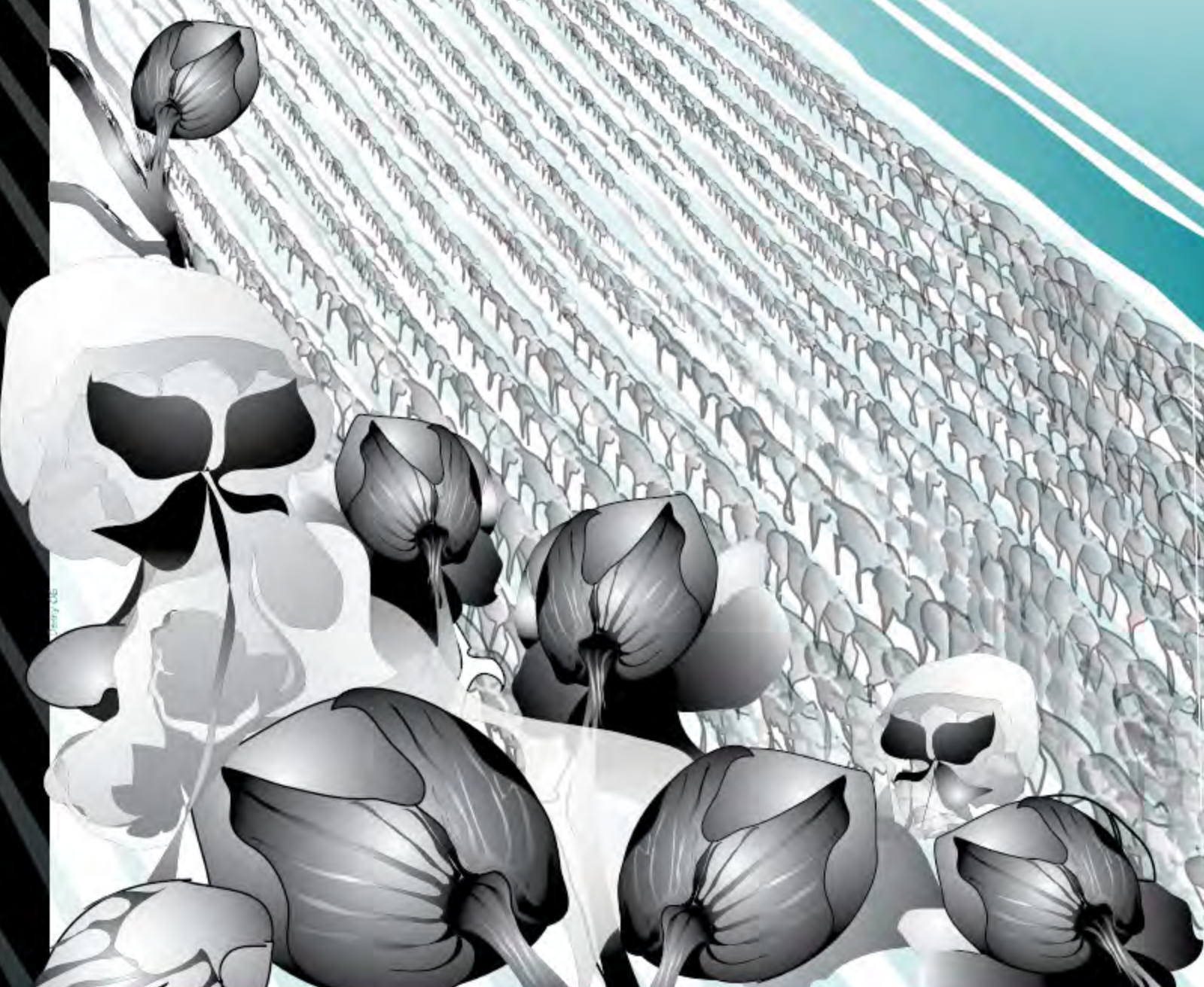


COTTON



Management Practices for Protecting Water

Thousands of acres of Central Valley cotton are planted near sensitive sites such as waterways and wildlife areas. When using cotton inputs such as pesticides and nutrients, it's important to follow sound Best Management Practices (BMPs) to minimize the potential for drift or runoff from those fields into sensitive sites. Pesticides, nutrients and sediment have the potential to be carried off-site through surface water runoff. Spray drift can also contribute to off-site movement of pesticides and some nutrients.

BMPs are intended to minimize off-site movement of pesticides and nutrients to waterways and other sensitive sites. These practices, when combined with strict adherence to product label directions, can provide cotton growers and applicators with the tools necessary to produce a profitable crop while minimizing or eliminating off-site impacts.

Severe Consequences for Mistakes

Consequences for application mistakes or ignoring proven stewardship practices can have far reaching impacts on the cotton industry as well as the entire agricultural community. Potential actions in response to application errors include product use restrictions or cancellations, hindering growers' ability to efficiently produce profitable cotton. Or, individual farms could face permitting requirements by state water agencies.

Each individual who handles or uses pesticides and fertilizers has the responsibility to take the appropriate precautions. Adhering to proper stewardship practices is good for the entire agricultural community and the environment too!

CONTENTS

Cotton BMPs to Protect Water Quality

Nutrient Management
(page 5)

12-Month Approach
(page 6)



Growing Season BMPs
(page 7)

Spray Application Management
(page 11)



General Stewardship Recommendations

This publication outlines Best Management Practices (BMPs) recommended for cotton growers and pesticide applicators. These practices are intended as guidance for both ground and aerial pesticide applications and nutrient use, especially near sensitive sites. General stewardship practices recommended for California cotton include:

- Applicator must be aware of and comply with county permit conditions and restrictions on pesticides. Make sure applicator always has any required county permit(s) and Manufacturers Safety Data Sheet (MSDS) on hand during applications. Be aware that application conditions and restrictions can be modified. Check with your County Agricultural Commissioner for details on updates or new regulations.
- Avoid pesticide applications just prior to an irrigation or rainfall event to minimize the potential for runoff. Check weather forecast services or website forecasts such as www.fieldwise.com and www.foxweather.com. Plan for an interval of 48 hours or more between applications and forecast rainfall.
- Avoid aerial and ground spraying when wind is blowing toward nearby waterways or sensitive sites.
- Aerial and ground pesticide applications should be made only if wind is blowing at least 3 mph and away from nearby waterways or other sensitive sites.
- Avoid aerial spraying when wind speed is less than 3 mph (possible inversion layer) or greater than 10 mph. Check the label or with your County Agricultural Commissioner for specific wind speed requirements.
- Avoid air and ground applications when wind speed is greater than 10 mph.
- Use a registered, effective drift-control agent and drift-reducing nozzles. Check the pesticide label and with your farm input supplier for an appropriate drift-control agent.
- Maintain an adequate buffer zone (untreated area between sprayed crop and sensitive area) to protect waterways and sensitive sites. Check with the product label and your County Agricultural Commissioner for specific buffer zone requirements.
- During ground applications, always shut off nozzles when making end-of-row turns.
- Shut off individual nozzles when spraying partial swaths.
- Start spraying only when nozzles are adjacent to the first plants.
- Shut off boom over irrigation ditches, washes, drains and culverts.
- Avoid aerial spray applications during furrow, sprinkler or flood irrigation when ponded water is visible in fields.
- Attend annual pesticide training for growers and/or applicators. Check with your local County Agricultural Commissioner or farm advisor for specific dates.



- Conduct regular – at least annual – applicator training. Anytime a new pesticide is used, conduct training on the proper use according to the latest label.
- Adopt onsite practices to reduce runoff

On-site practices include but are not limited to:

Irrigation Runoff Management

- a. Sediment carried in irrigation runoff can transport pesticides. Managing irrigations to minimize tailwater can help mitigate the impact of off-site movement of sediment. Practices to manage sediment runoff include:
 - Tailwater return systems to recirculate tailwater and reapply to other parts of the field.
 - Sediment basins or holding ponds that retain runoff for a period of time to allow sediment to settle out.
 - In some soils, use of PAM (various polymer compounds) can reduce the transport of sediment in irrigation water. Consult with manufacturers and Cooperative Extension for application recommendations.

Benefits of PAM can include:

- Reduction in runoff volume through increased water infiltration.
- Reduction in pesticide mass carried by sediment.
- Reduction in furrow erosion.
- Although PAM is commonly used in the northern San Joaquin Valley, the product is still being evaluated for environmental impacts.
- b. Precision irrigation can reduce the amount of tailwater leaving a field.

These irrigation practices include:

- Monitor soil moisture levels and schedule irrigations according to moisture levels rather than the calendar.
- Irrigate when moisture levels are not too high, allowing for increased infiltration.
- Adopt the use of sprinklers or drip irrigation to reduce the amount of tailwater runoff.
- If row lengths are more than 1000 feet, consider reducing irrigation run length with corresponding reductions in set time.
- If your soil has a high infiltration rate, use high flow rates initially to push water across the field then reduce flow to finish off the irrigation. Avoid doing the opposite which can greatly reduce water application uniformity.
- Recirculate surface water runoff for reuse in the same or other fields unless specific plant diseases (*fusarium*, *phytophthora*, *phymatotropicum*, etc.) are worsened by this practice
- c. Diverting tailwater through vegetated ditches at field ends has shown to reduce pesticide and nutrient residues in tailwater. Vegetated ditches function because:
 - Slows water movement and allows sediment to settle out
 - Enable pesticides to attach to plant surfaces (faster pesticide breakdown on vegetation than soil).
 - This practice could lead to an increase of invasive weed species carried in tailwater if tailwater is recirculated to other fields. This would result in increased herbicide use to control problem weeds.



Nutrient/Fertilizer BMPs

All cotton nutrients, including commercial fertilizer, animal manure, compost or other soil amendments, have the potential to move off site and enter waterways. Implement good housekeeping practices to prevent contamination of groundwater and/or surface water. Nutrient management BMPs include:

1. Soil, Tissue and Water Testing

- Base amounts and timing of nitrogen (N), phosphorus (P) and potassium (K) fertilizer on estimated crop needs and a realistic assessment of past crop production levels versus production goals.
- Before applying N early in the growth cycle, assess the amount of nitrate already present by soil (or soil solution) sampling and analysis.
- Use plant tissue sampling for mid- and late-season fertilizer decisions. According to University trials, petiole or leaf blade testing for nutrient assessments are most useful during the primary bloom period, from about 1 week before first bloom through the first 3 to 4 weeks of bloom.
- Measure nitrate levels in the irrigation water and adjust N fertilizer rates accordingly. If changes in water supply occur during the season (such as from canal water to well water), re-test for irrigation water nitrate.

2. Application Timing

- Split nitrogen fertilizer applications where possible to reduce the chance of deep percolation losses (moving soluble N with rain or irrigation water) below the effective rooting zone.
- Do not apply excessive fertilizer N immediately prior to or during the rainy season.
- Avoid high application rates that supply N in excess of total season plant needs for well-managed cotton, particularly when applying manure or liquid dairy waste prior to planting or early in the growing season.

3. Fertilizer Placement

- Place N fertilizer where maximum plant uptake will occur.
- Immediately incorporate manures or compost to prevent transport in storm runoff.



12-Month Approach to BMPs

Cotton stewardship practices go beyond just the period from planting to harvest. BMPs should be considered on a year-round basis to minimize impact that seasonal cultural practices might have on water quality.

Visit the University of California IPM website

(<http://www.ipm.ucdavis.edu>) for further information on year-round BMPs for cotton production.

Know Your Surrounding Area

Evaluate the surrounding area to determine if waterways or other sensitive sites (schools, day-care centers and urban/commercial areas) are in close proximity or are connected via ditches to your cotton fields. Check with your County Agricultural Commissioner for product-specific restrictions in your area. Many pesticides have restrictions on aerial and ground applications near sensitive sites. Be aware of other crops nearby and the risks posed by spray drift from cotton fields.

Preplant Field Preparation

• Choose Fields Prudently

Cotton fields with a significant pest history will most likely need more pest management in the future. Rotating cotton with other field or vegetable crops can maintain soil productivity and help reduce the incidence of various cotton pests and diseases thereby reducing the need for pesticide applications.

• Know Soil Type and Storm Runoff Potential

In general, heavier soil types (loams to clays) have slower infiltration rates and more potential for runoff during heavy rain storms. However, even some sandy loam soils have significant potential to develop crusts and low water infiltration, so take into consideration local soil conditions on runoff potential. Where possible, capture storm runoff and spread it across other fields or direct it into vegetated ditches to help filter sediment and pre-emergence herbicide residues that may be transported. Fall and winter applications of pre-emergence herbicides have the potential for runoff into waterways. (For example, Treflan (trifluralin) has been detected in Central Valley rivers after winter rains.) Take precautions to minimize or eliminate the potential impact of herbicide runoff.

• Maintain Post Harvest Field Sanitation

Use a practice that minimizes exposed crop residue remaining after post harvest operations. Where possible, incorporate plant residues after harvest to reduce pest survival and buildup on harvested plants and pest migration to other crops. Reduce pest buildup by controlling weeds that are host plants for damaging insects. If using reduced tillage or conservation tillage, be aware of pest and disease problems associated with prior crop residues and utilize targeted, low impact control measures.

• Understand Neighboring Crop Impact

Understand pest impact on cotton from other crops grown in your area. Alfalfa can be used as a trap crop for lygus if managed correctly (also cowpea and lima beans). Consult with nearby growers and local Pest Control Advisors about managing crops to minimize pest impacts.



Growing Season BMPs

Pest Management - IPM Strategies

Consider all available pest management strategies, including cultural practices, host plant resistance, biological controls and crop protection chemical controls. See the UC IPM website (www.ipm.ucdavis.edu) for more detailed information. Stay informed about new practices and materials compatible with an IPM program. Key components of an IPM strategy include:

1. Monitor and assess pest situation
 - Base treatment decisions on thorough monitoring of the field and the pest situation. Consider all reasonable options to mitigate a pest problem when making decisions concerning pest management. Understand the role and value of natural enemies in your fields.
 - Thorough monitoring and use of action thresholds can lead to reduced sprays: "spray as needed" rather than "spray by the calendar".
 - Document scouting practices by keeping good records.
2. Rotate chemistries to avoid pest resistance.
 - Resistance leads to ineffective control and additional sprays in the future.
 - Avoid overuse of any class of chemicals. Chemicals can be characterized or classed according to mode of action (see following section).
 - Know your chemical classes and what is available for use in your situation. See www.cottoninfo.ucdavis.edu for insecticide and herbicide Resistance Management Guidelines. UC Pest Management Guidelines have the mode of action (MOA) class listed in all management guidelines for insecticides and herbicides. MOA classes are also on many labels.
 - Consult your PCA and farm input supplier for specifics.

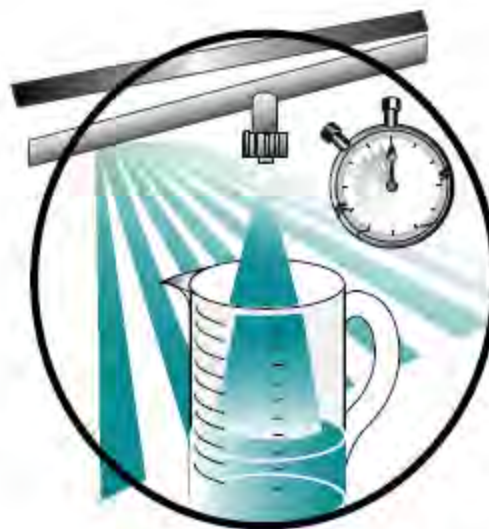
3. Be aware of off-site movement potential for each chemical class. The list below is not comprehensive, but serves to illustrate the potential role of pesticide chemical characteristics on modes of off-site transport. Refer to UC Pest Management Guidelines for Water Tox, an interactive pesticide and water quality evaluation tool (<http://www.ipm.ucdavis.edu/PMG/selectnewpest.cotton.html>) Some useful generalizations associated with different chemical classes include, but are not restricted to, the following:

- Organophosphates readily dissolve in water and can move with runoff.
- Pyrethroids attach to sediment which can be transported by runoff.
- Certain herbicides can dissolve in runoff water or move with sediment.

On Site BMPs

On-site BMPs can help manage soil, water, pesticides and nutrients while minimizing environmental impacts. The goals of on-site practices are to:

- Reduce or eliminate sediment movement from the field
- Reduce or eliminate flows of runoff water carrying dissolved pesticides and nutrients.



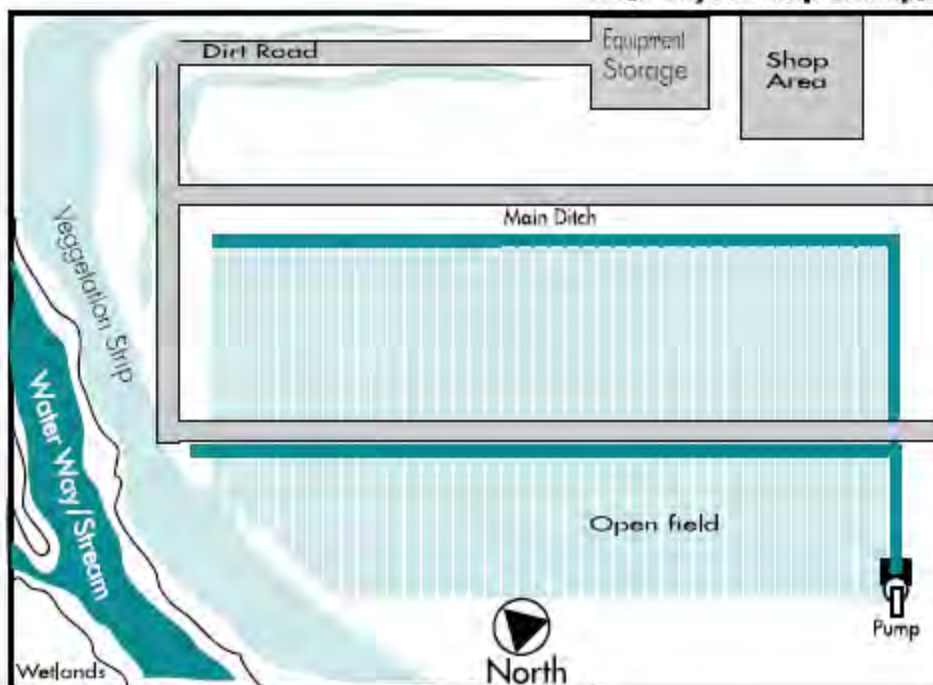
4. Fertilizer Application Practices

- Shut off fertilizer applicators during turns and use check valves when possible.
- Maintain proper calibration of fertilizer application equipment.
- Whenever injecting fertilizer into irrigation water, install proper backflow device.
- Fertilizer tanks and equipment should be cleaned by rinsing in the field or at a properly designed wash facility. Rinseate and/or sludge should be spread evenly across a field using good agronomic practices.
- Cleanup fertilizer spills promptly.
- When equipment is parked, use care to prevent material from leaking into storage area. If equipment is known to be in disrepair, completely remove fertilizer material before parking equipment.
- When making foliar fertilizer applications by air, avoid overspray of waterways or sensitive areas.
- When transferring fertilizer into on-farm storage or into a fertilizer applicator, take care not to allow spilled materials to accumulate on the ground.

Spray Application BMPs

1. Evaluate each field to identify areas where sediment or surface water runoff might move offsite to waterways or other sensitive areas.
 - Sketch your field and note the location of wells, sinkholes, highly erodible land, drainage ditches, streams and rivers.
 - Flag or stake no treatment buffer zones.
 - Provide the sketch to all sprayer operators or commercial applicators.
2. Reduce drift potential by recognizing potential problems in your area and taking precautions. Identify other crops, waterways and sensitive sites. Use appropriate nozzles and drift-reducing agents for your situation.
3. Time spray application to allow at least 48 hours between applications and irrigations. Where possible, do not apply pesticide sprays (such as by air) within the first 48 hours after a field is irrigated; and conversely, do not irrigate a field within 48 hours after ground or aerial spraying.

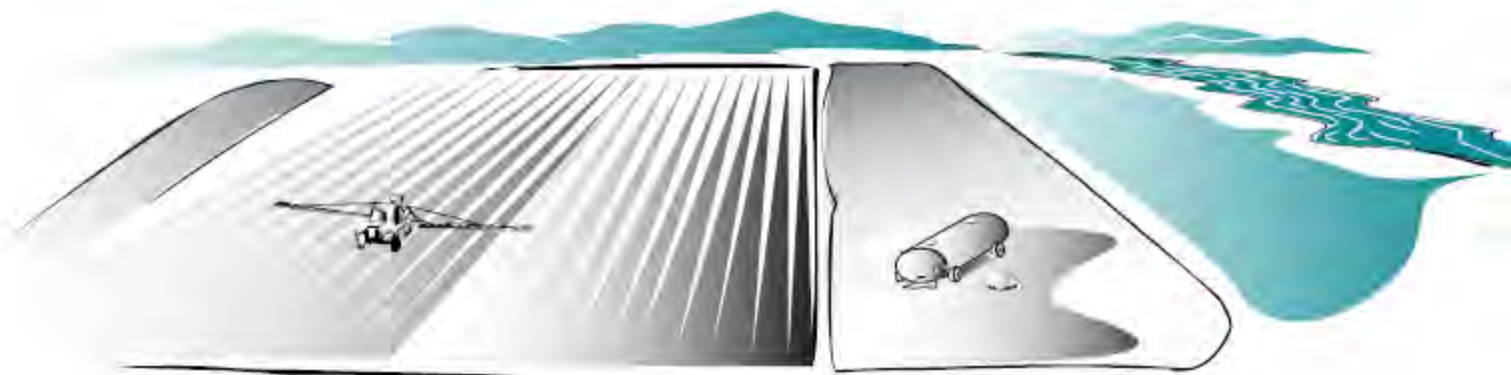
Field Layout Map Example



4. Use a smoke column to determine the wind direction and possible presence of any inversion layer. Check with your County Agricultural Commissioner to determine the proper device (burning tire, smoke flare, etc.) to use.
5. Use an anemometer or hand-held wind speed device to determine wind speed before and during the application.
6. Be a responsible applicator. The individual responsible for the application must be aware of:
 - Wind conditions (speed and direction - current and forecast) and whether rainfall is forecasted or an irrigation will occur within the next 48 hours.
 - Air temperature (current and forecast).
 - Presence/absence of a temperature inversion layer.
 - Presence/absence of waterways and sensitive sites in the area, especially downwind of the application site or connected to the site by drainage ditches, canals or sloughs.
 - The application equipment setup and calibration; proper use of any drift-reducing application equipment.
 - All chemicals and rates used to complete the application.
7. Always wear the required personal protective equipment when mixing, loading and applying chemicals. Check the label for guidance.

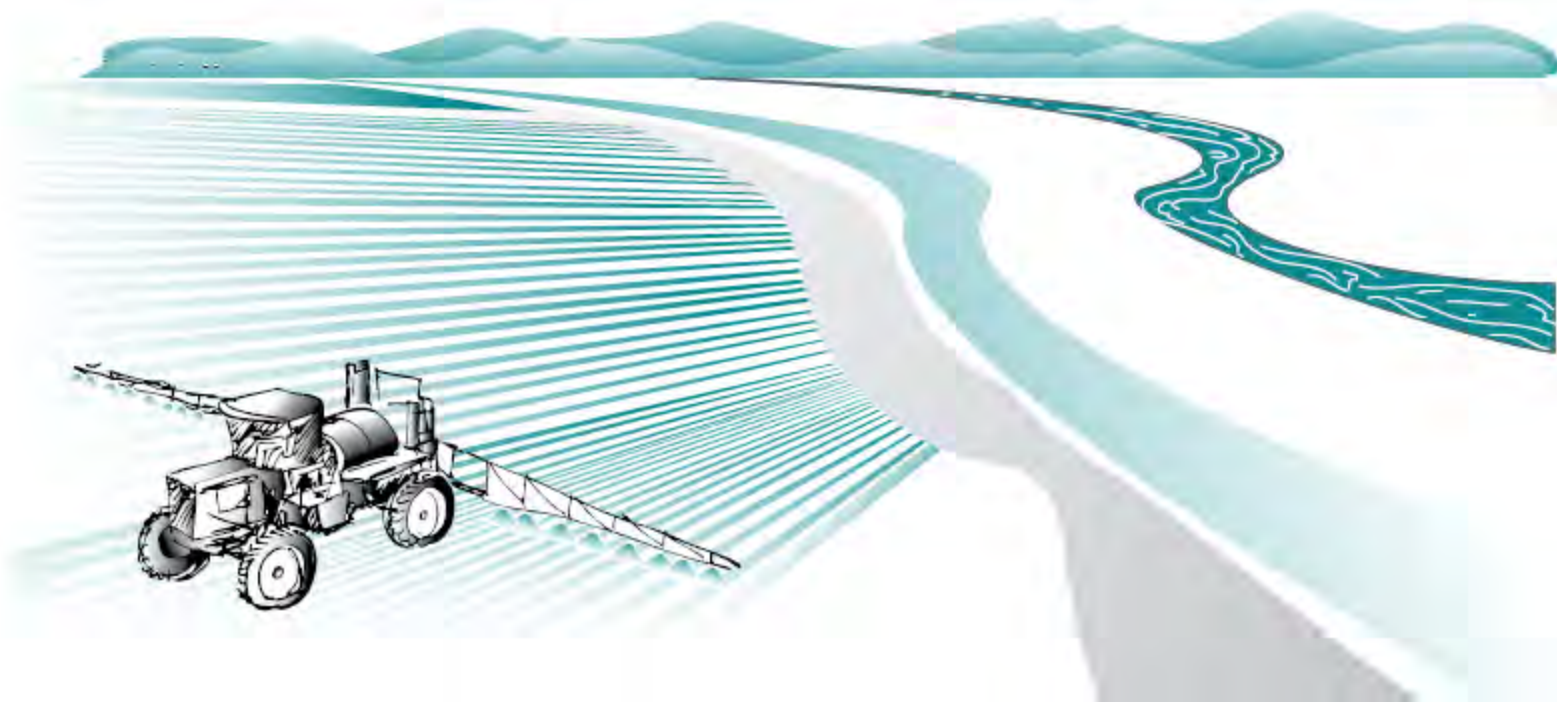
Carefully Select Mixing and Loading Site

1. Take precautions to ensure there is at least 100 feet between a mixing/loading area and any wells or ditches, canals or streams that feed into nearby rivers.
2. Mix and load on a site not prone to runoff and where soil can be disked after mixing/loading is completed. Do not mix or load on hard-packed roads that could drain or run off into nearby ditches or waterways.



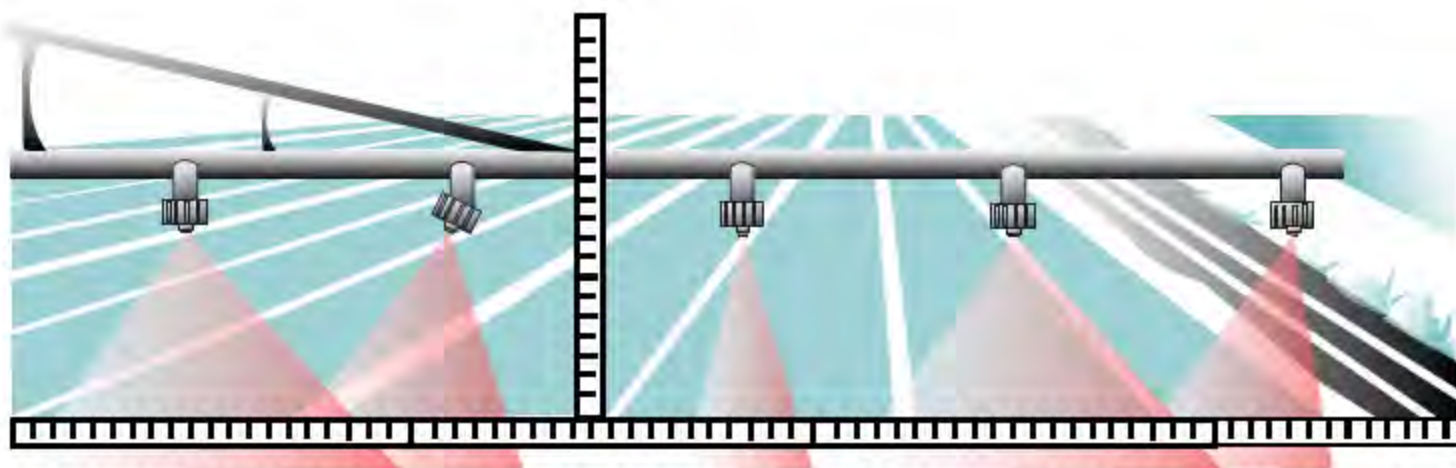
Follow Proper Mixing and Loading Practices

- Do not leave sprayer unattended while filling.
- Partially fill tank (usually 1/3 to 1/2 full of water) prior to the addition of chemicals.
- Do not overfill tank. Spills can wash away to sensitive areas. Use air gap to prevent tank overfilling.
- Use backflow valve on the fill tube.
- Use a closed chemical transfer system whenever possible.
- Open paper chemical packages with scissors or knife, rather than tearing.
- Immediately triple rinse containers. Pour rinsate into tank prior to filling.
- Apply rinse water back to treated field. Never just drain out.
- Never leave pesticides in the rig over night.
- Check with county for proper disposal methods for empty pesticide containers.



Sprayer Set Up And Good Application Techniques

- Replace worn nozzles when necessary with newer, more effective nozzles (at least once per season).
- Use nozzles that provide adequate coverage at the largest possible droplet size and the recommended droplet size spectrum to reduce drift while maintaining efficacy.
- Use nozzles with volume median diameter (VMD) appropriate to the chemical being applied. Check with County Agricultural Commissioner for local requirements.
- Consider spray controllers that adjust nozzle output based on ground speed. Be sure to understand the limitations of the controller and select the proper nozzle for use with the speed range you expect. Do not allow the pressure to get too low as to cause streaking or too high as to cause excessive fine droplets.
- Use the lowest boom height that provides uniform coverage.



References:

Integrated Pest Management for Cotton in the Western Region of the United States 2nd Edition: University of California Statewide IPM Project. 1996. 164pp.

UC IPM website (<http://www.ipm.ucdavis.edu/PMG/selectnewpest.cotton.html>)

Field and Row Crop Sprayers, Tips and Techniques, Protecting Water Quality: Coalition for Urban/Rural Environmental Stewardship (<http://www.curesworks.org>)

Cotton Production Manual: University of California, Division of Agriculture and Natural Resources. 1996. 422pp.

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Coalition for Urban/Rural Environmental Stewardship (CURES)



Application Equipment

Checklist

Before filling the tank, adding pesticides and beginning an application, closely perform a visual inspection of the equipment. Always wear personal protective equipment when checking application machinery.

Check and Make Sure:

- Hose connections are sealed and tightened.
- Regulator connections are sealed and tightened.
- Sight gauges are clear and working.
- Clean filters and screens on a daily basis.
- Fix leaking gaskets immediately.
- Pressure gauges are located at the proper points with proper scales and are sealed and working.
- All nozzles and metering devices are of correct size, sealed and unobstructed.
- All sprayer shields are in place (where appropriate).
- Tank drain plug is in place.
- There is no damage to hoses or piping.
- Never leave pesticides in a sprayer overnight.

Fresno County
Farm Bureau



Coalition for Urban/Rural Environmental Stewardship
www.curesworks.org