

# Herbicide

## Why use herbicides:

1. Provides safe and effective control of invasive vegetation
2. Greatly reduces the need for retreatment
3. Environmentally "safe" when used properly

## NPS herbicide policy

The Regional IPM Coordinator, prior to use in National Parks, must approve all herbicides. Herbicides labeled as restricted use by the U.S. Environmental Protection Agency require permission from the Washington Office through the regional IPM coordinator for use. Restricted use herbicides contain chemicals that may bio-accumulate, remain persistent in soil or groundwater, have an increased ability to cause off target damage or be hazardous to the applicator or resource. Annual herbicide usage must be reported by park staff.

## Label Reading

Prior to mixing, handling or applying any herbicide, individuals must read and *understand* the label. It is a violation of Federal law to use an herbicide in a manner inconsistent with its label. In short, the **label is the law!**

The label provides the following information:

- Product trade name
- Manufacturer
- **Signal word**
- EPA Registration Number
- Hazards to applicator
- Environmental hazards
- First aid recommendations
- Site specific information
- Emergency spill procedures and contacts

**You must read and understand the label prior to use.**

## Signal Words

Nearly all chemicals, house hold cleaners or fuels have a label with a signal word. These words describe the acute (short term) toxicity of the chemical based on all routes of exposure (oral, dermal, inhalation, and other effects like eye and skin irritation). Herbicide labels always have one of the three signals words printed in bold letters to indicated the level of toxicity to people. These indicators can assist applicators to select the least toxic herbicides and heighten awareness when handling more toxic formulations. Applicators should recognize that the chemical continues to have the potential to be harmful despite the signal word. Signal words are ranked as follows:

## Signal Words

- **Caution** indicates the pesticide product is slightly toxic if eaten, absorbed through the skin, inhaled, or it causes slight eye or skin irritation.
- **Warning** indicates the pesticide product is moderately toxic if eaten, absorbed through the skin, inhaled, or it causes moderate eye or skin irritation to an applicator if used or handled incorrectly.
- **Danger** means that the pesticide product is highly toxic by at least one route of exposure. It may be corrosive, causing irreversible damage to the skin or eyes. Alternatively, it may be highly toxic if eaten, absorbed through the skin, or inhaled. If this is the case, then the word "POISON" must also be included in red letters on the front panel of the product label.

When mixing an herbicide with a signal word **caution** with a surfactant that has a signal of **warning**, follow the safety precautions that fit the **warning**.

$$\text{Risk} = \text{Toxicity} \times \text{Exposure}$$

## Commonly used herbicides:

Herbicides most commonly used are systemic. This means that they enter the plant through the cambium or through the foliage. They are also categorized as amine or ester. Amine herbicides are water based and use salts to stabilize them, i.e. Isopropylamine salt of Glyphosate. Herbicides categorized as ester are oil based. This could be mineral oil or a petroleum base.

1. **Garlon 3A:** plant killing agent is Triclopyr amine (44.4%).
  - Controls woody stemmed and broad leaf plants.
  - The chemical triclopyr mimics a naturally occurring plant hormone. When plants absorb the herbicide and utilize the natural hormone and extra "fake" hormone, it takes up too much space in the cell. This causes cells to explode.
  - Becomes adsorbed with soil contact, binding with clay particles. Can have some activity in sandy soils.
  - Can be applied in cut stump treatments at higher rates (50%) and in foliar applications at reduces rates (.5- 5%).
  - Approved for near and in water use.
  - PPE when mixing and applying is eye protection, chemically resistant gloves, long sleeves, boots and socks.
  - Garlon 3A has a signal word of **danger** and has the ability to become a corrosive eye agent causing irreparable eye damage with prolonged contact. This is caused by the chemical being an alkaline formula much like a strong detergent

2. **Garlon 4:** plant killing agent is Triclopyr ester (61.6%).
  - Controls broad leaf and woody stemmed plants.
  - See statement above for mode of action.
  - Can be applied as a basal treatment when mixed with agricultural oil at moderate rates (10-20%) or in foliar applications (.5- 5%).
  - Has the potential to vaporize and be absorbed by overhead foliage in hot and humid conditions.
  - Not approved for near water use because it has an oil base (ester).
  - PPE for mixing is eye protection, chemically resistant gloves, long sleeves, boots and socks.
  - Garlon4 has a signal word of *caution*.
  
3. **RoundupPro:** plant killing agent is Glyphosate (41%). Also has surfactants (17.4%) and water (41.6%).
  - Can be used to control woody stemmed vegetation in the late summer and fall but is most effective on grasses and perennial weeds. This is a non selective herbicide.
  - Mode of action is to prevent the production of chained amino acids. This does not allow for the production of proteins in the plant causing weak plant cells to collapse on top of each other.
  - Chemical is adsorbed upon contact with organic soils. Can remain active in sandy soils.
  - Can be used in stump cut applications (15-50%) or as a foliar spray (.5- 5%).
  - Not approved for near water use because it includes surfactants.
  - PPE for mixing, handling and applying is long sleeves, eye protection, socks and boots.
  - Signal word is *caution*
  
4. **Accord Concentrate:** plant killing agent is Glyphosate (41.5) with no additional surfactants.
  - Can be used to control grasses, perennial weeds and broad leaf woody plants. This is a nonselective herbicide.
  - Can be applied as a foliar spray (.5- 5%) with additional surfactants or as a cut stem treatment (15- 100%).
  - Has been approved for near and in water use because of the absence of surfactants.
  - Surfactants should be added to foliar mixes when possible
  - PPE for mixing, handling and applying is eye protection, long sleeves, socks and boots.
  - Signal word is *caution*

5. **Milestone:** Plant killing agent is Aminopyralid (40.6%)
- Systemically enter the plant and shuts down auxin usage.
  - Targets legumes, Ailanthus and thistles
  - Not approved for near water use and can be soil active.
  - Signal word is **caution**.
  - PPE for mixing, handling and application is chemical resistant
  - Follow manufacturer's guidelines for application rates. One tablespoon per three gallon backpack typically satisfies the acceptable label rate for spot treatment. Maximum amount for application is 7 ounces per acre/ year.

\*Herbicide Fun Fact: the average herbicide cost \$250 million and 10 years of research and permitting for a new herbicide to be market ready. The patent is in effect for 17 years.

### **Mixing:**

All herbicides should be mixed according to predetermined specifications using calibrated measuring equipment. All herbicides should be mixed over some form of watertight, chemical resistant container for the safe collection of accidental spills. Proper PPE **must** be worn at all times. Exteriors of containers and sprayers should be rinsed if herbicide, surfactants and/or dyes are present. All empty herbicide and surfactant containers (jugs) are required to be triple rinsed when emptied punctured and recycled or disposed of. Dye containers can be disposed of in the same manner.

Care should be taken not to mix Triclopyr and Glyphosate. This creates what appears to be dissolved paper towel like substance that clogs sprayers.

Additional dyes tend to be extremely messy and a small amount goes a long way. Use chemically resistant gloves and caution when handling.

Emergency spill kits should be kept in close proximity and readily available in any mixing or handling situation. All persons must wash hands after mixing, applying or handling herbicides and prior to eating, drinking, chewing gum, using the toilet or using tobacco products, even if no herbicide came into contact with skin. If contact with skin occurs, quickly wash the contaminated areas with soap and water. If irritation occurs, continuously flush with water and seek medical attention.

The smallest amount of concentrated herbicide is recommended when creating herbicide formulations. *HOWEVER*, this sometimes causes ineffective control and a need for retreatment. Use an appropriate concentration of herbicide to control your target species.

**Mixing Agents:**

Herbicides should be mixed and diluted with several different agents to allow the target species to properly absorb the plant killing agent. Herbicides can only be absorbed when they are wet. Some invasive exotic vegetation requires several chemicals mixed into one formulation to make them most effective.

**Surfactants and Adjuvants:**

Often added to foliar formulations, these are additional chemicals that assist herbicide absorption. They are emulsifying, dispersal, anti-foaming, drift control, wetting or surface modifying agents. When selecting a surfactant, check to make sure it is intended for agricultural use and compatible with the herbicide. These chemicals sometimes contain detergents that may be corrosive and cause skin and eye irritation or damage. Check labels for *warning* or *danger* signal words. Proper PPE should be worn when handling concentrates to prevent contact. Do not use house hold soaps as a substitute for agricultural surfactants.

**Agricultural Oils:**

Used when girdling or basal applications are used. These oils are often non-food grade vegetable oil or mineral oil that are mixed with concentrated herbicides. The oil keeps the herbicide wet, stuck to the plant and assists with penetration into the cambium layer for maximum absorption of the killing agent. Some trade names of common ag-oils are JLB Oil and Impel Red.

**Water:**

Used to dilute herbicide in foliar, girdle and cut stump formulations. Simply reduces the amount of concentrated herbicide. Surfactants, adjuvants and dyes can later be added as required. Water must be free of sediment and algae.

**Dyes:**

Added to assist the applicator in seeing where herbicides have been applied. This prevents excessive amounts of chemical from being introduced to the environment. Add the smallest amount of dye possible.

**Storage:**

All herbicide containers, sprayers, rinse water jugs and spray bottles **must** be labeled with the formulation. Any thing that contains an herbicide should be stored in an herbicide locker, over a containment sump or in some form of secondary containment. All herbicides should be kept under lock and key to insure that only authorized personnel have access to them. Areas where herbicides are kept should be well ventilated.

### **Transportation:**

When transporting herbicides, all containers with mixed or concentrated herbicides, mixing agents, surfactants/adjuvant, dyes or mixing water must be in some form of watertight, chemically resistant, secondary containment. Action Packers and five-gallon buckets satisfy this requirement. Wooden boxes do not meet the standards. Wands from sprayers should be placed in a down ward position inside secondary containment. All sprayers should also be depressurized when transported or not in use. All herbicide containers and secondary containers should be properly secured to prevent shifting or moving during transportation. This can be done with rope, tie down straps or bungee cords. Herbicides must be labeled and a copy of a Material Safety Data Sheet (MSDS) or a complete legible label from original herbicide container must be present during all operations. Herbicides and fuel may never be transported in the same compartment as passengers or operators of a vehicle.

### **Applications (how to kill a plant):**

Several methods are available when attempting to eradicate invasive exotic vegetation. Some methods work better than others depending on the type of plant, its size and its location. Care should always be taken to prevent accidental off-target damage, including plant identification, control of over spray, selecting the best technique according to weather and applying the appropriate amount of chemical.

#### **Foliar:**

Applying a low concentration (.5-5% concentrated herbicide) to the leaves or foliage of the target species. Foliar sprays often contain water, adjuvants/surfactants and dyes. For effective control, all foliage should be sprayed to wet from the top of the plant and continue downward with formulation. Spray to wet is applying the formula to the point before it starts to run off the foliage. Care should be taken to insure the **growing tip or tallest lead** is adequately covered in herbicide. Usually done on smaller trees, ground covering vines, shrubs, bushes and grasses as well as in large-scale operations to control unwanted vegetation in field management. Has the greatest chance of non-target damage due to over spray, especially in windy conditions.

#### **Girdle or Frill:**

Using a machete, knife, handsaw or chainsaw to remove the layers of the plant between the bark and sapwood of trees, vines, shrubs and bushes. This **must** be done completely around the **entire circumference** of the plant to be effective. This eliminates the flow of nutrients up and down the plant. An herbicide must be used with this method, as girdling is not enough to kill the plant. Failure to apply a cut stump or basal formula will result in resprouting.

### **Cut Stump:**

Using any type of cutting tool to cut the tree, vine, bush or shrub at its **lowest point** to the ground then immediately following through with an herbicide application. Cut stump formulations usually run a little higher with the amount of concentrated herbicide (25-50%). Use of chainsaws or handsaws are recommended for this type of treatment as it offers a clean flat surface with limited exposure of the cambium layer where the herbicide is to be applied and absorbed. A machete or knife effectively does the same thing but offers more exposure of the cambium layer through jagged edges and offers a greater chance of missing a spot with the herbicide. The entire exposed cambium layer must be covered with the herbicide to reduce the chance for resprouting. Herbicide should be applied as soon as safely possible after cutting. Water based herbicides tend to mix better with the hydrolipid system, resulting in better kill than with oil-based herbicides.

### **Basal or Basal Bark:**

Applying an oil based herbicide that has been diluted with agricultural oil to the **entire circumference** of the trunk or stem at the base of the target species. Desired heights to apply the herbicide will vary depending on the size of the tree, vine, bush or shrub. The larger the plant, the higher up the herbicide will be applied. This should also be applied as spray to wet; spray the stem or trunk until the point just before run off. Care should be taken to spray all exposed roots and/ or multiple stems. Failure to spray completely around the stem or trunk may result in resprouting. High pressure in the sprayer will also result in splattering the chemical resulting in off target damage. Avoid treating any trees with thick bark as the formula will not penetrate. Basal formulas usually contain 8- 25% concentrated herbicide.

### **Spray Pattern Adjustment**

Adjusting the sprayer tip to get the correct spray pattern is important. A direct stream, in most instances, will result in applying an excessive amount of herbicide and off target damage. Adjust the spray pattern to give the most amount of coverage and least amount of off target damage and drift. The spray pattern will be different for cut stump as opposed to foliar. Avoid applying a mist as wind currents can carry the herbicide solution a great distance and cause damage to surrounding vegetation.

### **In Case of a Spill:**

The first step in dealing with any chemical spill is to have on all PPE. Insure that those around you or those who may help in the clean up or containment also have on proper PPE. Keep others out of the contaminated area. **Do not** approach or handle any spilled chemicals without PPE. **Do not** approach or attempt to contain any chemical spill if you do not know what chemical is present. **Do not** leave the spill unattended. The overall size of an herbicide or chemical spill will determine what course of action is required. Simple spills of a few ounces over soil can be cleaned up by digging up the contaminated soil and placing the soil in a double plastic bag. Smaller spills over black top, concrete or other hard surfaces can be controlled by using oil absorbing rags or cloth, or sweeping cat litter or other similar oil absorbing compound over the spill, collecting the contaminated materials and placing them in a double plastic bag. For larger spills containment is the priority before clean up can begin. Areas on a slope, with a hard surface or a wet surface will make the spill spread faster. Protect drains, water sources, stream etc. from runoff. The use of oil absorbing booms or large amounts of cat litter can slow and reduce the rate of spread. Try and head off the spill if possible. Make sure all contaminated materials are placed in double plastic bags or a single plastic bag and into a chemically resistant container.

### **Personal Protective Equipment (PPE)**

Personal Protective Equipment (PPE) is important to reduce the risk of on the job injury. Exotic plant management has an inherent risk through the common use of tools like machetes, chainsaws, hand saws, brush cutters, all terrain vehicles and chemicals. Work performed outdoors can be in remote areas, on steep terrain, during periods of uncomfortable cold and heat and in areas inhabited by poisonous snakes, fire ants and black bears. Protective gear will be readily available and in most cases **must** be worn as part of OSHA and NPS standards.

#### **Field Work/ Herbicide**

The label on the concentrated herbicide jug will describe, in detail, the exact PPE required for each application. As a rule of thumb, when applying a mixed herbicide the minimum PPE to be worn is eye protection, boots and socks, long pants, long sleeve shirt and gloves. When mixing, handling, or pouring any concentrated or mixed herbicides the minimum PPE is the same as that in application but requires the use of chemically resistant gloves. Additional PPE may include face shields, respirators, Tyvex suit and a hard hat.