INTEGRATED PEST MANAGEMENT ACTIVITIES TO IMPROVE TIMBER PRODUCTIVITY CONCEPTS AND ACTIONS

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ABSTRACT.—Pest management actions are a critical portion of any efforts to improve forest productivity for timber. History documents the impact of insect and disease agents on fiber and wood products availability. Federal, state, and some private agencies have ongoing pest survey programs in place. We need to periodically review the numerous direct and indirect control actions that forest managers can use to reduce pest impacts in actively managed stands. A combination of actions is defined as integrated pest management. A review of the specific pest management recommendations from the Minnesota Department of Natural Resources' Forest Development Manual for Jack Pine, Aspen, and Oak outlines stand manipulation techniques and points out the need for continuing research in the areas of application technologies, biocontrol, and crop genetics.

The impacts of insects and disease agents on the availability of wood fiber and other forest products are well documented (Leatherberry *et al*. 1995). Data from the 1990 forest inventory and analysis for Minnesota indicate that 37% of the wood volume produced by all species annually is lost due to tree mortality. Insects and disease organisms account for over 53% of this loss or over 143 million cubic feet of wood (Miles *et al*. 1995). In surveys of oak and birch mortality, triggered by drought and attacks by boring insects and root rot organisms, the Forest Health group of the Minnesota Department of Natural Resources Division of Forestry found more than 300,000 oaks and 200 million birch dying during the late 1980's and early 1990's (Albers 1998). Over 40% of the birch type in Minnesota was affected.

Current observations on pest occurrence and impact are reported in the DNR's Forest Insect and Disease Newsletters and Annual Reports. Federal and state forest health specialists conduct annual aerial surveys of approximately 13.5 million acres of Minnesota's forests from June through August to detect forest insects and diseases. This information, combined with ground checks and pheromone trap results, provides managers with the locations of important pest outbreaks and target specific stands for salvage or control efforts.

INTEGRATED PEST MANAGEMENT

Pest management actions are a critical portion of any plan to improve forest productivity for timber. Integrated pest management (IPM) is a philosophy, concept, and methodology for dealing with destructive insects and disease organisms in the forest. IPM recognizes that forest insects and diseases are an integral component of forest ecosystems that can have positive effects, but in some cases they reduce stand productivity and disrupt desired outcomes and specific management projects (Coulson and Witter 1984).

For most managers, pest management involves managing the host (tree) rather than the pest. Managers need to have practical understanding of the importance of selecting the proper site for a given planting project and maintaining crop tree vigor. The key ingredient is tree and stand vigor. Vigor can be defined as optimum physiological processes for growth and reproduction. The opposite of vigor is stress, which is a set of conditions that cause aberrant changes in physiology resulting in injury or decline (Nilsen and Orcutt 1996). Stress episodes will always occur during the lives of trees and stands. In other words, all plant species are under environmental conditions that limit their performance. Only through knowledge-based stand manipulations can that performance be enhanced to increase productivity.

Forest managers need to support continuing work in tree improvement to find tree varieties resistant to being damaged or killed by insects and disease organisms. Continuing efforts are still needed to develop crop protection systems for forest stands using strategies that both directly and indirectly manage insect and disease occurrences and populations. The potential and often unknown impacts of exotic pests such as gypsy moth and Asian longhorned beetle also need to be addressed through actions to reduce their entry and spread as well as prepare trees or stands for the inevitability of their occurrences. With the advent of shortwood processors and strong market demand for multiple species and products in Minnesota, the maintenance and enhancement of stand diversity can provide both economic return and

[1]*MN DNR Forest Health Unit: Badoura State Forest Nursery and Grand Rapids, respectively.*

reduced impact from insect and disease organisms. This supports forest health recommendations for diverse stands and the avoidance of intensive monoculture.

COVER TYPE GUIDELINES

The DNR Division of Forestry has specific pest considerations and management recommendations for the major cover types in Minnesota (Anonymous 1994). The objective of the recommendations is to increase the available wood volume and quality available for harvest. Three cover type examples will illustrate the scope of these recommendations. For jack pine, the first recommendation is to directly control populations of jack pine budworm and pine tussock moth when stands are not economically salvageable (due to factors such as tree size and age, and availability of markets) or when insect populations are high enough that there is reasonable certainty damage and death will occur. The other recommendations are aimed at jack pine stands to reduce the chances that high populations will build up. Examples of these kinds of recommendations include removing open-grown, large-crowned trees (wolf trees) and suppressed trees by maintaining stocking between 70 and 100 ft^2 of basal area. Both wolf trees and suppressed trees tend to be heavy or consistent staminate cone producers, which is a critical food source of young budworm larvae. Other examples include favoring stands with a site index of greater than 55 to maintain tree vigor; harvesting stands between 45 and 50 years of age; and creating diversity of cover types in areas of large contiguous jack pine.

The main concerns with aspen are poplar borer, white trunk rot, and Hypoxylon canker. Poplar borer—It is estimated that over 60% of mature aspen has been attacked by poplar borer. The management recommendation for poplar borer: remove infested brood trees. White trunk rot—For managing white trunk rot, we recommend using a pathological rotation age, i.e., harvesting stands at an earlier than normal rotation age, to ensure that there will be adequate volume and quality to harvest. For example, when white trunk rot is obvious on 30% or more of the basal area, use a rotation of 35 to 40 years. Hypoxylon canker—Hypoxylon canker causes annual losses approaching the net annual growth of aspen. To manage for Hypoxylon canker, we recommend harvesting the stand early if 15 to 25% of the basal area shows evidence of the canker. Do not regenerate the aspen stand if more than 25% of the basal area is infected with Hypoxylon canker because aspen clones vary in their susceptibility to this disease. Harvest during the winter to regenerate dense stands because Hypoxylon tends to be more prevalent in more open stands. Finally, favor bigtooth aspen over quaking aspen because it is more resistant to Hypoxylon canker. In the study by Jones and Ostry (1998), individual tree decay losses ran as high as 40%.

In the oak cover type, concerns are oak wilt disease, twolined chestnut borer, Armillaria root rot, decay, and gypsy moth. To help limit decay and oak wilt, management should center around protecting the trees from wounding, maintaining tree vigor, and reducing wounding from fire, grazing, logging and pruning. Increasing vigor through intermediate thinning will help reduce the impact from twolined chestnut borer, Armillaria root rot, and gypsy moth. Increasing cover type diversity will also help reduce the impacts of gypsy moth feeding.

LOOKING AHEAD

Although policy makers and politicians will ultimately determine the extent of intensively managed stands on public lands in this era of ecosystem-based management, landowner objectives and economics will determine the response on private lands. Insects and diseases do not respect ownership boundaries, and regardless of management intensity, productivity will be increased only through the successful management of insects and disease organisms. Research is needed to develop new application technologies for cost effectively improving the vigor of the trees and to break the life cycle of the pest organisms in outbreak situations. Crop genetics work needs to be accelerated in the screening and deployment of resistant tree selections. We need continued applications research on biological control strategies and stand manipulations. Our concern with non-target impacts that can lead to non-action will increase the likelihood of further advances by introduced pests such as gypsy moth and Asian longhorned beetle.

If timber productivity is the goal, clearly defined management objectives are needed that include articulating specific volume and grade goals to support a defined economic return on investment. Given these specific targets and dollar guidelines, an integrated pest management plan should be put in place that includes establishing several crop species of proven genetics on the properly selected and prepared site. With the stand's basal area and species composition rigorously controlled, survey and evaluation actions can be scheduled and carried out. This will lead to implementing a crop protection plan that is supported by real dollars and staff so that timely actions to reduce pest impacts can be initiated. Cooperation with adjacent landowners would be critical for the effective implementation of control actions as part of sustainable forest management operations on designated landscape units.

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