

Good Agricultural Practices: animal avoidance and pest control [1]

1. Introduction

The term “pest” applies to all organisms that can contaminate fruit and vegetables during production in the field (growing, harvesting) or handling at later stages (packaging, storage, distribution, etc). The products may become contaminated either directly or indirectly when the pest acts as a vehicle for other organisms. “Pest” includes (wild) animals like mammals, birds, reptiles, insects, or microorganisms and weeds (which can also harbor insects, vermin, etc.). All of these should be considered when implementing a pest control program

In this document, animal avoidance and pest control are presented as GAPs. It must be realized, however, that the approach described in this article is based mainly on pest control programs that are relevant to the USA^[1]. The European strategy with respect to control of pesticides is presently being harmonized^[2].

2. Animal control

Feces are usually considered the main source of pathogenic organisms from animals (Murray et al., 1995). However, since animals are in contact with soil, manure and water, they can easily pick up contaminants from these sources on their hide, paws, hair, etc. In addition to foodborne pathogens, animals can carry many spoilage microorganisms, which can greatly reduce the quality and shelf life of fresh produce. Quality deterioration also can be accelerated by physical damage to the surface of the fruit or vegetable caused by animals, birds and insects. In addition to reducing quality, the wounded surfaces become an open window to pathogenic and spoilage organisms, greatly increasing the risk of contamination for the inner parts of the produce.

Domestic animals, such as pets and livestock, offer as much a risk for contamination of produce as wild animals. The risk of contamination is greatly increased when there are large numbers of wild animals near the growing area. This includes animals such as crows, migratory birds, bats, etc. The presence of these animals is common when there are large forests, rivers, etc. around the fields. In such cases, there are a number of different measures that can be implemented to exclude animals from the fields.

All animals, including pets, should be kept away from crop growing and handling areas. Dead or trapped animals should be promptly disposed of to avoid attracting other animals. Proper disposal procedures are to bury or incinerate the animal.

Maintaining an animal-free area, such as cleared land, around the growing site is an important control measure. Farmers often use homemade devices to repel animals, and in many cases, these are very effective. The devices range from scarecrows, to water guns,

traps, and physical barriers. When selecting a method of animal exclusion, it is important to consider the country's environmental and animal protection laws.

Since animals are attracted by water, which is needed for bacterial growth, the presence of water in the field and the packing building should be limited to that needed for specific uses. In the packing house, surfaces and floors should be kept clean and as dry as possible to avoid the availabmaking water available for bacterial growth and pests. Water tanks and storage containers should be covered to prevent access of animals to water sources.

2. Pest control

Insects (cockroaches, flies, etc.) and rodents are the pests most commonly found in food handling facilities. Rats and mice not only cause significant losses of fresh produce, but also damage the buildings. In addition, they can contaminate fresh produce with parasites and other diseases agents. Rodent feces and urine can contaminate produce with microbial pathogens.

2.1 Pest control programs

It is recommended that an in-house pest control program is implemented to prevent contamination of fresh produce. A pest control program often includes general measures, like cleaning as well as specific controls. Many produce-packaging operations prefer to use professional pest control services. However, packing house personnel play an important role in detecting pest problems. A pest control program should include a series of scheduled inspections to identify situations that can encourage the introduction of pests, identify the presence of pests and quantify their number.

A sound pest prevention and control program will help to ensure that pests are not a problem in production and handling areas. Records should be kept of all inspections, pests identified and control treatments recorded. These records will demonstrate that the pest prevention and control program is effective. Registration will save time and money, and help prevent small problems from becoming large ones.

Maintaining the fabric of buildings is important in controlling pests. Repair of cracks and holes will prevent pests from entering the building, while eliminating places where pests could gather will discourage them from becoming permanent residents.

2.2 Common pest control procedures.

Pest control can be accomplished by either non-chemical or chemical methods, or through a combination of both (Table 1). When selecting a pest control method, choose one that is approved for local, regional and/or national use and then apply it in an appropriate manner.

Table 1. Control measures used to prevent or lessen crop damage caused by pests (U.S. EPA, 2001).

Method	Description
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Biological control	<p>Uses living organisms for pest control. Bio-pesticides fall into 3 major classes:</p> <p>(1) Microbial pesticides contain a microorganism (e.g., bacterium, fungus, or virus) that generally attacks a specific pest.</p> <p>(2) Plant pesticides are substances that plants produce once appropriate genetic material has been incorporated in the plant.</p> <p>(3) Biochemical pesticides are naturally-occurring substances that control pests by non-toxic mechanisms (e.g., pheromones).</p> <p>Some plant growth regulators are naturally-occurring bio-pesticides. Biological control also includes the release of parasitic and predaceous insects to control insect pests or weed species.</p>
Plant resistance	Crop plants are bred to produce varieties that resist insects and other pests. Crop plants are also genetically modified to allow them to withstand herbicides, so that only weed species are killed, when the crop is treated with chemical pesticides.
Cultural methods	Methods include crop rotation, soil tillage, use of trap crops, change in planting or harvesting time, inter-cropping with other crops or with varieties which repel pests.
Mechanical and physical methods	Techniques such as collecting pests with traps, suction devices or by hand, using fire, heat, cold, sound, barriers or screens.
Chemical methods	They comprise conventional pesticides that are synthetic chemicals aimed at preventing, destroying or repelling pest or mitigating their effects; otherwise, a pesticide may be intended for use as a plant regulator, defoliant or desiccant.
Integrated pest management (IPM)	IPM is a pest management approach that uses all available pest control methods, including, but not limited to, the judicious use of pesticides to optimize a crop's ability to resist the pest, with the least hazard to man and the environment.

2.3 Pesticide use and misuse

Pesticides are used to protect growing crops and stored grains, control household pests and nuisance insects, and eliminate vectors (organisms that carry pathogens from one host to another) of human and animal diseases (U.S. EPA, 2001).

They are toxic (hazardous) chemicals used to control pests. Classes of pesticides are commonly named after the pests that they aim to control, i.e. insecticides control insects; herbicides control weeds; fungicides control fungi; and rodenticides control rodents.

Since pesticides can be extremely hazardous, they should be applied, handled and stored

in accordance with the instructions given on the label or in the manufacturer's safety data sheet for the product. Because of the potential health hazards associated with pesticides, only those approved for use on a specific product or in food processing facilities should be used and the application rate should be controlled to limit the amount of remaining on the product as a residue.

Note: Present situation in Europe

In the EU White Paper “Strategy for a Future Chemicals Policy”, a total re-evaluation has begun of the Community’s risk management policy for chemicals, coupled with the equally important strategy for reducing the dangers posed by pesticides.

Recently a proposal has been published for a new EU Regulation on maximum residue levels (MRLs) for pesticides of plant and animal origin [2]. The consequence of this draft Regulation will be that all MRLs for plant protection products will become harmonized after a transitional 'phasing-in' period.

The proposal will remove all inconsistencies in the trade that result from the current situation. At present, Member States can set their own MRLs in the absence of any Community limits. In addition to consolidating and simplifying existing legislation, a major objective of the Regulation is to define the roles of the different authorities in the process of setting MRLs[3].

The responsibility for testing and risk assessment of chemicals will be changed from national authorities to industry. Also a tailor-made authorization system, where stringent control is ensured for the most dangerous substances, will be introduced.

Registration enables authorities to control quality and usage levels, and deal with efficacy claims, labeling, packaging and advertising. Registration also helps to ensure that the interests of end-users are well protected.

Pesticides should be used only on crops for which they are registered. The use of pesticides on other crops or at inappropriate levels can result in produce being refused for importation, thus leading to significant loss of income for growers, packers and shippers.

Selection of pesticides. Pesticides should be used only when needed and in amounts that will adequately control pests. Minimizing the amount of pesticide used reduces costs and helps to protect the environment (Nesheim, 1993). The label on the pesticide is the ultimate source of information on usage rates. It is recommended that growers document and verify that the pesticides they use have come from certified distributors, and that usage has been approved by a competent authority.

Pesticide handling. Pesticide handling should be controlled through every phase of use from acquisition through storage to use in the fields. It is very important that the individuals in charge of handling these products carefully follow the instructions printed on the label or on the information page that usually accompanies the product.

Pesticide application in the field. The instructions for application of a particular pesticide

should be read carefully before the product is used. Information such as restrictions on use, application rates, approved doses, number of applications and minimal intervals between applications and consumption of the treated product should be carefully considered.

Pesticides can be applied in liquid, solid, or gaseous form. It is important to follow label instructions for mixing, loading and handling of the specific pesticide being used and the actual conditions of use. The amount of pesticide concentrate needed to treat a specific site should be calculated carefully. The water used for dilution purposes should be free from pathogenic organisms.

Special attention should be paid to spray equipment, pumps and nozzles used to apply pesticides. To minimize the potential for over- or under-dosing, accidents or spills, the equipment should be calibrated for accuracy and checked frequently for malfunctions. Spray equipment should be washed regularly to prevent possible contamination of a fruit or vegetables with compounds not authorized for that commodity and to avoid accidentally overdosing.

Warning signs should be posted on fields that have been treated recently with pesticides to prevent workers or visitors from inadvertently coming into contact with treatment chemicals. Such signs should only be removed after the established re-entry period into the field has passed so that residual levels are acceptable.

Pesticide storage. The amount of pesticide on hand should be kept to a minimum by buying only what is needed for the growing season or for the specific application intended. All pesticides should be stored safely away from children, animals and anyone who might misuse them. Pesticides should be stored in clearly labeled containers, preferably in the original ones. Containers should be kept in a safe storehouse that is well ventilated and can be locked to prevent unauthorized entry. The storehouse should be located away from populated areas, on well-drained land, and away from domestic water supplies. It should be constructed from non-combustible material and have a leak-proof floor and emergency exits. Any pesticide spillage should be cleaned up thoroughly with large amounts of water. Pesticides and food should never be transported in the same vehicle.

Pesticide residues. High levels of pesticide residues on crops may be a hazard to humans who eat the produce. To regulate pesticide residues, each one has a legally enforceable MRL.

Pesticide disposal. Instructions and restrictions on pesticide disposal are available from the product manufacturer and may also be established by local environmental regulators. These should be followed. Empty pesticide containers should be washed repeatedly before being returned to the supplier or taken to an appropriate place for disposal. Excess spray and rinse water from equipment cleaning can be sprayed on sites or crops listed on the label. Neither pesticide residues nor spent containers should be disposed of in unused wells or near water sources. Empty, properly-rinsed pesticide containers can be taken to most sanitary landfills (USA only!). In view of the persistent, volatile nature of many pesticides, disposal by burning or burying on the farm is discouraged.

Training and documentation. Thorough training of the personnel responsible for using and applying pesticides is critical. They also should be trained in the use of safety equipment. Personnel should be aware of the dangers that can result from improper use of the product and field workers should be reminded that adverse health effects caused by pesticides are often not noticeable in the short term, but can develop over time if exposure is not reduced.

The producer or person responsible for pesticide application should have the following information:

- Technical data sheets on the pesticides to be used
- Pesticide permits issued by an authorized regulatory organization. If the product is not listed as authorized for the crop being treated, it should not be used.

A producer should evaluate critically the need for a pesticide and, when possible, use an alternative method of pest control instead. Careful records should be kept on pesticide usage and should include the information listed above (Buttler et al, 1993).

A pesticide record sheet should contain information on:

- Crop data (variety, planting date, product code, etc.)
- Names of pesticides used
- Place of application
- Dosage
- Application dates
- Period of time before harvest
- Name of the person responsible for the application
- Date of last equipment calibration

For more information on considerations in selecting and using pesticides, the U.S. Environmental Protection Agency Technical Information Package (TIP) – Pesticide Use and Disposal is recommended. (Available via the Internet at www.epa.gov/oia/tips/pestint.htm)

3. Summary

1. All animals, including mammals, birds, reptiles and insects are considered to be potential vehicles of pathogenic organisms that can cause illness and death in humans. In addition to foodborne pathogens, animals can carry many spoilage microorganisms, which can greatly reduce the quality and shelf life of fresh produce.
2. Animals, both domestic and wild, should be kept away from production and handling areas (growing fields, storage facilities, packaging areas, machinery, etc.) to prevent contamination of fresh fruit and vegetables with pathogens. The maintenance of animal-free areas, such as cleared land, around the production site is an important control measure.
3. Good hygiene practices (GHP) are essential for controlling animals and pests in produce production and handling areas. All areas where produce is grown and handled

should be kept clean and free of garbage, unused equipment or other conditions that might encourage animals to inhabit the area.

4. In addition to cleaning procedures, it is important to implement a pest control program, that should include a series of scheduled inspections to identify conditions that can encourage the introduction of pests.

5. Pest control can be accomplished by either non-chemical or chemical methods, or through a combination of both. The method chosen should be approved for local, regional and/or national level use and then applied correctly.

6. Pesticides are used to protect crops and stored grains, control household pests, including insects, and eliminate vectors (agents that carry pathogens from one host to another) of human and animal diseases. Because of the potential health hazards associated with pesticides, application rates should be controlled to limit the amount of residue on produce and only pesticides approved for use on the produce or in food processing facilities should be used.

7. Good quality water should be used for mixing and applying pesticides to minimize the risk of microbial contamination of treated produce.

8. Pesticides used on produce to be imported into the U.S.A. must be registered with the U.S. Environmental Protection Agency.

9. High levels of pesticide residues on crops may be a hazard to humans who eat the produce. To regulate pesticide residues, each one has a legally enforceable MRL. Countries that export foods should have appropriate monitoring programmes and comply with MRL requirements in order to demonstrate a responsible attitude.

References

1. Murray, P., Drew, W., Kobayashi, G. and Thompson, J. 1995. Medical Microbiology. Mosby-Doyma Libros, S.A. Madrid, Spain. pp. 423.
2. Nesheim, O.N. 1993. Best management pesticides to protect ground water from agricultural pesticides. University of Florida, Florida Cooperative Extension Service. Fact Sheet PI-1, June, 1991.
3. U.S. EPA. 2001. Pesticide Use and Disposal. Technical Information Packet. U.S. Environmental Protection Agency. Available via the Internet at <http://www.epa.gov/oia/tips/pestint.htm>

[1] This document is partly based on the publication “Improving the safety and quality of fresh fruit and vegetables”, published by the University of Maryland, USA. ©2002 University of Maryland.

[2] The existing EU Directives on pesticide residues (76/895/EEC, 86/362/EEC, 86/363/EEC, 90/642/EEC) will be repealed by the “Proposed Regulation on maximum residue levels of pesticides of plant and animal origin” (COM 2003, 117 final, dated 14.3.2003) which aims to harmonize these maximum residue levels (MRLs) at the European level.

[3] A MRL is the upper legal limit of a pesticide residue to be found on a food or feed commodity. It is not a toxicological limit and a violation is not necessarily a cause of concern for public or animal health. For pesticides authorized for agricultural use, the MRLs are set at the maximum safe level that one would

expect if the pesticide is to be used according to the rules and restrictions specified in the authorization.
More information can be found at: http://europa.eu.int/comm/food/fs/ph_ps/pest/intro_en.pdf