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Pesticide Information Leaflet

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No. 36: Pesticide Usage and Exposure Patterns

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BACKGROUND

A pesticide is defined as any substance that is used to kill or otherwise control a pest. The term "pesticide" includes insecticides, herbicides, fumigants, fungicides, repellents, rodenticides, disinfectants, etc. In the United States, the Environmental Protection Agency (EPA) is responsible for regulation of pesticides. No pesticide may be sold in the U.S. before EPA has reviewed the manufacturer's application for registration and determined that use of the product will not present an unreasonable risk to humans or the environment. A pesticide that passes EPA's scrutiny will be registered for use on specific crops or sites, with specific label directions for how the product is to be used.

When used properly, pesticides can provide great benefits. Pesticides control important crop pests, ensuring a plentiful and diverse food supply. They prevent diseases of humans and animals and control pests that infest homes, schools, hospitals, food warehouses, and other buildings. Pesticides also may directly protect human health through controlling pests that transmit human diseases.

Pesticides are designed to be toxic to the pests they control, but they may also pose risks to humans and wildlife. Therefore, it is extremely important that pesticides be used only in strict accordance with the label. A pesticide should never be used on a crop, plant, or site for which it is not labeled, and should never be applied more frequently or at a different rate than the label allows. By choosing alternative measures when feasible; using pesticides sparingly; wearing the proper protective gear (as indicated on the label); and applying, storing, and disposing of pesticides properly, potential risks can be minimized.

Each pesticide product consists of one or more active ingredients (the substance that kills or controls the pest) and may have one or more inert ingredients (substances for which no pest control claim is made). Inert ingredients are usually added to make the

formulation easier to handle or apply, to dilute the product and thus make it safer for the applicator to handle, to increase the efficacy of the active ingredient by making it last longer in the range of the target pest, or other reasons. However, inert ingredients, while not providing direct control of a pest, may themselves cause adverse effects in humans and/or the environment.

NEWER VS. OLDER PESTICIDES

Pesticides in use in the U.S. today differ in significant ways from pesticides relied on from the 1940's through the 1970's. DDT and several other organochlorine insecticides have long since been banned for use in this country, while others in this class, while still registered for use, have little actual use. The older products tended to be low in terms of acute toxicity to humans, but had very long half-lives. Their long persistence in the environment, coupled with their tendency to be stored in fat, allowed them to accumulate in living organisms and to bioconcentrate in the food chain.

Newer pesticides tend to have shorter half-lives and to be water-soluble, so that they are excreted, primarily in the urine, and are less persistent in the environment. However, the acute toxicity of some of the products (notably, some of the organophosphate insecticides) is much higher than the older products, making them more hazardous for users to handle. Also, their increased water solubility has resulted in some contamination of ground water through improper application, poor well construction, improper disposal, and leaching.

Whereas earlier pesticides tended to have a broad spectrum of pests they could control, many pesticides today are far more specific in their action. Today's pesticides are effective at much smaller concentrations than in the past. Together, these two factors result in more different products being applied, but in a far smaller volume (ounces per acre, rather than pounds per acre).

REGULATORY FACTORS DECREASING RISKS

Each active ingredient intended for use on food must have a tolerance established. The *tolerance* is the legal amount of residue that may remain in or on the food at harvest. A specific tolerance is set by EPA for each pesticide/crop, pesticide/meat, or pesticide/meat byproduct combination. The relative proportion of each food in the diet, as well as the acute and chronic toxicity of the substance, is considered in setting a tolerance. Differences in the foods most relied on for infants and children's diets are also considered.

Under the Food Quality Protection Act (FQPA) of 1996, EPA was charged with reviewing all tolerances for existing pesticides within ten years to determine that they meet the revised standard of "reasonable certainty of no harm" from aggregate and cumulative exposures. *Aggregate exposure* refers to exposures from all sources, including residues in food and drinking water, occupational exposures, and incidental exposures. *Cumulative exposure* refers to exposure to different pesticides that share a common mechanism of action.

Pesticides used on food or feed crops often have a *preharvest interval* (PHI) established by EPA and appearing on the product label. The PHI is the amount of time that must pass before a treated crop can be harvested. The PHI is important in allowing time for the pesticide to degrade to a level at or below the legal tolerance.

Some pesticides, classified as *Restricted Use Pesticides* (RUP), have been determined by EPA to pose a potential hazard to humans and/or the environment even when used according to label directions. These products may be purchased and used only by certified applicators, or by someone who is acting under the supervision of a certified applicator. Certified applicators have received instruction in the proper use of RUPs. Non-RUPs are available for sale to and use by anyone without special training.

USAGE

About 940 million pounds of active ingredients are applied yearly to agricultural land to control insects, weeds, fungi, nematodes, bacteria, and other pests[1]. By volume, herbicides account for the majority of applications to agricultural crops. Pesticides are also applied to forests to control insects and understory vegetation; rights-of-way along railroads and under electric wires to control vegetation; boat hulls to control fouling organisms; houses, schools, and office buildings to control insects, rodents, and fungi; landscapes, parks, and recreational areas to control weeds, insects, and disease pests; aquatic sites to control mosquitoes and weeds; wood products to control wood-destroying organisms; food preparation areas to control insects and rodents; livestock to control insects and other pests; human skin to kill or repel insects; and other sites.

In many cases, the same active ingredient may be registered for use on many different sites such as on several crops, in a yard, and in a food warehouse. However, the concentration, application method, and rate applied may differ. Also, products with the same active ingredient may include different inert ingredients. For some applications, such as those to crops, pets, and livestock, pesticide usage patterns are seasonal. For other uses, such as structural pest control and greenhouse situations, pesticide applications may continue throughout the year. Pesticides may be applied as sprays, dusts, granules, baits, fumigants, injection systems, roll-on applications, shampoos or animal dips, and other methods.

FORMULATION AFFECTS EXPOSURE POTENTIAL

There are three main routes of exposure: oral, inhalation, and dermal; eye exposure is considered a special type of dermal exposure. Most pesticide active ingredients can be absorbed to some extent by all three routes, but the formulation of a product has a large effect on potential absorption.

Formulations

Emulsifiable concentrates have a liquid active ingredient with one or more petroleum-based solvents, plus an agent that allows the product to form an emulsion when mixed with water. *Ultra-low-volume concentrates* are products that may approach 100% active ingredient; they are designed to be used as-is or diluted with only very small quantities of water. Both emulsifiable concentrates and ultra-low-volume concentrates are easily absorbed through the skin.

Wettable powders are dry, finely ground formulations designed to be mixed with water. They are less easily absorbed than emulsifiable concentrates and other liquid pesticide formulations, but the powder may be inhaled during the mixing/loading process.

Dusts have a low percentage of active ingredient plus a very fine, dry, inert carrier made from talc, chalk, clay, nut hulls, or

volcanic ash. They are applied as dry material and are less easily absorbed through the skin but are easily inhaled.

Granules also have a low percentage of active ingredient but with larger, heavier absorptive materials such as clay, corn cobs, or walnut shells forming the carrier. They are also applied dry but pose less hazard of inhalation.

Baits have low percentage of active ingredient mixed with food or another pest-attractive substance. These may pose an ingestion hazard if they are placed where children or pets can access them.

PATTERNS OF EXPOSURE

Occupational exposures

People who work in manufacturing or distribution plants for pesticide products have the most potential exposure to pesticides; however, these individuals often have less actual exposure due to installation of engineering controls at the facilities and use of *personal protective equipment* (PPE).

Wettable powders and most liquid pesticide products, except those specifically designed for use by homeowners, require dilution with water, oil, or other solvent prior to application. Workers who mix and load these concentrates into the application equipment also have a high potential for exposure, especially if they do not wear the PPE designated on the product label.

Farm workers, migrant laborers, and others who must reenter treated areas to perform tasks such as cultivation, harvest, irrigation, and equipment maintenance may be exposed only to small amounts of pesticide residues remaining on the plants, but their jobs may require them to spend more time in the treated area than the applicator.

Labels specify PPE; *restricted entry intervals*, or REI (the time that must be waited after treatment before a worker can reenter a treated area without specific PPE); and training for workers and pesticide handlers on farms, forests, greenhouses, and nurseries. The REI applies only to workers, not to the general public. For instance, consumers may be allowed to enter and pick in a treated strawberry field, whereas farm workers would not be allowed in until the REI had passed. The reason is that workers may be in the field 8 hours per day for many days or for an entire growing season, while a consumer would only be in the field for a short period of time, and for only one or a few days per growing season. Thus, the potential exposure for a worker is much greater than for the consumer.

The type of equipment used for application of pesticides varies with the crop or site, the formulation of the product, the pest being targeted, the pesticide chosen, and the economic situation of the applicator or business. Airplanes and helicopters, tractor-mounted sprayers, backpack sprayers, canister sprayers (commonly referred to as B&G type), granular spreaders, etc. each provide different opportunities for exposure.

Some application equipment, such as closed cab systems where the operator is separated from the outside environment, provides very good protection from exposure. Some products are available for loading through closed systems and present very little opportunity for exposure of the mixer/loader. Many structural applications of liquid pesticides call for crack and crevice treatment, *i.e.*, a stream of pesticide is directed into the angles formed where floors and walls meet or other such corners along

which pests run, rather than a broadcast or space spray. Homeowners usually have the least specialized application equipment, but are usually applying dilute materials.

Many types of PPE are available, and label directions provide specific information on what equipment must be worn when performing specific tasks, such as mixing and loading, applying, or reentering treated areas. Applicators may also be overexposed if equipment is not properly maintained, when respirator filters are not changed often enough, etc.

In general, the hands and forearms receive the most exposure. Depending on the application equipment, splashback may occur to the lower legs, drift may fall on the head and ears, or a vortex effect may be generated, resulting in contamination of the back of the neck. A full protective suit, gloves, respirator, hood, and boots, while providing excellent pesticide protection, constitute a very hot outfit and may present a heat stress hazard.

Incidental exposures

Individuals who are not occupationally exposed to pesticides may still be exposed through residues in foods and water; in and around their apartment buildings, homes and yards; in their office buildings; schools, or public buildings; and at recreational areas. National attention is focusing interest in utilizing integrated pest management (IPM) strategies rather than conventional pesticide treatments in and around schools and public buildings. Long utilized in many agricultural systems, the IPM approach utilizes physical, cultural, biological, and other means of pest control as well as pesticides. It is important to recognize that IPM often still involves the use of pesticides, with pest detection, quantification of threshold levels for treatment, placement of pesticide, and timing of applications being improved to maximize crop yield, aesthetic benefits, and public health while minimizing potential adverse effects on human health and the environment. Pesticides may be needed, for instance, to control cockroaches and rodents in school cafeterias, but they may be able to be applied as baits contained in bait stations, with little opportunity for exposure of children and staff. Herbicides are frequently used to control weeds on athletic fields to prevent potential injuries associated with uneven playing surfaces, but they may be able to be applied as spot treatments rather than broadcast applications.

Many homeowners have herbicides and fungicides applied to their lawns throughout the growing season, either by themselves or by commercial firms. On a per-acre basis, homeowners use many times more pesticide (5 - 10 lbs/acre annually) than the amounts applied on agricultural land. Consumers also use insecticides, herbicides, and fungicides on their own fruit and vegetable gardens and inside their homes and apartments. Because the general public does not have special training or knowledge about the proper use of pesticides, they may be more likely to misuse pesticides than trained commercial applicators. For example, they may use a pesticide at a higher rate or more often than the label allows, not wear appropriate PPE, etc.

Another problem is use of a pesticide on a site for which the product is not registered. For example, a pesticide labeled for use on ornamentals that is instead applied to vegetable and fruit gardens, or the use of a pesticide labeled only for outdoor application in areas inside homes or apartments. Some products are not registered for additional sites only because there has been no particular need for them

(for instance, if more effective products already exist for such use), but in other cases, the product is not registered for a particular site because it would present a hazard.

A common source of accidental exposure in the home is improper storage of household pesticides. Children and others have also been injured when empty pesticide containers have been re-used for other purposes, as residues remain in the containers.

FOR MORE INFORMATION

For general information about exposure patterns in a particular agricultural setting, the local University of Maryland Extension educator can be a very good resource. You can find contact information for your local Extension office at extension.umd.edu/locations

For information about a specific potential exposure, contact the business or the applicator involved in the application.

SOURCES

Robinson, J.C., W.S. Pease, D.S. Albright, and R.A. Morello-Frosch. 1994. *Pesticides in the home and community: Health risks and policy alternatives.* CPS Report, California Policy Seminar, Berkeley, CA.

U.S. Environmental Protection Agency, United States Department of Agriculture, U.S. Department of Health and Human Services, U.S. Department of Labor, and the National Environmental Education and Training Foundation. 2000. *Draft implementation plan: Pesticides and national strategies for health care providers*. Environmental Protection Agency, Washington, D.C.

Lindell, A.R., G.M. Bernier, C. Burns, J.R. Roberts, B. Rogers, C. Simpson, and A.E. Brown, (in press). *Recommended practice skills for pesticide management –Primary care medicine and nursing.* U.S. Environmental Protection Agency and the National Environmental Education and Training Foundation, Washington, D.C.