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WOODLAND MANAGEMENT

Forest Pest Control Perspective

Harvey A. Holt, Professor, Department of Forestry and Natural Resources, Purdue University
and Michael Newton, Professor, School of Forestry, Oregon State University

Forest Pest Management

Pests and the Long-Term Outlook for Forests

Pest control in forests entails several considerations seldom, if ever, encountered in other pest control situations. Management of forest pests is a long-term proposition. It takes many years and much capital investment to build up timber growing stock. Because forest tree species are managed for periods of 5 to more than 100 years, effective pest management must be combined with other management objectives to prevent recurrence of pest problems. Healthy, fast growing, and pest resistant forests can and should be among the management objectives of pest control, an objective that cannot be accomplished simply by producing dead pests.

Many of the pest problems in forests are present because of past forest practices. Exploitive harvesting has left nonmerchantable trees, brush, and nonstocked lands covered with weeds that prevent regeneration of desired species. Present forest managers are now adopting management methods that minimize the creation of new pest problems. However, there remain vast areas of forest where vegetation or insect control is needed to restore productive forest or to minimize loss caused by major insect outbreaks.

Forest Resources Values and Pest Management

Timber supplies of high quality are vital to this country, and, at the same time, forests are everybody's playground. Many people place special values on scenery and wildlife and become emotionally distraught with the prospect of pesticide use. However, pesticides are used to protect the forest. Of the various methods of protection, pesticides may be among the least destructive. No one questions the desirability of healthy forests. Used properly, pesticides are one alternative way for keeping them healthy.

Successful reforestation is dependent on high quality tree seedlings delivered from the nursery on schedule. Without effective pest control, this may be impossible. Forest nursery management is entirely different from the management of forests themselves. Seedling production for the nation's reforestation is dependent on approximately 9,000 nursery acres. Seedlings in the nursery represent values of $3,000 to $30,000 per nursery acre, and each acre may represent up to 1,000 acres of reforestation commitments. Incentives are enormous to avoid seedling loss caused by pests, especially weeds, insects and diseases.

Potential for Constructive Use of Pesticides in Forests

We can assume that maintenance of the various forest resources is in the best interests of all. If we are to use these resources and maintain them indefinitely, we must manage them carefully.

All forests have many species other than commercial timber species. As long as the commercial trees are dominant, these noncommercial plants provide diverse habitat for wildlife and do not usually interfere with the management for timber. When timber species are removed without suppressing the noncommercial species, the noncommercial trees become dominant forest weeds and restrict develop-

ment of a new forest. They can form an entirely unutilizable stand.

Forest managers must use various means for controlling forest composition. The lack of using any method has been the prevailing approach on most of the commercial forest land in the United States for its entire history of exploitation. We have 300 million acres of timberland (60 percent of the total) that are producing at 70 percent or less of the potential productive capacity and much of the current production is of marginal quality. Restoration of productivity on these lands means weed control. If this restoration is not accomplished with herbicides, it must be done by other means. When used properly, herbicides have less total impact on the land than most other methods, such as mechanical or fire. Applicators need to know how to use herbicides to *promote* growth of desirable species. Controlling weed species is only one step in this restorative process.

Pests can be controlled in forests quite often without resorting to highly toxic or persistent chemicals and without violence. Both pest and nonpest species are highly specific in their habitat requirements. A change in stand decomposition can cause insect or vertebrate pests to move elsewhere, (i.e., 2,4-D may be substituted for strychnine, in some instances).

In general, forest managers have strong control over forest pests through management of habitat, i.e., vegetation. Vegetation control and management are also the means by which forest managers control composition of the dominant forest and its wildlife. Overall, then, forest pest control will involve vegetation management most of the time. Pesticide applicators should be familiar with forest pest species and their habitats. They should also be alert for opportunities to use the least destructive method, including chemical, and for achieving permanent solutions to forest pest problems. Bulldozing, brush raking, and rolling chopper systems can all be used on favorable topography when soils are dry. These methods have a maximum effect on soil compaction, wildlife habitat, and erosion and can be destructive if used improperly.

Action of Pesticides in The Forest Environment

The forest environment is constantly changing; alterations of one component will cause changes in another. Since pesticides act exclusively by removing various living things, it is appropriate to consider the general way in which the entire forest responds when a pesticide is used on a particular target species. Although the target species may be the only organism injured directly by the pesticide, it is important to consider the other organisms that depend on the ones removed.

The pesticides used in forest situations, i.e., herbicides, insecticides, rodenticides, and fungicides, are quite specific in injuring plants, insects (and perhaps other animals), vertebrates, and fungi. The general discussion of their effects can, therefore, be lumped by class of pesticide.

Herbicides

This class of chemicals includes a small number of chemicals actually registered for use in forestry. Some are used exclusively for killing large woody vegetation, (e.g., picloram, fosamine); some are used for general control of woody and other herbaceous plants, (e.g., phenoxys, glyphosate, dicamba); and some are used for grasses and broadleaf herbs exclusively, (e.g., triazines).

Trees have a major impact on every other living thing in the forest. Removal of trees by any means causes an increase in the amount of soil moisture, nutrients, and light available for the vegetation that survives the disturbance. Thus, logging, herbicide application, and girdling have many common results.

The most important impact of tree killing is the release of site resources, followed by the increase in development of ground vegetation. This is an ecological principle of great importance. Because of it, it is possible to establish regeneration of light demanding species after trees are removed. Also, many species of wildlife flourish in the openings, and the entire plant complex is changed.

Some brush-killing herbicides are more persistent than others. Picloram and dicamba residue may interfere with the planting of sensitive species soon after treatment, and a lag of 3-12 months may be needed between treating and planting. None of the woody plant herbicides persists long enough to cause prolonged deforestation unless application greatly exceeds registered rates.

Herbicides effective on woody plants are used for the specific purpose of improving the competitive position of desirable tree species. It is important to recognize that *all* species not injured by the herbicide are similarly benefited. This is why it is so important to reforest with trees that are competitively able to dominate the other vegetation that will surely be present soon after treatment.

When herbicides are used for removing only a part of the tree cover, the remaining trees expand in root and top growth, thus utilizing the resources vacated by those killed. It may take several years for the trees to take up the space. During this period of overstory development, the ground vegetation prospers, then declines.

When ground cover changes in density and food quality, animal populations fluctuate. Thus, the removal of all trees tends to provide large increases in forage for 5-20 years until trees again shade the ground. As the forest develops, from new regeneration to mature timber, wildlife habitat changes from abundant food and scant cover to abundant food and cover, and finally to less food despite dense

cover. These changes are caused by forest succession, not by the herbicide; the chemical was merely the tool that initiated the changes.

Control of vegetation in preparation for reforestation temporarily removes a substantial portion of the ground cover. The results of this are, in effect, the conservation of soil moisture, release of soil nutrients, and removal of food and cover for certain small mammals. These site resources are not bound by living roots. Devegetation can cause the loss of soil nutrients if soil remains bare during periods of warm rain. It will also cause a marked decrease in most wildlife activity during the period of devegetation.

Herbicides are generally quite immobile in soil. A compound that has an effective life of several months will usually not travel in solution more than a foot or two from the site of application. Herbicides, therefore, do not pose a serious threat to water supplies and have negligible potential effects on fish exposed through herbicide movement in soil. It has been demonstrated that if herbicides are not placed directly in forest streams, they will not occur in water in biologically active amounts.

Insecticides

Insecticides have no direct effect on vegetation. Therefore, they do not have major direct effects on the entire forest as do chemicals used to control woody vegetation. Because these chemicals are highly toxic to certain animal forms, it is important to understand how animals will be affected and how these effects will influence the rest of the forest.

Some insecticides are highly specific in their effects on insects, (e.g. carbaryl, malathion). If the insecticide is short-lived, it has a very transient effect on the forest. Use results in a temporarily decreased abundance of certain insects. Some birds that prey on the victim insects will have reduced food supplies. If the insecticide does not persist in the environment nor accumulate in fat of animals, the birds will probably not be harmed substantially by secondary poisoning. If the chemical is persistent, there is more opportunity to accumulate harmful amounts over a period of time. Persistent insecticides are stringently controlled by federal regulations and are virtually never used in forests today.

Rodenticides

Very small amounts of rodenticides are used in forests. The chemicals that are used are all highly toxic to mammals as the pure product. However, only very small quantities are placed on baits that attract target animals.

The adverse effects of rodenticides include killing of some nontarget species and secondary poisoning of predators feeding on poisoned animals. Since no bait is likely to be attractive to the target species only, rodenticides often cause temporary reduction in populations of species other than the offending ones. Because of reproductive potential of most small mammals, such decreases in populations, including that of the target species, are likely to be limited to a year, more or less, unless a very large area is baited.

Many predators feed on a variety of small mammals and other predators. Substantial reduction in the population of one or even several species of small mammals would not cause a long-term effect on the predator population. Other parts of the forest are affected little by the use of rodenticides.

Fungicides

The use of fungicides in forest pest control is essentially limited to nursery bed treatments protecting seedlings from root rots and foliage diseases and to protect certain species of Christmas trees from foliage diseases.

The most common use of fungicides in nurseries is soil fumigation before seeding. The fumigants are general biocides, which are effective in killing seeds, fungi, and the various soil insects. Because of the very limited acreage of forest nurseries, these treatments do not have a general effect on the environment in the broadest sense. In the nursery, however, their effects on all biota are severe; weed control, for example, is a useful byproduct of the disease control operation.

Forest seedlings depend on beneficial fungi, mycorrhizae, for their survival and growth. Seedlings can and do grow without them but with less vigor than infected seedlings and with less chance of becoming well established in the field after transplanting. The fungi are severely reduced for a time by fumigation. Colony restoration is often deficient.

Hazards of Pesticide Use

The decision to use a pesticide should involve an understanding of which species are adversely affected by its use, as well as those species responding to its nonuse. A forest is a constantly changing environment.

Even without pesticides, there are great changes in habitat for various organisms. A forest can support only a certain population level of each organism — its carrying capacity in any given state of vegetation — and these numbers change in the normal course of succession as a forest stand increases in age.

Introduction of a pesticide into the forest can have either a direct or indirect effect on the plants or animals. Herbicides that are toxic to woody plants directly affect the species composition of the forest. Growth of ground cover increases shortly afterwards. So the application of these herbicides

causes a temporary decrease among the tall woody plants (presumably the forester's objective) and results in an increase in the carrying capacity for many foraging animals. Because the herbicide causes no direct injury to these animals, their numbers are likely to increase. The loss of nut bearing trees or shrubs may cause a temporary decrease in the numbers of squirrels and chipmunks.

Herbicides that remove herb cover in forest plantations have a major indirect effect on gophers, mice, and other small mammals that depend on ground cover for food and protection. Subsequent changes in mammal populations may or may not increase or decrease the expected survival of planted seedlings. An understanding of population responses of such mammals can be important in evaluating the over-all effectiveness of a vegetation management strategy, or in anticipating undesirable side effects.

Herbicides applied by aircraft in forestry unavoidably appear in small quantities in forest waters. Many of the same materials are used in far higher concentrations as aquatic weed control agents. Thus, these traces will not cause unreasonable adverse effects if the operator makes every effort to avoid applying them to open water. In the event of spills, or accidental application of heavy dosages to open water or to water that doesn't flush out rapidly, fish may sustain a brief decrease in growth rate. Some fish may also suffer to some degree from decreases in production of certain forage algae. Even these effects can only be caused by major spills.

Insecticides of different groups have different effects. Those that are quickly degradable influence only the organisms that are killed immediately. Because of the rapid disappearance of the chemical, survivors tend to be relatively unaffected. Because persistent organochlorine insecticides are not used in broadcast applications, problems of food chain accumulation will not occur as they have in the past. Thus, predators will not pick up toxic burdens. They may have a temporary decreased food supply.

Fish are particularly sensitive to certain insecticides. Very low concentrations can cause heavy mortality, particularly in slow moving streams. The extreme sensitivity of fish is attested to by the very small amounts of such insecticides that will dissolve in water. The ability of a stream to support fish is not impaired after the insecticide is gone. Insecticides may be flushed out or inactivated by adsorption to the organic surfaces, where they are usually degraded to relatively harmless materials. An exception is in lakes, where they may persist in low, but possibly harmful, concentrations.

Pesticides used in forests seldom come in contact with humans at exposure rates high enough to cause injury. Low dosages, spread high in the trees or distributed in a heavily vegetated area, cannot be picked up by normal human activity. Except for the most toxic insecticides, direct exposure to aerial application is of minor consequence from the standpoint of poisoning. Humans consuming game animals that have been feeding in treated areas are unlikely to encounter residues that exceed federal tolerances for domestic meat production.

Over all, pesticides can be used with safety and great effectiveness in forests. They are a part of, not a substitute for, good management and they permit the forest manager to achieve a variety of goals with minimum disruptive impact. Pesticides can cause great damage if grossly mishandled. The general lack of public understanding about how they are used and about their short and long-term effects leads to needless public alarm. They need to be used with care, and in accordance with registered use guides, to minimize both damage and public outcry about forest management in general. But if the insect, weed, fungus, or animal pest situation is within the prescription limits of appropriate pesticides, forest managers can seriously consider them in constructive programs for reaching management objectives.

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