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TREE STRESS FROM SALTS AND HERBICIDES[1]

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Abstract

Trees are damaged from both salts used in deicing highways and herbicides used for weed control. Aerial salt sprays lifted by traffic are more damaging to trees than soil accumulations. Salt injury can be reduced by applying antidesiccants, constructing physical barriers, leaching soils, incorporating activated charcoal and planting high and away from salt spray and runoff.

The most damaging pre-emergence herbicides include simazine and dichlobenil while dicamba, 2,4-D and related compounds are the most harmful post-emergence chemicals. Prevent injury from herbicides by proper chemical selection, application at desired rate, with accurately calibrated equipment on a day when drift is minimized. Avoid soil residues, treating susceptible cultivars and treating under plant stress conditions. Activated charcoal can be used to detoxify many herbicides in the soil.

Stress from Salts

For many years plants growing along highways have been injured from deicing salts. Injury is typically most severe on plants closest to the highway and on the side facing the road. Injury has been detected for several hundred feet downwind but usually is more prevalent within 50 feet of the highway. Plant damage is most pronounced in areas with the highest density of traffic and traffic at higher speeds since these streets are associated with the greater amounts of applied salts.

Symptoms. Injury on deciduous plants is often not evident until growth begins in the spring and occasionally not until stress conditions occur in late spring or summer. In the more severe cases, branches facing the road may be leafed-out at the base only, with much of the previous seasons growth dead. The side of the plant away from the highway may be completely leafed out. Where growth does occur on deciduous plants, the leaves may be small, tip and marginal leaf burn may occur, followed by leaf browning, leaf drop and finally stem dieback and death. General stunting and tufting of growth are other common symptoms.

Evergreens are generally more sensitive than deciduous plants. In some cases, foliage may become bluish green, however, the most typical symptom is needle browning or a rust color. Browning progresses until the needles completely turn brown, drop and branch dieback ensues. The injury is normally confined to the lower portions of the trees depending on distance and elevation of the salt spray.

Causes. The materials used to deice highways consist of salts alone, abrasives such as sand, cinders, washed stone and slag screenings alone, or a combination of salt and abrasives. The salt, primarily sodium cloride (NaCl), although calcium chloride ($CaCl_2$) is used in certain instances, is applied at rates ranging from 200 to 2,000 pounds/2 lane highway mile/storm. In 25 of the northeastern states, an average of 11.6 tons/mile of deicing salt was applied each year from 1961-1966 (3).

Salt injures plants primarily through direct contact with the foliage as well as root absorption. Salt spray lifted by traffic and blown onto plants causes desiccation of foliage and stems as a result of movement of cell water to the salt deposit on the plant. Salinity reduces metabol-

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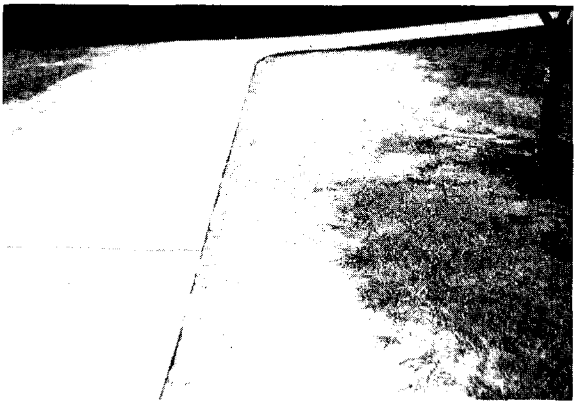

Figure 1. Turf damage from deicing salts used on the sidewalk.

Figure 2. Typical simazine injury on the older foliage of Regels Privet.

ic activity of plants and suppresses RNA and protein synthesis (8).

High salt levels in the soil increase the osmotic pressure of the soil solution which limits the water supply to trees and this can be especially troublesome during drought or dry weather. Injury also occurs if either the chloride or sodium concentration in the plant tissue becomes too high. High sodium levels may decrease both potassium and calcium levels within the plant which alters the plants mineral nutrition balance.

Preventing Salt Damage

1. Leaching (as soon as contamination is suspected) the salt out of the root zone is feasible where only a few plants are involved. A number of thorough waterings, depending on plant size and salt concentration, will be necessary to move the chemicals below the root zone.
2. Encourage the use of abrasives in place of salt by homeowners to deice drives and sidewalks.
3. Suggest the use of anti-desiccants for homeowner use, especially on evergreens near the highway and drive. Anti-desiccants are useful in preventing winter damage as well as in reducing the severity of salt injury caused by aerial drift (1).
4. Although unsightly, specimen plants can be protected for 2-3 months with physical barriers, such as plywood, burlap, plastic film, etc.
5. Activated carbon or charcoal is used to neutralize pesticide contamination of soils and may protect trees from salt injury as well. Charcoal to be effective should be incorporated in the soil around the plant extending to the dripline. Its effectiveness will depend on how soon it's applied following contamination since charcoal penetration will be limited by its physical incorporation.
6. Consider small diversion ditches between the roadway and the plant materials in areas where water run-off may carry salt to tree root zones. Quite likely, this may help prevent some of the damage to evergreens caused by poor drainage.
7. Future planting sites should be selected to minimize damage by planting no closer than 30 feet from highly travelled high-speed highways. Sites should be selected on the highest ground to avoid aerial drift as well as surface water run-off. Select and encourage others to plant trees, shrubs and evergreens on their basis of salt tolerance. Publications by Davidson (2), Hanes (3), and Lumis (5,6) list many plants according to their salt tolerance. Austrian pine has been found more tolerant than white pine, blue spruce more resistant than Norway spruce and deciduous plants with sticky, pubescent or sunken buds less likely to be injured than plants with smooth, exposed buds.

Stress from Herbicides

Factors such as disease, nutrient deficiencies, insect damage, adverse weather conditions and other pesticides can cause symptoms similar to

Figure 3. Dicamba injury can usually be distinguished from 2,4-D by the "cupping effect" noted above on London Planetree.

those caused by herbicides.

Often herbicides are implicated as the primary suspect in plant injury when, in fact, they were not responsible for the damage. The accusations are becoming quite common as lawn service companies become more active in a community. Herbicide injury in trees usually displays a definite pattern with a characteristic group of symptoms. Knowing these patterns and symptoms along with a history of herbicide use can aid in diagnosing the cause of injury and differentiating it from non-herbicide causes.

Herbicides are generally classified as either pre-emergence or post-emergence. The former is normally applied prior to weed germination while post-emergence refers to applying the chemical on the actively growing weed. Most injury to trees is associated with the use of post-emergence herbicides such as 2,4-D and dicamba (Banvel-D).

Cause and symptoms

A) Pre-emergence herbicides can be harmful to trees although injury in the nursery is more frequent than in the landscape. The pre-emergence herbicides most frequently encountered in the landscape are those included in crabgrass preventers. These most often include DCPA (Dacthal), siduron (Tupersan), benefin (Balan), and bensulide (Betasan), and all are quite safe when used near or under trees.

When damage does occur, it's usually from high rates of simazine (Princep) or dichlobenil (Casoron). The symptoms of injury are typically marginal chlorosis around the leaf margin. Simazine causes marginal and interveinal chlorosis while dichlobenil which can cause both, typically results in a narrow band entirely around the leaf margin giving a "halo" effect. Symptoms of both herbicides are more notable on older foliage. More ornamental species are sensitive to simazine than dichlobenil.

B) Post-emergence herbicides can be most simply classified as those acting as 1) hormones and 2) non-hormones (7).

The hormone group includes 2,4-D, 2,4-5-TP (silvex), MCPP and 2,4-DP all used for broadleaf weed control. The new growth of treated ornamentals usually exhibits twisted petioles, swollen stems and distorted leaves often strap-shaped or fasciated in shape. Dieback or death may follow depending upon amount of herbicide and sensitivity of the plants. This group of herbicides causes injury in the form of drift from air movement during spraying and from violatility in the form of vapor from the application point.

Dicamba, a benzoic acid, causes injury similar to 2,4-D compounds. Injury continues to occur although less often than in previous years since its combination with fertilizers has been nearly discontinued. The symptoms of dicamba typically differ from 2,4-D in that cupping of the foliage is usually always present. Since this herbicide is extremely persistent in the soil, injury often occurs in low sites 2-3 years following application upland and symptoms are evident for 1-2 more years.

Non-hormone herbicides include systemics, contact and soil sterilants. Two systemic herbicides are sold as aminotriazole and dalapon. Aminotriazole, used for broadleaf and grass control, interferes with photosynthesis and causes trees to turn pinkish-white to completely brown if high rates are applied to the soil or foliage. Dalapon, selective for grass control causes marginal scorch of foliage when taken up from the soil. Contact with plant foliage causes partial to complete death in most cases.

Contact herbicides cause a desiccation of the vegetative portions of the weeds but are not

Figure 4. Lilac damaged by aminotriazole applied at a higher than recommended rate. Foliage of most plants is usually pinkish white in color when injured by aminotriazole.

translocated to roots as the previous group. Injury to trees, usually from drift, occurs as brown spots. On occasion, injury occurs in the form of bark splitting or streaking of the lower trunk of green barked trees such as Laburnum, Sophora and whips of honeylocust and Tilia when treated to control weeds around the base. This type of injury is more common in the nursery that in landscaping plantings.

Injury to trees does occur from soil applications of sterilants, in the form of yellowing and browning of foliage to twig and branch dieback. These compounds should never be used near trees and injury should seldom be seen.

Prevention of herbicide damage

Several factors are important in the prevention of herbicide injury (4).

1) Select the proper herbicide for the job and apply according to label directions which state under what conditions the chemical can be used and expected results.

2) Use the proper dosage rates: apply herbicides at rates recommended on the label. Rates vary depending on soil type and some judgement is necessary particularly with pre-emergence compounds. Organic matter is often higher in low areas of a site and lowest on knolls thus injury can be expected on the higher elevations with pre-emergence herbicides. Erosion of the treated soil, however, can result in injury in low areas.

3) Equipment. Application equipment should be working properly and must be accurately calibrated to avoid overdosing. Nozzles should be examined and changed periodically since wettable powders are abrasive and cause nozzle wear.

4) Drift prevention. Drift potential increases as the distance between the sprayer nozzle and the soil or weed surface is increased. Drifting increases as wind-speed and spray pressure increase. Consider the use of spray additives which change the physical properties of herbicides and eliminate the fine droplets. Equipment is available which apply foams or water in soil (inverted emulsions) that will not drift as much.

5) Avoid soil residues. Some herbicides may leave a residue for more than one growing season. Common sense is the guide in reapplication. Reapply herbicides only if new susceptible weed growth is evident and only at recommended rates. Alternating herbicides, where possible, tends to reduce soil residue concerns.

6) Weather influences injury. Stress conditions contribute to herbicide damage. Trees are most likely to be damaged when they are under stress from lack of water. Hot, humid conditions are conducive to leaf scorch from some postemergence herbicides (4).

7) Avoid treating susceptible cultivars. Certain cultivars are inherently more susceptible to specific herbicide injury. Such is the case with the hormone herbicides and pin Oak. Dichlobenil readily injures spruce and simazine occasionally damages ash.

8) Detoxifying herbicides. Activated charcoal can absorb and detoxify a wide variety of pesticides. It is used to overcome injury from high rates of herbicides accidentally applied to turf and tree areas. Apply the charcoal, available from industrial chemical or drug supply companies, at the rate of 150 pounds times the suspected aia (active ingredient/acre) of herbicide applied (9). For example, is simazine was broadcast at the rate of 6 pounds aia to cover 1000 sq. ft. then 6 x 150 = 900. Divide 900 by 44 (thousand sq. ft./A) and 20 pounds of activated charcoal is required for 1000 sq. ft.

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ARTHROPOD PESTS ON JUNIPER

by J.R. Steinhauer

In the area of agricultural research, there is a serious lack of work on ornamentals or enviornmental plants. These plants have traditionally taken a back seat to the "important" food and fiber crops. The few scientists working on environmental plants have generally limited the scope of their investigations. Most research has consisted of biological information about one pest on a particular environmental plant. A lack of effort also exists in the area of chemical control of pests on environmental plants. The rate at which pesticides are falling into disuse is alarming. To keep up with changes we must be constantly looking for new pest control chemicals and developing new uses for existing chemicals.

The Pennsylvania Department of Agriculture, Bureau of Plant Industry, has recognized the need for research on environmental plants. Several years of basic research in the form of surveys and compilation of species lists, led to the funding of a three-year research project. This project will involve an in-depth study on the arthropod fauna associated with conifers in Pennsylvania. Results from the preliminary surveys have given us a fairly complete list of arthropods occuring on several environmental plants. Because of the basic information available on the fauna associated with juniper and the economic value of juniper as a nursery crop in Pennsylvania, the initial scope of the conifer project was limited to the arthropods associated with juniper.

This article will report on the results of the basic surveys on juniper and the first season of intensive study on the arthropods associated with juniper. As with most scientific articles, the information contained here is not the result of just one person's effort. The entire staff of the Entomology Division of the Bureau of Plant Industry was involved in taxonomic work, basic surveys, and biological studies. The Plant Pathology Division assisted with diagnostic work. Our chief entomologist, Finley Negley, was instrumental in formulatioin of the project.

During the preliminary survey, 54 species of arthropods were collected from juniper. Of the 54 species 20 were considered plant feeders and