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Introduction

Farming operations of all types and sizes should employ multiple strategies to minimize impact on the environment. The purpose of this document is to provide a summary of practices used on Monsanto's farms in Hawaii to enable efficient production while using the best agronomic and environmental approaches for our production needs.

This document summarizes our existing practices in the areas of soil and water conservation, renewable resources, integrated pest management, responsible pesticide use, and community dialogue. We continually improve our practices as new approaches and technologies are identified or developed.





Conservation Practices

Soil and water conservation are two key areas for efficient and sustainable crop production. Without careful management of these critical components, farming cannot be a long-term endeavor. We take pride in our efforts to be good stewards of our farms and maintain the quantity and quality of our soil and water resources.

SOIL CONSERVATION PRACTICES

- NRCS Soil Conservation Plan
- Cover Crops
- Windbreaks
- Tillage and Dust Mitigation

NRCS Soil Conservation Plan

Our farms operate under conservation plans developed in conjunction with the United States Department of Agriculture's Natural Resource Conservation Service (USDANRCS). The components of this comprehensive plan include:

- Vegetative terraces established across slopes to slow and divert rain water runoff.
- Grassed waterways to channel rain water runoff and slow its flow rate.
- Sediment basins at the base of the slopes to collect excess rain water runoff and allow soil particles to settle to the bottom, allowing clear water to continue on its natural path.

The overall purpose of managing rain water runoff is to slow the water down, enabling it to enter the soil and keep soil particles on the farm, while the water continues on its normal flow path.

Soil Conservation: Cover Crops

In addition to having established conservation plans, we also use cover crops on our farms. Any specific field on our farms is typically used to produce seed crops just once a year, and at any given time, only about one-third of our fields are planted with seed crops. This allows us to have three seed crop production seasons per year. During the period between seed crop production, the fields are usually planted with cover crops for conservation and crop rotation purposes. Cover crops typically include grasses, small grains, mustards and legumes that provide vegetation to help:

- protect against wind-blown soil loss.
- improve soil structure for better water infiltration
- work with our other soil conservation plan components to slow the flow of rain water and allow it to enter the soil.

Soil Conservation: Wind Breaks

Where appropriate, we establish vegetative wind breaks to help reduce the wind velocity across our farms. This approach can help keep soil in place by reducing wind speed to allow soil particles to fall back to the ground.

Soil Conservation: Tillage and Dust Mitigation

There are many activities on farms that can produce dust. The main activities we deal with are vehicular traffic on farm roads and tillage operations in the fields.

We have many dirt roads across our farms that we use to transport employees and equipment from field to field. We minimize dust created from traffic on these roads by limiting vehicle speeds, applying gravel to main roads, and occasionally applying water on certain roads to reduce dust creation.

We use tillage on our farms in order to effectively produce our seed crops. Wherever and whenever practical, we utilize various forms of minimum tillage to maintain as much plant residue on the soil surface as possible. This helps to minimize water and wind erosion. We also consider several factors before initiating tillage in order to minimize the dust that is inherently created with tillage practices. These include:

- Wind speed and direction.
- Moisture level in the soil
- Appropriate speed of tillage based on the previous two factors

WATER CONSERVATION PRACTICES

- Irrigation
- Cover Crops

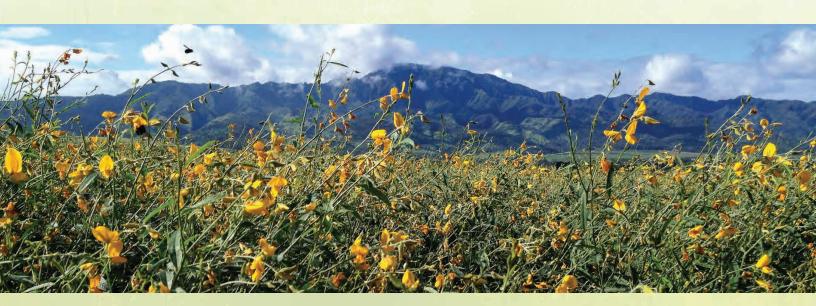
Water Conservation: Irrigation

In order to use irrigation water most efficiently, we utilize highly efficient, sub-surface, drip irrigation wherever possible. This type of irrigation involves the installation, at crop planting, of a flexible plastic hose beneath the crop seeds, which allows us to provide accurate amounts of water to the plant's root zone during the growing season. This practice eliminates evaporation and water runoff, which in turn enables the growing crops to make maximum use of the water. After harvest, the plastic hoses are removed from the soil, baled and sent for recycling.

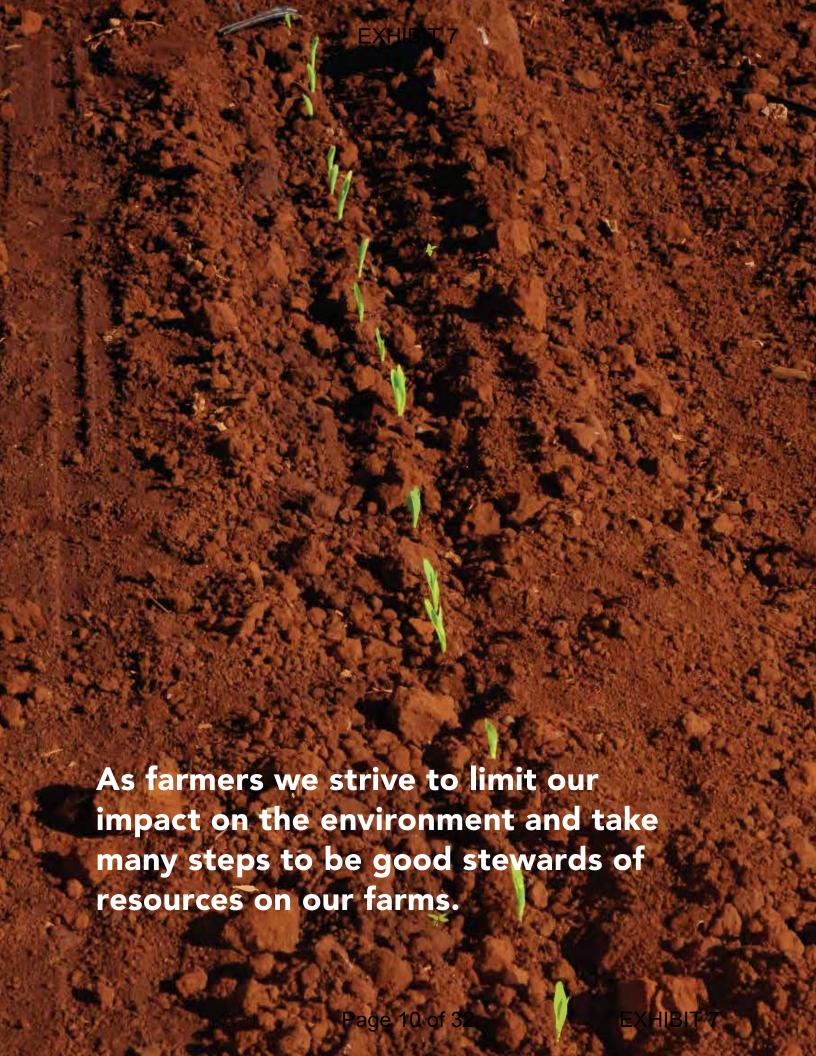
Where we don't have plants planted in rows (i.e. cover crops, fallow fields or non-crop areas like lawns and sanctuaries), we use sprinkler irrigation to deliver water. Using drip irrigation in these circumstances would be like trying to water your lawn using hoses with small holes in them versus a yard sprinkler.

Water Conservation: Cover Crops

Cover crops are typically used on our fields when seed crops are not being produced. They serve as a valuable tool for both soil and water conservation. Cover crops play an important role in water conservation during rainfall to slow the movement of water and allow the rainfall to soak into the soil through the pores and channels created by the cover crop root systems.



Cover crops, such as these sunn hemp, are a valuable tool for soil and water conservation.





Renewable Resources

As farmers we strive to limit our impact on the environment and take many steps to be good stewards of resources on our farms. From managing nutrients that are important for good plant growth and development to conserving energy, our farms are continually improving how we operate.

RENEWABLE RESOURCES

- Nutrient Management
- Water Quality
- Recycling
- Energy

Renewable Resources: Nutrient Management

We approach nutrient management in two main ways. First, we return as many nutrients as possible from plant material back into our fields, and second, we supplement existing nutrients in a very precise and controlled manner.

At harvest, there are two types of materials: the harvested material (for example, an ear of corn) and non-harvested material (such as plant stalks and leaves). While the harvested material contain a certain amount of nutrients, they are not directly available for return to the soil. The rest of the plant material also contains nutrients. We return this non-harvested plant material to the soil to recapture the nutrients it contains.

Since some nutrients are lost from the soil in the harvested material and to other natural processes, there will be a deficit of nutrients returned to the soil. In the case of our cover crops, which are not harvested, we return all of the plant material to the soil. When we select which cover crops to use, we consider which plant options are suitable for environmental growing conditions as well as how we can maximize the nutrients returned to the soil.

To provide the appropriate nutrients to the next seed crop we use various fertilization levels depending upon the crop and its growth stage. The fertilizer containing the necessary nutrients, along with water, is delivered to the root zone of the planted seed crops through the sub-surface drip irrigation lines. This precise practice places the nutrients directly where the plant needs them, and minimizes the potential for any movement of those nutrients off of our fields.

Renewable Resources: Water Quality

Despite all of our efforts to maximize water entering the soil on our farms, on occasion we can experience heavy rainfall that results in water moving off our fields. This water typically contains soil particles that could be carried away as it moves down slopes. To improve the water quality during these heavy rainfalls, we have installed grassed waterways that lead to sediment ponds at the base of our farms. This approach slows and captures the water, and allows soil particles to settle to the bottom before the water continues on its natural path to streams and the ocean. Periodically, the accumulated soil is removed from the sediment ponds and returned to the farm fields.

Renewable Resources: Recycling

We are very active in recycling on our farms. Not only do we practice recycling in our office operations (i.e. cans, bottles, paper, light bulbs and printer cartridges), we extend these efforts to our farming practices.

From a farming standpoint, we recycle in several ways. We recycle nutrients back into the soil by returning plant material to the soil, recycle our cardboard and packaging material, and recycle our plastic irrigation lines by removing them from the soil after each harvest and sending them to a commercial recycler.

Renewable Resources: Energy

We have several seed farms in Hawaii and energy is an important resource for our operations. It is important to us to continually improve our energy efficiency in our operations.

On our farms, we currently utilize solar hot water production and are working to expand our use of photovoltaic panels for electricity production. We continually explore these sustainable tools as an ongoing practice. During the planning and construction phases of new buildings, we invest to achieve the most energy-efficient facilities feasible. Our newest facilities are LEED Silver certified by the U.S. Green Building Council.



Retaining soil on the farm is an important part of our stewardship efforts. During heavy rainfall, grassed waterways and sediment ponds enable soil particles to settle out of flowing water, allowing the water to continue on its natural path.







Integrated Pest Management

Pest management is an important activity across society. Pests need to be managed to prevent health issues, improve safety, and avoid economic losses. Management of pests occurs in many places including homes, schools, hospitals, restaurants, public spaces and on farms.

Pest management on farms requires an approach that involves many tools. Over-reliance on any one tool will not result in the best sustainable production of the crop. Our farms employ a program known as Integrated Pest Management (IPM) which uses cultural, mechanical, ecological, and when appropriate, pesticides to minimize the impact of pests on our seed crops.

INTEGRATED PEST MANAGEMENT

- Fallow Periods
- Timing and Pattern of Planting
- Beneficial Insects and Sanctuaries
- Pollinator Sanctuaries
- Field Scouting

- Mechanical Control
- Netting
- Traps
- Pesticides

Integrated Pest Management: Fallow Periods

Many insect and disease pests spend part of their life cycle in the soil waiting for their desired food source to be present before continuing to their next generation. As part of our overall crop rotation strategy, one approach we use on our farms is called a "fallow period" which is a period of time during which a seed crop is not being grown. This fallow period helps to reduce pest populations by removing their preferred food source for a period of time, which helps to break their generation cycle. While this approach doesn't eliminate all of the pests, it reduces their population growth to a more manageable size. When combined with the other tools of the IPM program, this step plays a key role in the overall IPM program.

Integrated Pest Management: Timing and Pattern of Planting

Many insects that cause direct damage or carry diseases to the seed crops tend to move from older plants to younger plants using the wind to aid their movement. Another tool in our IPM program is to consider the timing of our seed crop planting and the pattern of planting, in relation to the prevailing winds. This can reduce the movement of insect pests across our farms.

Our goal is to plant the first seed crops of a season downwind of the next seed crops to be planted, in an effort to use the prevailing winds to help push some of the insects away from younger plants. While the prevailing wind direction is not constant, and not all types of insect pests travel with the wind, this approach does have an impact within the IPM program to help reduce pest pressure on the growing seed crops.

Integrated Pest Management: Beneficial Insects and Sanctuaries

Farming is part of an ecosystem that contains many living things, some of which can be pests and some which can be beneficial to crop production. From a farming perspective, beneficial insects are those that prey upon the key pests that can damage a crop. An important part of a good IPM program is to recognize and foster populations of these beneficial insects.

As part of our IPM program, we understand the key beneficial insects for our seed crops in Hawaii. Many efforts are undertaken to foster populations of these beneficial insects and minimize impacts to them from our other farming operations.

One practice we use is to plant sanctuaries to attract and maintain various beneficial insects on our farms. To ensure we attract multiple beneficial insects, we plant several types of flowering plants to encourage the most diverse populations of beneficial insect possible. These sanctuaries are planted in between and along the edges of our fields, which helps to provide many locations around our farms for these key insects. Cover crops can also serve as an additional tool to attract beneficial insects.

Integrated Pest Management: Pollinator Sanctuaries

Pollinator insects are an important part of the farming ecosystem. While not all farmed crops require pollinators for production, many do. In addition, many non-farmed plants rely on pollinators to produce seed from one generation to the next. Helping to maintain pollinator insect populations is not only beneficial for the farmed crops, but is also helpful to the overall ecosystem of plant sustainability.

Our main seed crops, corn and soybeans, do not depend upon pollinator insects to produce seed; however, many plants growing on our farm benefit greatly from these insects. Similar to the beneficial insects that help us manage pests, we strive to provide sanctuaries of flowering plants to foster populations of these pollinators.



Monsanto's IPM program includes recognizing and fostering populations of pollinator and beneficial insects through plant sanctuaries.





Photo of a corn earworm at our Kunia farm.

Integrated Pest Management: Field Scouting

Just as you monitor your home and yard for problems and pests, farmers closely monitor their crops. Farmers are very watchful of their crops, monitoring plant growth rate, soil moisture levels, fertility levels, and potential damage from pests.

All of our fields are monitored multiple times a week by trained field scouts. These individuals are looking at several things when they scout a field:

- plant growth rate and stage of development
- overall plant health
- weed populations
- beneficial insect populations
- pest insect populations
- signs of plant diseases

If overall plant health appears to be poor, the field scout evaluates the cause. There may be several possibilities including non-optimal water, non-optimal fertility or even damage from animals. When the cause is determined, the appropriate adjustments can be made to remedy the plant health problem.

If the field scout notices potential pest issues, an evaluation is made to determine if any action should be taken. This evaluation will include:

- Is the pest population large enough to cause unacceptable losses at the current plant growth stage?
- If the cause is an insect pest, is the beneficial insect population large enough to offset the pest population?

If it is determined that a pesticide application is warranted, the field scout will notify the IPM manager so that the most precise product, with the smallest potential environmental impact, can be used in that particular field's situation.

Integrated Pest Management: Mechanical Control

Mechanical control of weeds has been one of the most basic tools used throughout the history of farming. Whether it's pulling a plow through the soil to destroy weeds and prepare a seed bed, or using a hoe or other tool, weed control by tillage is one of the foundations of farming.

We include mechanical weed control as part of our overall IPM program in a way that balances soil disturbance with overall productivity of the farm. Each tillage operation is done for a specific purpose and is the most efficient way to achieve that purpose. Each tillage practice to control weeds comes at a cost including financial, labor, fuel, loss of soil moisture, and release of carbon into the environment. Therefore, the mechanical weed control decisions are evaluated for need versus other options.

Integrated Pest Management: Netting

Keeping pests out by covering crops with netting is a tool that is very effective in farming on a small-scale basis. In Hawaii, many small-scale vegetable farmers use netting to minimize pests' access to their crops. As farming operations become larger the use of netting can become impractical.

We use netting where practical on our farms. The netting we use is primarily to prevent birds from eating newly planted seeds of certain seed crops, or to exclude certain insects from smaller seed crop plantings in a netted growth house.

Integrated Pest Management: Traps

Insect pests can be present in high populations and are typically very mobile. A tool that can be used to help reduce potentially damaging populations of insect pests is trapping devices. Trapping devices have a limited impact on overall populations, but can play a role when combined with other tools and tactics within an IPM program.

On our farms we employ different insect trapping efforts. Some traps specifically provide information to our field scouts so they can better monitor changes in insect pest populations. Other traps are used to help reduce insect pest populations in addition to providing information to field scouts. The traps we employ fall into two main categories: those that are general and non-specific, and those that work by attracting certain insect pests into the trap.

General, non-specific traps are typically adhesive-based: large strips of colored plastic covered by an adhesive to which the insects stick (sticky traps). These are most similar to sticky fly strips that have been commonly used by the general public. The goal is to place these larger, farm-sized sticky traps in strategic locations around cropping areas to trap some of the insect populations flying towards the crops.

Traps that are designed to attract certain insect pests are typically containers that use either a sexually attractive chemical (pheromone) specific to certain insects, or a light source that emits wavelengths of light that are attractive to certain insects. The goal is to capture specific insect pests to reduce their populations. These traps have a limited area of influence so they are strategically placed around the crops to increase their effectiveness.

Integrated Pest Management: Pesticides

The least used tool of any good IPM program is the application of pesticides, which are employed when needed to manage pests whose numbers have reached levels that will result in unacceptable damage to crops, despite of all of the other IPM tools employed. Pesticides relevant to crop production fall into three main categories:

- herbicides to control weeds
- insecticides to control insects
- fungicides to control fungal pests

Based on field scouting, the appropriate pesticide products are selected depending on the specific pest in question.



On a small scale, netting can be an effective tool for minimizing pests' access to crops.







Responsible Pesticide Use

In spite of various efforts to prevent and/or control pests, there are times when they do exceed acceptable levels and need to be managed with pesticides to help reduce risks to human, animal or plant health. Pesticides are used in many places including homes, schools, hospitals, restaurants, public spaces and on all types of farms.

When a pesticide application is necessary, there are numerous regulations and safety considerations to consider before the application is made. Whether it's by a homeowner, pest control service, maintenance provider or a farmer, pesticide products should be handled, used and disposed of safely and according to its label.

RESPONSIBLE PESTICIDE USE

- Regulation of Pesticides
- Product Selection
- Resistance Management
- Application
- Reporting

Responsible Pesticide Use: Regulation of Pesticides

Pesticides can be either synthetic (man-made) or non-synthetic (i.e. oils, bacterial proteins, plant extracts). Regardless of whether they are synthetic or non-synthetic, they are all classified as pesticides because they are used to control "pests." Both types of pesticides should always be used in a safe and responsible manner according to the label for each pesticide.

Pesticides are highly regulated in the United States and many other countries. In the U.S. pesticides are regulated at both federal and state levels. Federally, the United States Environmental Protection Agency (EPA) is responsible for pesticide regulation. At the state level, the Department of Agriculture is typically responsible, working in partnership with the EPA, for regulating pesticide products.

Before a regulated pesticide can be sold and legally used in the commercial marketplace, it must undergo several years of rigorous testing to evaluate potential impacts related to safety, health and the environment. These evaluations are performed using scientific, evidence-based processes to ensure that proper use of the product has acceptable risks based on scientifically established criteria. "Acceptable risk" is a necessary standard because "zero risk" is an unattainable standard for anything in life (including cars, cell phones, cooking, etc.).

Once the EPA has evaluated a new product to their satisfaction, they may provide a registration for that product along with its label instructions. The label contains the legal requirements for the product's use. The product's legal label includes information such as:

- when the product can be used
- where the product can be used
- how much of the product can be used at one time
- how much of the product can be used over a period of time
- how the product can be applied

After a pesticide product has been approved by the EPA, each state evaluates the product's suitability for use in its state, usually based on EPA information, and provides approval by the state agency responsible. Once federal and state approvals are both in place, the product can be used, according to its label, by the appropriate end-user.

The appropriate end-user of a pesticide product depends upon both the product and the end-user's qualifications. Pesticide products are classified into two end-use categories:

- General Use Pesticides
- Restricted Use Pesticides

General Use Pesticide (GUP) products may be purchased by any consumer to meet their pest management needs on the basis of the products' properties and concentration. These products can be found in most hardware or consumer goods stores.

Restricted Use Pesticide (RUP) products are those that, based on their properties and concentration, may only be purchased and used by individuals who are licensed or working under their direct supervision of a licensed individual (http://www.epa.gov/pesticides/safety/applicators/restrict.htm). It's important to note that most RUP products' active ingredient (the part of the product effective against the target pest) are also found in GUP products. The reason they are restricted in RUP products is typically due to a difference in concentration between the GUP and RUP products.

While professional users buy concentrated RUP products and dilute them with water at the time of use, GUP products are typically already diluted for the customer.

Responsible Pesticide Use: Product Selection

It is important to select the appropriate pesticide product based on the pest(s) being targeted. The correct pesticide can only be determined when the target pest (weeds, insects or fungi) is identified. This will help ensure the most effective results.

When our field scouts have identified a need to use a pesticide on our farms, we select our pesticide product depending on the specific pest(s) that need to be controlled. The products we use on our farms are registered and commercially available to all farmers. Many modern pesticides precisely impact only certain pests with little, or no, impact on other things. By selecting the most precise product to address the pest issue, the risk of impact on the rest of the ecosystem is minimized.

Responsible Pesticide Use: Resistance Management

In nature, there is a naturally occurring phenomenon that allows populations to shift in order to overcome an external pressure that reduces their population. In any population, there are a very small number of individual members that have natural resistance to the agent that is reducing their population. When most of the population is destroyed, the remaining resistant individuals multiply, resulting in an increase in the size of the resistant population. This phenomenon occurs across nature and is most notable in medicine when bacteria become resistant with the overuse of a single antibiotic. This can also occur when managing pests on a farm, and care must be taken to manage this phenomenon.

When we select products to manage specific pests on our farms, we not only identify the specific pest(s) but also which product(s) we have used previously to control that pest. If multiple products are available to control that pest, we change the product in order to diversify the controlling agent in the pest population. This is similar to doctors diversifying antibiotics to treat infections. This approach helps to keep resistant individuals from increasing in number, as the chance of those resistant individuals being resistant to two or three different pesticides is extremely small.

Responsible Pesticide Use: Application

Once the appropriate pesticide product is selected for a needed pest management application, our attention turns to responsible and effective application of the pesticide product. Effectively delivering the pesticide product to the target helps ensure effective results, minimizes environmental risk and maximizes the financial return for the application.

All of our pesticide applications are made by trained applicators. These individuals have been trained on application techniques, product knowledge and safety precautions. Our applicators use their knowledge and training and always follow the product labels to ensure proper use and compliance with the law.

In some cases, our field scouts find more than one pest whose populations are at high enough levels to require a pesticide application. For example, there may be two insect pests that need control, or an insect and a fungus. In these situations, we may decide to apply two pesticides in one application time. This is a very common practice in all types of pesticide applications, including farming. It is important to note that before this is done, the product labels are consulted to make sure there are no restrictions for this practice. If there are no restrictions, the appropriate amounts of each pesticide are applied using the most restrictive product's guidelines (i.e. for crop growth stage, wind speed, safe field re-entry times, etc.).

The application of pesticides in any setting has a common goal of delivering the pesticide to the target pest(s) in the most precise, efficient and safe manner. Most farm applications of pesticides are done by spraying the pesticide mixed with water (about 95-98% of the final spray solution is water) to the crop area containing the target pest(s). When spraying pesticides, there is a potential for off-target movement (drift) of the spray solution. We take many steps to help ensure our applications reach the target which minimizing potential drift. Some of the key approaches we take are:

- use of precision application equipment
- follow the label requirements on environmental conditions (wind speed, temperature, etc.)
- monitor the wind speed and direction prior to and during application
- select the appropriate nozzles to deliver the spray (largest effective spray droplets are used)
- use the lowest spray pressure effective with the selected nozzles
- calibrate the application equipment to ensure proper operation
- use the lowest spray release height related to the crop pest

Wind speed, spray droplet size, spray pressure and height of spray release are the major factors affecting the potential for spray drift. Taking these major factors into consideration prior to making a spray application can significantly minimize drift.

Our pesticide application equipment is some of the most technologically advanced machinery on our farms. They are specialized pieces of equipment designed for precision pesticide application in agricultural settings. These sprayers are operated by trained personnel who are either state licensed to apply pesticides or working under direct supervision of a licensed manager. They use GPS and computer controls to maintain

the proper speed and spray flow to deliver the desired pesticide rate to the target. In addition, the pesticides and water are housed in two different containers on the sprayer and the mixing occurs via a computer controlled injection system while the water flows to the spray nozzles. This eliminates any mixing exposure to the person applying the pesticides and minimizes leftover spray mix when the application is complete.

Responsible Pesticide Use: Reporting

Restricted Use Pesticide (RUP) products are regulated by the Hawaii Department of Agriculture (HDOA) for both purchase and use by state licensed professionals. The HDOA monitors RUP sales by receiving sales information from the pesticide dealers and RUP use through reporting by the RUP applicator. We report all RUP products used on our farm to the HDOA and undergo random audits by HDOA inspectors to ensure our compliance with all existing laws. More information on the RUPs employed on our farms can be found at www.MonsantoHawaii.com.



When we use pesticides on our farms, we diligently comply with federal and state laws that govern responsible pesticide use, and in many cases we follow additional stewardship measures.





Community Engagement

As members of the community we understand that there may be questions about what we do and how we farm. We take pride in the good things we do and how we care for our farms, employees and community. We strive to be transparent about our farming practices by welcoming scheduled visits and tours of our farms and through open dialogue with interested members of our community.

Collectively, our commitments to employ good stewardship approaches on our farms, engage in open dialogue with our neighbors and the community, and voluntarily share information about our agronomic and environmental efforts form the foundation of our Good Farm Stewardship Program.

We frequently host tours of our farms for groups and individuals from across the community. School groups, business organizations, policy makers and social clubs are a few of the types of interested parties who have visited our farms. On these visits, we show and discuss our various stewardship practices, as described in this document. In addition, we explain the processes and science involved in development of our seed products that will be grown by farmers around the globe. Questions are always welcomed in order to provide the most relevant information to those visiting our farms.

In addition to farm visits, we also spend time discussing our farm operations, and the science of modern agriculture, with groups in the community. Our farms meet quarterly with Community Advisory Panels (CAP) which are comprised of key community members, homeowners association representatives and public sector representatives, to name a few. We are also invited to come and speak to community groups including schools, neighborhood committees and business organizations. These discussions are very important opportunities for us to share the sustainability and safety approaches we use on our farms.

Lastly, our farms and employees are very generous with our time in terms of supporting non-profit organizations and worthwhile community endeavors. We gladly support numerous efforts that can enhance the lives of residents within our community, which in turn makes our community a better place for all.



Resources

1. Soil and Water Conservation:

http://dlnr.hawaii.gov/swcd

- 2. Integrated Pest Management: http://www.ipm.ucdavis.edu/GENERAL/whatisipm.html
- 3. Pesticide Selection: http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn74126.html
- 4. Pesticide Drift Management:
 http://pesticidestewardship.org/drift/Pages/default.aspx
- 5. Monsanto Hawaii: www.MonsantoHawaii.com

