Using Arsenal for Brushy Species Control

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Abstract

Arsenal is an effective herbicide for control of many species of exotic weeds, such as saltcedar and *Melaleuca*. It has low human and animal toxicity and very specific toxicity to plants. It can be used as a foliar spray or as a selective application on cut stumps and stems, or as frill, girdle, or injection treatments. The selectivity of Arsenal raises concerns that weeds may become resistant to this herbicide. Resistance can be avoided by using Arsenal as one tool in an integrated control strategy for management of exotic pest plants.

Introduction

Arsenal is a member of the imidazolinone family of herbicides discovered by American Cyanamid Company during random screening in the 1970s. The herbicides in this family are active at very low rates and have low toxicity to animals, including humans. Of the four imidazolinone herbicides currently in use in the U.S., three are used in crop production; only Arsenal is used for weeds in non-crop or industrial areas. Arsenal is also used in forestry for brush control and for some tropical plantation crops, such as oil palm and rubber trees. Registration of Arsenal, also sold as Chopper and Contain, was first granted in the US in 1984. Registration in California for forestry use is currently pending. The non-crop label registration for California will follow after the forestry labeling has been attained. Arsenal will control many brushy species of exotic plants with foliar applications, making it more effective on some plants than glyphosate (Roundup) or triclopyr (Garlon) which have to be used as cut-stump or basal bark sprays.

Chemistry and Toxicology

The common name accepted by the Weed Science Society of America and internationally for Arsenal is imazapyr. The herbicide is formulated both as an acid and as an isopropylamine salt. Acute toxicity of imazapyr is low. When tested on laboratory animals, "it was rapidly excreted in the urine and feces with no significant changes. Residues of imazapyr did not accumulate in the liver, kidney, muscle, fat, or blood (Miller 1991)." Acute toxicity levels are greater than 5,000 mg/kg, equivalent to about I cup of formulated Arsenal for a typical adult human. Arsenal does not cause skin or eye irritation, even though the pesticide label contains precautions on skin and eye contamination. It is not oncogenic (cancer-causing), teratogenic (tumor-causing), or mutagenic (causing mutations to reproductive tissues or embryos).

As an herbicide, Arsenal is stable for periods of more than one year at normal temperatures. In the soil, this herbicide is weakly bound to soil particles, mostly to clay and organic matter. Studies have shown that Arsenal generally stays within the top 20 inches of the soil and does not leach or run off; movement is lowest in low pH soils. The half-life of Arsenal in soil varies from 25-142 days, depending upon moisture content, microbial activity, and pH. Weed control activity can last up to two years when the herbicide is applied at high rates.

How Arsenal Kills Plants

Imazapyr is absorbed by the foliage usually within 24 hours of application and also by the roots of plants. Once in the plant, it moves readily through the xylem and phloem to meristematic tissue (growing points or buds), but can take several days to reach all sections of a plant. Arsenal stops the growth of susceptible species by inhibiting an enzyme, acetolactate synthase (ALS) or acetohydroxyacid synthase (AHAS) required by plants to produce three essential amino acids. This specificity of imazapyr and the other imidazolinone herbicides, attacking just one key plant enzyme, accounts for their low toxicity to other living organisms. Imidazolinone herbicides kill plants slowly, first stopping growth, followed by the death of meristematic tissue, and lastly by

inducing chlorosis (yellowing) of the leaves. In the case of a deciduous perennial, such as saltcedar, when treated while the plant is still active just before it goes dormant, few symptoms are seen, the plant just fails to bud out in the spring. Some species of plants are tolerant of Arsenal, especially members of the legume (mesquites, palo verde, acacia) and composite families. This selectivity is apparently related to tolerant forms of the ALS/AHAS enzyme.

Arsenal for brush control

The list of weeds controlled by Arsenal is large, more than 100 known species. Of interest to this conference is the use of Arsenal to kill exotic species. It has been used for several years to kill Melaleuca in Florida and saltcedar (Tamarix sp.) in the southwest, but not in California. Once a registration is granted in California, more extensive tests with Arsenal can be conducted on which exotic species are controlled and which native species are sensitive or tolerant. According to the herbicide label and research in the weed science literature, Arsenal can be effective as a foliar application to actively growing sensitive species. Best results on perennial species occurs with summer or fall treatments that coincide with sap movement down into the roots or underground storage structures (i.e. rhizomes or tubers). The timing of this application is related to climatic conditions. In most of California's cooler regions, summertime will be optimal, but fall is better in the inland valleys and the deserts. In a test conducted in the Imperial Valley, we found that, at the same rates, a November treatment would kill mature saltcedar, while a June application achieved no better than 30% control. We also noticed that if we did not cover the whole plant with our spray, some of it recovered.

Recommended treatment rates of Arsenal vary from 0.5 to 1.5 pounds of acid equivalent per acre, depending upon the species and maturity of the plant. For small areas using a backpack sprayer, a 0.5 to 2.0 percent solution in water is generally adequate. The Arsenal label describes application techniques thoroughly and should be consulted before any application. Following up on research conducted in New Mexico by Keith Duncan, Extension Weed Scientist, we found that a 1% solution of Arsenal, with a non-ionic surfactant, applied as a foliar spray killed mature saltcedar 8 feet tall. An equally effective treatment was a combination of Arsenal plus Roundup, each at 0.5%, again with a non-ionic surfactant.

The Arsenal label also has sections describing cut stump and cut stem treatments, frill and girdle treatments, and injection methods. These uses, similar to Roundup or Garlon, reduce the total amount of herbicide applied per acre and are intrinsically more selective because only small areas of the undesirable plants are treated.

Precautions with the use of Arsenal

Even though Arsenal has low toxicity to animals and humans and does not leach or runoff readily from the treated site, it is still a pesticide and should be used with care. The label describes personal protective equipment or clothing that should be worn when using Arsenal and what to do in case of accidental spills or contamination. Arsenal, at typical use rates, persists a long time in the soil, up to two years. A residue of Arsenal, even a large amount, in the soil will not "sterilize" that ground forever, but there will be long-term effects. Some species of plants are naturally tolerant to imazapyr, others are very sensitive to even small amounts. At this time, considering the large number of native and desirable species of plants in California, it would be wise to be cautious. Arsenal is being used in several southwestern states as a broadcast spray applied by airplane for control of monotypic stands of saltcedar, but this will probably not happen in California until we have several years experience with this herbicide.

The fact that Arsenal is toxic to just one enzyme system only found in plants is an important factor in the environmental safety of this herbicide. On the other hand, this specificity, along with the fact that tolerance to Arsenal is common among different plant species, means that resistance to this herbicide will likely develop, although there are no known cases to date. Resistance of a species to a pesticide occurs when the gene for resistance or tolerance is present in the population of that species and that species is treated repeatedly with that same pesticide. Over time, susceptible individuals are killed and tolerant individuals constitute an increasing proportion of subsequent generations. As a population acquires resistance, stronger and stronger doses of the pesticide are required to achieve the same level of control. Eventually the population becomes completely resistant and no amount of the pesticide will work. The more specific a pesticide is in how it kills the target pest,

the sooner a resistance occurs. Herbicides with broad and varied modes of action, such as Roundup or Garlon, do not have problems with resistance in the same way as a specific herbicide like Arsenal.

Weed resistance to a herbicide can be avoided by using varied control tactics and not relying on one method of killing a weed. Do not use Arsenal by itself on the same population of weeds every year. A population includes the seedlings that germinate the next season from parents previously treated. The mixture of Arsenal plus Roundup will reduce the potential of resistance because treated plants are being poisoned in several ways. Mechanical control, with brush cutters, chainsaws, or bulldozers, should be integrated into the exotic plant control plan.

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