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Herbicide Misuse – An Overview

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Weeds are the undesirable plants which infest different crops and cause negative effects on their yield and in many situation it is notorious than pests and diseases. It is estimated that, in India, 37% yield loss causes due to weeds. Weeds compete with crop plants for sunlight, nutrients, water, and space and also decrease the productivity and yield of crop plants. Herbicides are chemical agents used to kill or inhibit the growth of unwanted plant species, such as invasive species or agricultural weeds. Many farmers are not aware of the proper usage of herbicides *viz.*, dose, time, method of application etc. It may lead to misuse of herbicide, which will damage the crop thereby affecting productivity.

Misuse of herbicide

Herbicide misuse is nothing but the use of herbicide in a way that violates laws regulating their use or endangers humans or the environment. It can be

- Changing dosage rates, or violating a specific safety instruction.
- Application inconsistent with the labeling, which could be use of a material in any way not described on the label
- Selling or using an unregistered herbicide/one whose registration has been revoked,
- The sale or use of an adulterated or misbranded herbicide.

Misapplication is when an herbicide is applied to soil or crop that it was not intended to be applied on, such as glyphosate in cropped area. These mistakes rarely happen and can be easily avoided if special attention is given when tank mixes are prepared or when fields are sprayed to ensure that the correct field is treated and the correct herbicide applied. The symptoms and level of injury will depend on the type of herbicide that contacted the plant, herbicide rate, plant species, stage of growth and weather conditions. Even though crop injury occurs from all types of herbicide application, most injuries is from post emergent herbicides (Wikipedia, 2019).

If soil misapplied with pre planting or pre emergence herbicide, symptoms may appear right after new plants begin to germinate and often more severe at high rates of application or shallow sowing of seed. Misapplication of post emergent herbicide may cause to appear the symptoms within hours to a few days after application depending on herbicide, rate, stage of growth and weather conditions. In general, symptoms are more severe on young and metabolically active plants. When misapplication occurs, symptoms of treated plants are usually uniform throughout the treated area. It is likely that plants in the treated area need to be destroyed due to significant injury and illegal herbicide residue on the plants.

Herbicide damage to crops

Factors determining herbicide efficacy and crop safety are complex and include plant species, plant size, stage of growth, soil chemical and physical properties, soil moisture, temperature, and relative humidity. Post emergence herbicide uptake and efficacy can be affected by spray additives that enhance the performance of the herbicide but may also increase the risk of crop injury. Herbicide symptoms vary with herbicide, rate of application, stage of growth, type of exposure and the plant species receptor involved. In general, herbicides with the same mode of



action produce similar injury symptoms, because the outward appearance of injury is a function of herbicide effect on the plant at the cellular level. Therefore, it is much easier to diagnose symptoms belonging to different herbicide modes of action than herbicides within the same modes of action. In addition, diagnosing herbicide symptoms can be difficult because herbicide symptoms may look very similar to symptoms caused by diseases, nutrient deficiencies, environmental stress and soil compaction (University of California Natural Agricultural Resources, 2019).

In general, annual plants that rapidly translocate herbicide are more susceptible to herbicide damage and may show more injury symptoms. Conversely, perennial plants tend to translocate herbicide slower than annual plants and are also able to dilute herbicide in larger biomass systems, resulting in less injury. In addition, perennial plants may have more ability to breakdown herbicide and recover from injury symptoms.

Herbicides can injure foliage, shoots, flowers, and fruits. If injury is severe enough, either from one incident or repeated exposure, it may reduce yield, produce poor fruit quality, distort ornamental or nursery plants and occasionally cause plant death. In addition, herbicides may reduce non target plant vigor, increase susceptibility to disease, and shorten the life cycle of a plant. Herbicide injury to nontarget plants also may result in illegal residues on the exposed crop. Several herbicide injury symptoms, such as general and interveinal chlorosis, mottled chlorosis, yellow spotting, purpling of the leaves, necrosis and stem dieback may result from causes other than herbicide exposure. Accurately diagnosing plants that show herbicide injury symptoms is difficult. In investigating herbicide symptoms, it is easier to accurately diagnose these symptoms from contaminated tanks, soil carryover, misapplication or sprayer overlapping than from herbicide drift.

Herbicide drift

Drift is defined as physical movement of an herbicide through air, at the time of application or soon thereafter, to any site other than that intended. The three ways herbicides may move to nontarget areas are physical spray-particle drift, vapor drift, and herbicide-contaminated soil.

a) Physical spray-particle drift

Physical spray-particle drift is the off-target movement of fine droplets generated during herbicide misapplication. Small droplets are produced when herbicides are applied with small nozzle tips at high pressure and low spray volume. The distance that droplets may travel depends on droplet size, with smaller droplets traveling farther than larger droplets. High wind speed, low relative humidity, high temperatures, and height above the ground where the herbicide is released also may increase herbicide drift.

b) Vapor drift

Vapor drift or volatility refers to the ability of an herbicide to vaporize and mix freely with air. The amount of vapor drift varies depending on herbicide, formulation and weather and soil conditions. Some herbicides are more volatile than others. Volatile herbicides may produce vapors that can be carried great distances from the target area to other crop sites.

c) Herbicide contaminated drift

Herbicide may drift from a treated site by adhering to soil particles and traveling as herbicide-contaminated soil. Herbicide may contaminate soil in several ways: when it is applied directly to the soil, when foliar applications are not intercepted by the foliage or when herbicide is washed off foliage by rain or overhead irrigation.



Preventing herbicide drift injury

Awareness is the key to preventing herbicide drift. Once applicators are aware of the hazards and possible consequences of misuse, they can take several steps to prevent problems:

- Learn the locations of sensitive crops in the area. Avoid herbicide application near sensitive plants or select herbicides that do not cause injury to nearby plants.
- Herbicide labels warn applicators to avoid using herbicides in the vicinity of susceptible crops. Therefore, it is important to be aware of any sensitive crops grown close to herbicide application. Although there is no legal obligation for herbicide applicators to consult and cooperate with neighbors in matters of herbicide use, it is advisable to do so.
- Leave a buffer zone between treated fields and sensitive plants. Herbicide labels may specify the width of the buffer zone. The buffer zone will allow larger droplets to settle before reaching sensitive plants.
- Avoid the use of highly volatile formulations of herbicides in any area near sensitive crops.
- Do not apply herbicides when wind is blowing toward sensitive plants. Apply herbicides when a light breeze is blowing away from sensitive crops.
- Use sprayer application techniques that minimize the production of fine droplets. Selecting proper spray tips, lower spray pressures, and using drift reducing agents will decrease the number of fine droplets. Use wide-angle nozzles, keep the nozzles close to the soil and keep the boom stable.
- It is also important to use lower application speeds.
- Use spray additives within label guidelines to reduce production of small spray droplets..
- In the case of trees or vines exposed to herbicide drift, consider pruning off the affected leaves or branches to prevent the spread of the herbicide into the plant.
- Read and follow the directions on product labels.

Herbicide contaminated tank

Herbicide symptoms may occur when the sprayer is not properly cleaned after a previous herbicide application. Sprayer contamination is problematic in highly diversified cropping systems. This problem can be easily avoided by ensuring that sprayers are properly cleaned between different herbicide tank loads. Herbicide symptoms from sprayer contamination can occur up to several months after using the uncleaned sprayer, since dry herbicide particles can be dissolved causing symptoms.

In general, post emergent herbicides sprayed directly on the crop foliage have greater potential injury than soil applications, especially when surfactant or adjuvants are included to enhance herbicide spread or uptake. Injury from sprayer contamination can affect crop growth and development for several weeks after application and in severe cases can reduce crop yields. Always follow the herbicide label for directions and recommendations for the best method and cleaning agent to use when cleaning out the spray equipment. Consult labels for the products that were previously in the tank and for the products that will be used for the next application. Rinsing with just water may not remove the residue and the herbicide may remain tightly adsorbed in the sprayer through several loads. Further loads that contain other herbicides, oils, fertilizers, or basic pH blend may cause the herbicide to desorb, disperse into the spray solution, and damage susceptible crops.

Herbicide carryover

Herbicide residues may persist in the soil and affect susceptible crops for one or more years following application. Crop sensitivity depends on the crop, soil properties, soil moisture and



temperature and herbicide. Crop injury from herbicide residue in the soil, however is not restricted to persistent residual herbicides applied the previous year. It may happen from herbicide applied to burndown weeds before planting. For example, dicamba and 2,4-D applied to burndown weeds before cotton or soybean planting may severely injure these crops. Herbicide labels often provide guidelines on intervals between herbicide application and the planting of sensitive crops.

Herbicide carryover can have considerable field variation in acreage affected and severity of plant injury. Injury can occur anywhere in the field and may be patchy. Uneven plant stands can affect crop maturity. Areas of low organic matter, headlands, corners or overspray may have more symptoms.

Why less chance for herbicide residue in crop produce especially grains???

If the herbicide molecule was to reside in the crop plants as residue, the plant should die before reaching the grain or fruit formation stage in the first instance. But still some herbicide may persist in crop plants in minute amounts if their mode of action was such that they escape their complete metabolism in plants by bonding themselves with the plant cell proteins and other molecules in intact forms. The chance of residue is very less because the when a herbicide enters the crop plant it will either degrade it fast enough or it will deactivate by any mechanism so that residue won't be remaining.

Safe herbicide use

Correct use is essential to ensure that chemical residues on crops do not exceed the limits set by law. Recommended herbicides do not generally injure people, livestock, wildlife, or crops if used properly and if recommended precautions are observed. However, any herbicide is potentially dangerous if improperly handled or used (Pennstate Extension, 2019).

Follow these basic herbicide safety procedures:

- Make sure that you are familiar with current federal and state herbicide laws and regulations and that you have a license if required.
- Avoid drift of spray or dust that may endanger other crops or animals. Cover feed pans, troughs, and watering tanks in livestock areas; protect beehives.
- To protect yourself and others, follow all safety precautions on the label. Know and observe the general rules for safe herbicide use, and record the date, time, location, and amount of each herbicide used.
- Wear protective clothing and use protective equipment according to instructions on the herbicide label.
- Never eat, drink, or smoke while applying herbicides.
- Avoid spilling spray materials on skin or clothing. If such an accident occurs, wash immediately with soap and water.
- Bath after applying herbicides and change into freshly laundered clothing. Wash clothing after applying herbicides, keeping in mind that, until laundered, such clothing must be handled according to the same precautions as the herbicide itself. Wash herbicide-contaminated clothing apart from other laundry, and take care in disposing of the wash water.
- The place should be out of reach for the children and animals.
- The place should be locked, secured and ventilated.
- Highlight the place with following posters- “WARNING”, “POISON”, “NO SMOKING”, “NO DRINKING”, “NO EATING”, “DO NOT TOUCH”.



- Herbicides must be duly separated and isolated from seeds, forage, harvested products and fertilizers.
- Empty containers – triple wash, break/perforate them and keep them in close bags to deliver them to reception centres.
- Store herbicides in their original containers in a locked, properly marked cabinet or storeroom, away from food or feed. If you suspect poisoning, contact your nearest Poison Control Center, hospital emergency room or physician

References

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