted-use pesticides for a set number of years. Upon request, copies must be furnished to any authorized agent at any time during the regular business hours of the applicator. Service technicians are required to keep records of their pesticide applications, usually including time and place of each application; applicator's name; name and address of the person receiving the service; street address or other legal description of land where used; date; tank mix, dilution rate and quantity; trade name and product registration number; and target pest. It is also recommended that the applicator record the wind speed and direction and other pertinent weather or location information. Additionally, many insecticides used for mosquito control cannot be used on crop or forage lands. Be certain that the insecticides selected for the control program are labeled for use on crops or are not used where they will contaminate crops.

Stewardship

Insecticides are useful and necessary tools, widely available and frequently used by almost everyone. They influence our daily lives in many positive ways, and they help protect the public from disease and nuisance pests, thereby making our environment a healthier and more pleasant place in which to live. Yet pesticides are not without disadvantages. They are expensive, and, if used inappropriately, they may themselves create human health problems, harm pets, wildlife or other nontarget organisms, or have other adverse effects. Pesticides are a double-edged sword that must be used intelligently with an understanding of what they can and cannot do, and with respect for their negative aspects.

Vector and nuisance pests can often be suppressed by nonchemical methods without causing adverse impact. Control organizations have the responsibility to use integrated management strategies when feasible. Among the successfully applied alternative techniques for controlling public-health pests are source reduction, exclusion, trapping, biological control, attractants and repellents. Strategies that minimize adverse impact on natural enemies of public-health pests or on species diversity and natural abundance of biological control agents should be favored when feasible. These stewardship strategies are discussed in the chapters that deal with specific pests.

Consider closely the possible side effects of phytotoxicity, fish toxicity, bee toxicity, drift damage, residues, contamination of drinking water or crops, the availability of pesticide baits to organisms other than the target pests, etc. Take care with insecticide application. When it is necessary to use insecticides, it is often possible to select strategies that minimize the risk of adverse impact. For example, treatment of mosquitoes in the larval stage minimizes the area required for application compared with treatment of adult mosquitoes after they have begun to disperse. Further, the use of an environmentally friendly IGR or microbial insecticide can help to target the pest with the lowest probability of adverse impact. It is incumbent upon the control organization to consider these factors and continually seek methods to reduce the probability of risk from insecticide use.

II. STAFF AND FACILITY

The commitments of a public-health pest control agency require professional attention to the factors involved in the intricate process of identifying and correctly addressing problems. The diverse responsibilities assumed by the staff are complex and require the leadership of trained professionals.

Responsibilities of the Director

The normal requirements of director of a public-health pest control agency are to plan, supervise and direct the control program, with responsibility for each aspect of the activity. These usually include:

- Determining the extent of the problem and locating the breeding or **harborage** areas
- Planning appropriate projects and actions to alleviate the problem
- Preparing and submitting regular reports
- Ensuring that political entities and higher management are educated in the requirements of the program
- Purchasing equipment and materials and maintaining inventories
- Providing for maintenance and security
- Hiring and assigning personnel
- Ensuring that work is carried out in a safe, effective and efficient manner in compliance with federal, state and local laws and regulations
- Evaluating program results
- Conducting continued surveillance of breeding conditions and pest density and distribution
- Establishing good public relations
- Continually improving the agency’s knowledge and abilities through interaction with local, regional and national professional associations

The director should keep up with new developments by reading technical journals and pamphlets, talking with representatives of equipment and chemical companies, and belonging to and attending meetings of associations in his field. One of the most useful information sources for both directors and staff is the Journal of the American Mosquito Control Association (AMCA). Annual meetings of the AMCA and state and regional associations serve as a source of new ideas and exchange of information.

The director is especially dependent upon the abilities and integrity of the supervisors and equipment operators. Supervisors must give their crews clear and complete instructions and see that all safety precautions are adhered to and that equipment is operated properly. Consequently, the success of such a program in turn depends on adequate insecticide inventory, equipment maintenance, correct application of pesticides, and the ability and willingness to use the materials and equipment as instructed and to immediately report malfunctions. It is important that each ground and aerial equipment operator know how to safely use, calibrate, check and maintain the equipment. The director is responsible for achieving this level of staff competency.

Together with staff, directors determine the most appropriate selection of control options and the timing of the operations. Careful consideration of these options can in many situations significantly reduce the probability of risk of adverse impact on workers, the environment and the public.

Public-health pest control is a professional endeavor. The complexity of factors related to the biology, ecology and diversity of the pests and nontarget organisms, including humans, combined with the regulations for pesticide application demand knowledgeable applicators. Professionalism comes from training, experience, alertness and attitude. Public-health pesticide applicators need to be highly trained technical staff.

Training, Certification and Continuing Education

Each employee should receive appropriate initial training and continuing education, be instructed in new methods and have a full understanding of the equipment, materials and concepts of the assignment. Although the director may have received the higher level of formal training, the supervisory staff should each be capable of independent leadership, and at least one (preferably all) is required by law to be certified as a commercial pesticide applicator. If economies in staff costs must be made, they should be made in a manner that preserves the integrity of the certification requirements and staff competency.

Facilities and equipment. The specialized functions of control programs are most effectively performed using equipment specifically designed or modified for the work and supported by facilities suited to this particular mix of biological and engineering activities. The better equipped and more responsive programs have dedicated maintenance staff and facilities for servicing and securing specialized equipment. They may have access to laboratory facilities to support necessary biological and chemical studies and evaluations, and office facilities where the various activities are coordinated. In-house capability for these activities significantly improves the ability of the agency to respond to the often unpredictable need for action. Safety of pesticide handlers and the public are critical factors, and risk reduction is further ensured by maintaining in-house capability.

III. APPLYING PESTICIDES CORRECTLY

The agency is responsible for the safety of its staff and the environment and must be proactive in establishing procedures that ensure safe handling and use of the products and equipment in its inventory. This responsibility extends beyond training and certification to provision of proper clothing and protective gear and supervisory oversight that ensures proper application techniques and safe working conditions.

Review the Core Manual, which deals with the acute hazards of pesticide overexposure for humans and other nontarget organisms and the many important factors and regulations regarding pesticide usage. Public-health pesticide applicators need to be thoroughly familiar with the wide variety of pesticide handling subjects found in the Core Manual:

- The law
- Labeling
- Registration types
- Precautionary statements
- Human exposure
- Toxicity
- First aid
- Environmental hazards
- Endangered species
- Pesticide formulations and compatibility
- Personal protection equipment
- Application equipment
- Calibration
- Safe application techniques
- Safe mixing/loading practices
- Packaging, storage and transport
- Pesticide spills and disposal
- Pesticide fires

These topics represent the basis for understanding the complexities of pesticide handling. Without a comprehensive understanding of these core issues, pesticide applicators are at risk of causing adverse health and environmental impacts and are likely to be unable to fully explain to the public the reasons for their actions.

Products and Techniques

The equipment and concepts of pesticide application differ little between applicator categories. Public-health pesticide applicators use much of the same types of equipment as agricultural and structural pest applicators. With the exception of some specialty insecticides, public-health insecticides are often the same as those commonly used for other types of pest control, but they are usually used at substantially lower application rates.

For information on the public-health pesticides registered in your state, contact the state pesticide coordinator.

Relationship Between Pesticide Application and Particle Size

It is important to understand the relationship between the types of applications used in public-health pest control and particle size. The effectiveness of a pesticide is influenced by the size of the droplets or particles applied and the equipment that is used for the application. For example, with residual applications that are used in agriculture and forestry the intent is to create a persistent deposit, which usually calls for medium to large droplets. But for an area application against adult mosquitoes or flies on the wing, aerosols with smaller droplets are used so that the insecticide will remain suspended in the air longer and thereby extend the period that the target insects are exposed to the droplets.

Liquid spray characteristics range from rainlike drops to mists and fogs produced by specialized generators. It may be impractical, if not impossible, to break up a liquid into entirely uniform droplets. But specialized equipment configurations can be used to restrict the range of droplet sizes. The usual practice to characterize these droplets is to refer to the mass median diameter (mmd) of the spray, which is the droplet diameter size that divides the volume or mass of the spray into two equal portions. The unit of measurement is the micron — 1/1,000 mm or about 1/25,000 inch. The average diameter of a human hair is about 100 microns.

Liquid applications may be categorized as follows:

- **Coarse** sprays contain droplets 400 microns or more in diameter that are produced with coarse disc nozzles or solid-stream gun nozzles. These droplets remain aloft for only a brief period.

- **Fine** sprays have droplets ranging from 100 to 400 microns, usually produced with hollow-cone and fan-spray nozzles. These droplets also remain aloft for only a brief period.

- **Mists** range in droplet size from 50 to 100 microns in diameter. They are produced by pumps using medium pressure and specialty nozzles, high-speed mechanical rotors and atomizers. Mists remain aloft longer than coarse and fine sprays and are subject to dispersal by wind and air currents.

- **Aerosols and fogs** are defined as very fine particles or droplets suspended in air and ranging in size from 0.01 to 50 microns. These may be produced by releasing the pesticide formulation directly into a blast of hot air, as with the thermal aerosol generator, or by mixing them with a liquefied gas that is then released through a small orifice, as with the household "bug bomb." They can also be produced by high-pressure atomization from specialized nozzles or dispersed from the rim of high-speed rotors.

Aerosol Generators

Fogs are dispensed as thermally generated aerosols through combustion exhaust systems, high-pressure steam exhausts, thermal pulse jet systems or as cold aerosols created by ultra-low-volume or high-pressure sprayers. Because of their small droplet size, these aerosols generally do not drop to the water surface and thus are not suitable for larviciding. But they are very effective for flying insect control because the individual droplets do not settle to the ground rapidly. They will impinge on small flying insects but usually go around larger objects. Dispersal of these droplets depends on air currents and other meteorological factors. For example, temperature inversion helps to hold the material below the canopy and consistent light wind (maximum, 8 to 12 mph) serves to propel it through the habitat. Under suitable conditions, such as a temperature inversion with a slight breeze, an effective swath width up to 300 feet or more may be obtained with truck-mounted ground aerosol generators, and much wider swaths with aerial applications.

Specialized generators are used to create aerosol droplets. This is accomplished mechanically with atomizing nozzles, spinning discs and high pressure nozzles, or by using heat. Thermal units usually produce fine droplets in the 5 to 10 micron range by vaporizing the carrier portion of the formulation to produce the small droplets. Truck-mounted thermal aerosol generators used in mosquito-control programs produce a highly visible insecticide fog that moves across open spaces, killing mosquitoes in flight as air currents move it. Thermal fogging requires a large vehicle to accommodate the volume of oil that is mixed with the insecticide, and, because of the sheer volume of droplets that needs to be **atomized**, the maximum road speed is 10 mph or less. Because of the high cost and possible environmental impact of the petroleum products used in this type of application, the popularity of thermal fogging has waned in recent years.

Ultra-low-volume (ULV) Application

Aerosols of undiluted insecticide are commonly used at extremely low application rates to control insects of public-health importance. Such **ULV applications** usually range from ½ to 3 fluid ounces per acre atomized into tiny droplets, the majority measuring 5 to 50 microns in diameter. Unlike thermal fogs, ULV aerosols are barely visible to the onlooker. These very fine droplets do not readily impinge or stick on the surfaces of large objects, but they disperse in air currents and deposit on small insects in flight. Drift of the ULV spray cloud is desirable and essential as it enhances the probability of reaching the target insects. Because of the low volumes of insecticide and the relatively wide dispersal of the application, the amount of the pesticide actually depositing on the ground or other surfaces per unit area is reduced compared with larger droplets — resulting in lower environmental impact.

ULV applications may be somewhat less effective than thermal fogs in heavy vegetation because of reduced penetration (Figure 9.1). Control of the droplet size is important to ensure proper drift and to prevent car spotting, which can occur with some insecticides due to the corrosive properties of the undiluted active ingredient in larger droplets.

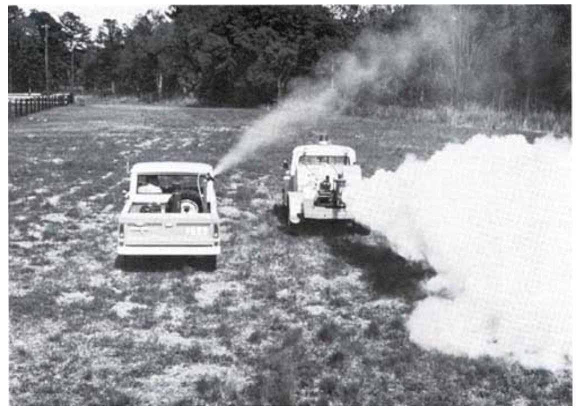

Figure 9.1. ULV (left) and thermal fogging

Greater care must be taken in handling the concentrated insecticides used in the ULV method than with the diluted fuel oil formulations used in the thermal foggers. This is due to the possibility of worker exposure during loading or handling prior to atomization. Applicator safety in recent years has been improved by several equipment improvements. For example, the aerosol generator is operated remotely from the cab of the vehicle, flow controllers are available that automatically adjust for vehicle speed, and automatic flow cutoff can be programmed to occur whenever the vehicle stops. Once dispensed and away from the point of release, the amount of active ingredient in the aerosol cloud has been determined by EPA to pose little risk to passers-by who might be momentarily exposed.

Ground ultra-low-volume application. Performance requirements for ULV ground applications against adult mosquitoes are as follows:

- The generator should be capable of producing most droplets within the 5 to 30 micron range. The optimum median mass diameter (mmd) is between 10 and 30 microns, depending on the label directives. Determination of droplet size can be achieved in several ways, but most commonly by catching a sample of the aerosol droplets on a silicone-coated glass slide and measuring the droplets in this deposit under a high-power microscope with a micrometer.
- Tank pressure should be not less than 3 to 3.5 psi, nor greater than 6 psi.
- Flow rate must be regulated by an accurate flow meter and should not be greater than 1 gallon/hour with truck speeds of 5 mph and proportionally greater volume at higher speeds.
- The nozzle should be in the rear of the truck and pointed upward at an angle of 45 degrees or more. Delivery of the pesticide should be interrupted when the vehicle stops.

Aerial ultra-low-volume application. Before aerial application, the applicator and equipment must meet Federal Aviation Administration (FAA) requirements, which may vary depending on whether the aircraft is public or private. Pilots must be certified as aerial applicators.

Equipment for aerial ULV has been similar to that used in ground delivery in that it consists essentially of three main parts: pump, nozzles and spray tank. For a boom and nozzle system, the pump selected should have a capability of producing at least 150 psi with an output rate of 3 to 5 gallons/minute. (The use of high-pressure nozzles in the range of 2,500 psi, which more effectively prevent the occurrence of large droplets, is currently in development.) Positive displacement or centrifugal pumps should be used, either driven by gasoline engines or electrically — electrical being more dependable. Centrifugal pumps require a 3/16- to 1/4-inch diameter bleed line installed on the high point of the impeller chamber to release trapped air.

When installed outside the wings, booms should be designed so that flight capabilities of the aircraft are not materially decreased. Trailing edge booms are desirable because the nozzles can be placed on the boom where the pilot can readily see them to check their performance during actual spray operations. For slower flying aircraft (90 to 125 mph), nozzle tips such as the Teejet No. 8001, 80067 or smaller may be required. Spinning disc nozzles and the more recently developed high-pressure nozzles are sometimes used because flight speeds and pump pressures are insufficient to provide adequate particle breakup.

However, with aircraft operated at 150 mph or more, nozzles such as Teejet 8002 to 8008 are commonly used. In most cases, these are flat fan-type nozzles, although the hollow-cone swirl-jet type of nozzle may be equally satisfactory. The projected output of insecticide by the system needs to be determined first to ensure the proper number of nozzles and appropriate orifice size to provide the desired rate of application. The nozzles should be installed at a 45-degree downward angle and facing forward to achieve proper atomization. Diaphragm check valves set at 5 to 12 psi are used on all nozzles to ensure positive cutoff of the spray. These should be checked frequently and replaced as needed.

Quick installation systems have been devised for the application of microbial insecticides in aircraft normally configured for other uses. These systems include a stainless-steel cylinder capable of containing several gallons of insecticide, connected by tubing to a rotary nozzle temporarily placed along the wing, and a small carbon dioxide tank to pressurize the system.

Aircraft spray tanks for holding technical grade insecticides are made of aluminum, stainless steel or fiberglass. Fiberglass is preferred when applying insecticides with corrosive properties. The tubing should be stainless steel or plastic and be able to withstand 2,000 psi pressure. Flushing the system after use and filling the lines with nitrogen reduces corrosion problems.

Aerial ULV vector-control applications must comply with label rates and directions and are conducted as follows:

- The optimum droplet size is about 25 to 50 microns mmd, depending somewhat on the insecticide characteristics regarding volatility and viscosity. Droplets larger than 50 microns should be avoided since they waste material, are an inefficient size for killing mosquitoes and do not give adequate coverage. In addition, the hazard to nontarget organisms and automobile finishes increases with droplet size, particularly with droplets larger than 50 to 100 microns.

- Typical applications are conducted at about 150 mph and 100- to 150-foot altitude, with swath widths of 300 to 700 feet. Greater swath widths have been used successfully with multi-engine aircraft flying at higher altitudes; however, droplet size and density per unit area may lose uniformity with increased swath width because the larger droplets fall faster than the smaller droplets, creating an uneven distribution. The greater the percentage of droplets smaller than 35 microns, the lower the application rate required, the wider the swath can be, the lower the deposition rate on the ground and the less the environmental impact.

- Application success is dependent on ambient wind conditions, temperature at and above ground level and other local meteorological factors, such as temperature inversion.

- Achieving the optimum configuration of application patterns and calibration of ULV spray planes to produce specified droplet spectra and swath widths requires considerable experience and time. Some state and federal agencies and commercial companies have experienced personnel who can assist public agencies with this work. Some of this information is available from the supplier of the technical grade insecticide.

Insecticide Resistance Management

Insecticide resistance occurs in vector populations as a result of selection of the more tolerant individual insects to the insecticide in use. Sometimes resistance to one chemical extends to other insecticides in the same chemical class because the **mode of action** that confers the resistance is similar. This phenomenon can cause an entire class of insecticides to become ineffective against the resistant insect population. Because the number of effective insecticides registered for public-health pest control is limited, it is extremely important to maintain susceptibility in the target insect populations. To minimize the probability of resistance, use these guidelines whenever possible:

- Do not use the same chemical class against both larvae and adults.

- Apply the rates indicated on the label, do not under-dose.

- Replenish persistent applications at the recommended interval.

- Use a different chemical class for a full season every second or third year.

- Assess susceptibility at the beginning and middle of each season.

IV. PUBLIC RELATIONS

Public relations are the methods and activities employed by an individual, organization, corporation or government to promote mutual dialogue and a favorable relationship with the public. When involved with pesticide applications, good public relations are a necessity.

Problems arise when consumers misunderstand or have incomplete or erroneous information. While the certification process ensures that an applicator has an acceptable level of technical competence, the process does not stop at this point. In fact, it has just begun. To be successful, the certified applicator must be able to communicate effectively with the public.

It is important to remember that issues surrounding pesticides are many and complex. Thus, it is unrealistic to expect to be able to resolve every issue or to have complete knowledge of such a complex field. However, development of a solid, well-thought-out, public-education plan will pay dividends. There are “dos and don’ts” in the art of public relations, which if understood will result in more effective communication. The beneficial results of good public relations identify the truly professional applicator.

Good public relations require technical competence, professional appearance and attitude, the ability to identify and resolve problems before they magnify, and educational materials for distribution. A commitment to practice quality public relations will pay off in increased professionalism and pride. Some general guidelines to follow for agency public relations:

- Acquire technical competence.
- Commit to excellence in all pesticide applications. See that technical decisions are made competently and with sensitivity to environmental quality and public-health safety.
- Know and understand the rules and regulations governing the work.
- Be aware of changing techniques and technologies. Keep current professionally. Maintain a current and technically correct reference library (journals, books, pamphlets, reprints).
- Keep good documentation and good records. Immediately investigate and attempt to resolve problems arising from control techniques or procedures. Write reports as soon as the facts are available.
- Be associated with appropriate professional organizations. These associations usually have journals and newsletters that provide information concerning the latest in technology.
- Know the community. Encourage employees to be involved in community affairs.
- Be prepared to educate and instruct constituents. Where possible, use handout brochures to reinforce public understanding of agency practices.
- Be honest about pesticide usage, and the pros and cons connected with it.
- Use a focused and concise format to educate. Take time to listen. Avoid emotion.
- Practice good public relations regularly. Do not limit this practice to crisis situations. Strive to educate the entire staff and those served at every possible opportunity.

Developing a quality public relations program requires strong informational and educational components. Various methods or styles of communication need to be recognized and included in the program. Whether the public relations efforts are conducted in-house or contracted out, they must be continuous and long term to effectively inform the public and overcome the many sources of misinformation.

Individual vs. Community Responsibility

Public information announcements should bring attention to the fact that residents have individual responsibilities, even when served by organized public-health pest control agencies. They should maintain their premises in a manner that neither produces nor harbors public-health pests. They may be required to provide access to inspectors and to permit the application of control measures on their premises. Because such pests can disperse beyond property boundaries, states may authorize designated public agencies the responsibility of ensuring that adequate control measures are practiced on private property.

The public should be advised how to minimize direct contact with pests. Light-colored clothing, lack of perfumed odors and the safe, judicious use of repellents can reduce exposure when it is necessary to be outdoors during periods of risk. Reschedule personal activities and public events to reduce individual exposure. For example, shift evening athletic contests to daytime schedules to reduce the probability of viral transmission by mosquitoes.

Public service announcements should be provided on pest biology and behavior and on the threat that pests present. Such knowledge on the part of the public can have positive effects in reducing the severity of the pest's impact. Avoidance, simple counter-measures and increased confidence result from a correct awareness of the problem. This factor is especially important from the standpoint of social acceptance of pesticidal control. Experience has shown that communities that are well-informed about the materials and methods used to combat public-health pests, and the consequences of failure to take action against the threat, are less likely to accept the unsubstantiated claims of antipesticide advocates. The safety of approved control methods and materials has been established and confirmed by the federal and state regulatory processes that issue pesticide labels.

Public Inquiry

Public-health pest control impacts everyone who resides, works or visits an area subject to these measures. Because much pest control activity is not highly visible to the public, many are not aware of the breadth of programs that are conducted to protect them. Furthermore, most are not familiar with the methods and products used to achieve control. Thus, continued effort should be made to inform the public of the various factors and considerations that are involved in the decision-making process and in carrying out the control options.

Continuity of public exposure to the information is important. Constituents who have not been made aware of the concepts and procedures are easily distracted by alarmists who may also be inadequately informed. Therefore, public service media announcements should be aired regularly. Agencies should encourage newspaper, radio and TV representatives to visit their facilities and find out what is going on and why. In this manner the public will become aware of the many nonpesticidal activities that are being conducted to reduce the need for the use of pesticides, and that the pesticides in use are approved by both federal and state governments for that particular usage. Furthermore, the level of professionalism that exists in the agency will be more apparent to the public.

When the public has been exposed to accepted concepts, it is more likely that open dialogue can be fruitful and mutually informative. Public-health control agency representatives should strive to be well-informed and to have accurate data at their disposal. Useful information is available in hard copy and electronic form at state and federal media and Internet sites, especially for CDC, EPA and USDA releases. An important factor in weighing the benefits and risks of pesticide use for public-health pest control is that much of the pesticide application to which the public may be exposed consists of small-droplet, low-volume delivery. This results in minimal exposure during and after treatment and rapid breakdown to nonpesticidal by-products. Thus, due to the use of deliberately selected product chemistry and limited application rates, the impacts are well below those that are likely to pose an unacceptable level of risk to the public or the environment when applied according to the label, which is the law.

A primary public relations issue is that public-health pest control products are often delivered in residential areas. For this reason, EPA and CDC have been very careful to assess the probability of risk to human health. Their current findings are presented at their Web sites and should be reviewed regularly to keep up to date on the currently registered products.

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