Best Management Practices for Fertilizer Storage and Nutrient Management

Rationale

Fertilizers can cause harm if they reach surface or ground water. For example, high nitrates in potable water cause heart damage in unborn and newly born infants and excessively high phosphorus in wetlands and estuaries causes eutrophication and loss of aquatic life. Potential problems associated with fertilizers fall into four primary phases of use. 1. Storage – greenhouse fertilizer storage areas contain relatively large quantities of concentrated chemicals. Risks in storage areas include release through broken, damaged, or leaking containers; loss of security leading to irresponsible use; accumulation of outdated materials leading to excessive quantity of fertilizer thus unnecessarily raising risk level; and combustion of oxidizing compounds in fertilizer (e.g., nitrates) caused by fire or another disaster event. 2. Handling – opening fertilizer product containers, measuring amounts, and transferring fertilizer to the delivery system involves some level of risk from spills. Since most products are granular, ease of containment and clean up is possible. 3. Delivery – containment tanks used to store concentrated solutions of fertilizer can cause a significant hazard. Broken, damaged or weak containers can lead to spills that may contaminate surface or groundwater. The possibility of backflow to, or cross connection with, potable water supplies is reduced. 4. Management – luxuriant or untimely application of fertilizer leads to excessive release from the production system to surface and/or ground water. Potential problems can be minimized through adequate environmental awareness, employee training, and emergency preparedness.

Environmental Principle: Fertilizer and concentrated and dilute nutrient solutions can have a significant impact on surface and groundwater when accidents or misapplications occur. Care in storage, handling, delivery system management, and nutrient management are essential to environmental stewardship. Application equipment must be maintained for proper use rate and to prevent backflow into wells and community water supplies, as well as to avoid cross connection with potable water supplies within the facility such as drinking fountains.

Operational Aspects	Environmental Assurance >>		
	Level 1	Level 2	Level 3
Overview			
Emergency Preparedness	all staff know to call 911 in the event of an emergency	emergency contact numbers posted	emergency contact numbers posted; emergency response plan on file
Environmental Awareness	employees are made aware of hazard to surface and groundwater by spills from tipped, damaged, or weak storage tanks of concentrated solutions of fertilizer	employees are made aware of hazards, and hazards are being reduced	hazards have been eliminated or are reduced and closely monitored

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Training	greenhouse manager assures all employees receive basic training	all employees receive basic training and updates, and are trained in the use and maintenance of the equipment used for fertilizer application and in the clean up of small spills	all employees receive basic training and updates in: use and maintenance of equipment, clean up of small spills, response to different emergency scenarios, proper interpretation of nutrient analysis reports, identification of nutrient deficiencies in plant material, and the correct selection of fertilizers and rates based on crop needs
Communication	greenhouse manager provides information to individual workers as necessary	greenhouse manager and all workers exchange information in a group setting	workers are encouraged to gain and exchange knowledge with the entire work group; meetings are held regularly
Management			
Application	occasional application of fertilizer at the discretion of the employee	fertilization at regular intervals with the proper dilution ratio and flow rate	automated controls monitor and apply fertilizers at the proper rate at each watering, based on crop nutrient status
Crop Nutrient Status	monitored as problems arise	monitored annually on each major crop	growing mix monitored before planting and 2 months into production of each crop
Employee Training	employees learn through on-the-job training	employees receive instruction from experienced users in monitoring crop nutrient status, selection and use of fertilizers, and selection and use of fertilizer injectors	supervisor provides employee with operating manuals plus instruction from qualified personnel; employees trained in identifying nutrient deficiencies, monitoring crop nutrient status, selection and use of fertilizers, and selection and use of fertilizer injectors
Leaching Volume	little consideration for the amount of water or fertilizer solution applied beyond saturation of the root zone; exceeds 10% leaching	conscious attempt to limit the amount of leaching of fertigated water to 10% of total volume applied	conscious attempt to limit the amount of leaching of nutrient solution to 10% of total volume applied; ebb and flow benches or other recirculating system used whenever practical

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Recordkeeping	records are sometimes kept of concentration and frequency of fertilizer application for each crop	records are routinely kept of concentration and frequency of fertilizer application for each crop	records are kept on quantities (concentration, volume, frequency) of fertilizer applied for each crop
Storage			
Compatibility	oxidizers are not stored on wood	oxidizers are not stored on wood	oxidizers are not stored on wood
Containers	all chemicals stored in their original containers unless damaged; labels are visible and readable; food or beverage containers are never used for storage	all chemicals stored in their original containers unless damaged; labels are visible and readable; food or beverage containers are never used for storage	all chemicals stored in their original containers unless damaged; labels are visible and readable; food or beverage containers are never used for storage
Container Arrangement	labels in plain sight; some containers in contact with floor; all containers stored up-right	labels in plain sight; no containers in contact with floor; all containers stored up-right; aisles wide enough to comfortably accommodate workers; containers not crowded on shelves or pallets	labels in plain sight; no containers in contact with floor; all containers stored up-right; aisles wide enough to comfortably accommodate workers; containers not crowded on shelves or pallets
Containment	no floor drain; some secondary containment used for open containers	no floor drain; secondary containment routinely used for open containers; bagged material on pallets or otherwise elevated above floor	no floor drain; floor provides containment in the event of a spill; secondary containment routinely used for most open containers; damaged or leaking containers are repaired and/or replaced as soon as possible; all spilled material is cleaned up upon discovery; and cleanup materials are discarded promptly and properly
Contents	storage area may also contain other greenhouse chemicals (no pesticides), and general greenhouse supplies	storage area does not contain pesticides, or other greenhouse chemicals; may contain general greenhouse supplies; no food, drink, tobacco products, or livestock feed is present	storage area does not contain pesticides, or other greenhouse chemicals; may contain general greenhouse supplies; no food, drink, tobacco products, or livestock feed is present

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Fire Prevention and Suppression	fire extinguisher available within general area	fire detection and alarm system present, fire extinguisher immediately available	fire detection and alarm system present, oxidizers and flammable materials stored separately; fire extinguisher immediately available; fire department notified at least annually of current inventory
Inventory and Recordkeeping	no inventory monitoring; materials no longer used are occasionally removed	records kept on amount of fertilizer purchased; materials no longer used are removed on a regular basis	inventory actively maintained as chemicals added or removed from storage; containers are dated when purchased; outdated materials removed on a regular basis; inventory is controlled to prevent the accumulation of excess material that may become difficult to use
Lighting	minimal electrical lighting provided	electrical lighting allows view into all areas and cabinets within storage area	electrical lighting allows view into all areas and cabinets within storage area
Location	site is not considered in selecting storage area	fertilizer storage within building is structurally segregated from general work areas, some consideration given to location of storage area away from environmentally sensitive areas, flooding is unlikely	fertilizer storage is separated from offices, workshops, laboratories, surface water, neighboring dwellings and bodies of water; flooding is unlikely
Management of Humidity, Flood Damage, and Clutter	area is dry	shelving is provided to keep materials off of the floor	area is clean and inventory arrangement is orderly; the floor, shelving and counters are kept free of debris and miscellaneous items
Monitoring	occasional inspection of storage for 1) signs of container corrosion or other damage - leaking or damaged containers are repackaged as appropriate, 2) faulty ventilation, electrical, and fire suppression systems – problems are reported and corrected	quarterly inspection of storage for 1) signs of container corrosion or other damage - leaking or damaged containers are repackaged as appropriate, 2) faulty ventilation, electrical, and fire suppression systems – problems are reported and corrected	monthly inspection of storage for 1) signs of container corrosion or other damage - leaking or damaged containers are repackaged as appropriate, 2) faulty ventilation, electrical, and fire suppression systems – problems are reported and corrected

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Security	no special provisions are made	fertilizer is stored in a dedicated room	storage room is locked, access is restricted to trained personnel
Signage	none	signs present; emergency contact information posted	signs posted; warning signs used as needed (e.g., for oxidizers); emergency contact information posted
Storage of Small Quantities of Chemicals	always stored on shelf or other solid surface; never on floor	always stored on shelf or other solid surface; never on floor	always stored on shelf or other solid surface; never on floor
Temperature Control	no mechanical temperature control; area not insulated	no mechanical temperature control; area insulated; no direct sources of heat (sunny windows, steam pipes, furnaces, etc.); area will not freeze	active mechanical temperature control; no direct sources of heat (sunny windows, steam pipes, furnaces, etc.)
Ventilation	room not particularly cool and dry; no mechanical ventilation	mechanical ventilation	mechanical ventilation working and used
Handling			
Storage and Record Keeping	fertilizer stock tanks are labeled with fertilizer formulation and concentration; no records are kept of application information	fertilizer stock tanks are labeled with fertilizer formulation and concentration; records are kept of frequency and location of fertilizer application	fertilizer stock tanks are labeled with fertilizer formulation and concentration; records are kept of fertilizer formulation, concentration, date, and location of application; records are kept of media nutrient analyses
Containment	concentrated stock solution stored near injector in heavy-duty plastic container	concentrated stock stored near injector in high density polyethylene or polypropylene containers with extra heavy duty walls	concentrated stock stored near injector in high density polyethylene or polypropylene containers with extra heavy duty walls; secondary containment provided
Partially-used Containers	open containers resealed and returned to storage	paper bags and boxes always opened with a box cutter or scissors; open containers resealed and returned to storage	paper bags and boxes always opened with a box cutter or scissors; open containers resealed and returned to storage; all open paper bags are sealed inside another, larger container, sealed and labeled

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Damaged Containers	when damaged containers are noticed, contents are repackaged and labeled or placed in suitable secondary containment which can be sealed and labeled	when damaged containers are noticed, contents are repackaged and labeled or placed in suitable secondary containment which can be sealed and labeled	containers checked often for damage; when damaged containers are noticed, contents are repackaged and labeled or placed in suitable secondary containment which can be sealed and labeled
Disposal	unused fertilizer products and concentrates are discarded using methods approved by environmental protection authorities	uses of unused products and concentrates are sought to minimize disposal	sufficient planning is made to eliminate the need for disposal; empty fertilizer containers are discarded based on latest advice from environmental protection authorities
Precipitate and Residue Disposal	fertilizer systems are cleaned and rinse solution is flushed to sanitary sewer	when fertilizer systems are cleaned, solids are removed first and discarded with solid waste before rinse solution is flushed to sanitary sewer	fertilizer systems are cleaned and solids and rinse solution are composted
Spill Prevention and Preparedness	secondary containment around fertilizer stock tanks is not used; spill clean-up materials for liquids (e.g., absorbent materials) and solids (e.g., shovel, dust pan, broom and empty and/or buckets) available within the general area	secondary containment is sometimes used for fertilizer stock tanks; spill clean-up materials for liquids (e.g., absorbent materials) and solids (e.g., shovel, dust pan, broom and empty and/or buckets) available within the general area	secondary containment used for fertilizer stock tanks routinely; spill clean-up materials for liquids (e.g., absorbent materials) and solids (e.g., shovel, dust pan, broom and empty and/or buckets) available within the general area
Delivery System			
Backflow Prevention (Building protection)	backflow prevention and inspection meets minimum local code requirements	backflow prevention and inspection meets minimum local code requirements	backflow prevention and inspection meets minimum local code requirements; redundant backflow prevention provided at each fertilizer injector
Cross-connection Avoidance	pipes and hoses carrying water for plant care are not cross-connected to pipes carrying potable water; local code requirements are met	pipes and hoses carrying water for plant care are not cross-connected to pipes carrying potable water; local code requirements are met	pipes and hoses carrying water for plant care are not cross-connected to pipes carrying potable water; local code requirements are met; signage instructs workers and visitors not to drink from hoses

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Equipment Maintenance	injector equipment maintained and calibrated when problems occur	injector equipment maintained as manufacturer recommends	all fertilizer containment tanks, injector pumps, backflow preventors, monitoring equipment and fertilizer lines are inspected regularly
Equipment Selection	venturi-type ("hozon" style) injectors used reluctantly and with awareness of their inaccuracy when pressure and flow vary	positive displacement or metering device injection used exclusively	computer or automatically controlled injection systems used
Fertilizer Injector and Surrounding Area	periodically - fertilizer injector is repaired when impairment of function is noticed; area surrounding fertilizer injector and concentrated solutions is cleaned periodically	semi-annual check of fertilizer injector function; clean surrounding area	monthly check of fertigation equipment accuracy; inspect containment tanks, back flow preventors and any equipment that holds fertilizer in the dry or liquid form; manufacturer recommendations are followed when calibrating or working on fertilizer injector equipment; stock solution tanks and the areas surrounding fertilizer injectors and concentrated solutions are kept clean and free of debris