HOW to

Manage Jack Pine to Reduce Damage From Jack Pine Budworm

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Cover Photo
Trees defoliated by jack pine budworm have a reddish color in late summer.

Introduction

Jack pine budworm, *Choristoneura pinus pinus* Freeman, is a needle feeding caterpillar that is generally considered the most significant pest of jack pine. Vigorous young jack pine stands are rarely damaged during outbreaks. The most vigorous stands are well-stocked, evenly spaced, fairly uniform in height, and less than 45 years old. Stands older than 45 years that are growing on very sandy sites and suffering from drought or other stresses are very vulnerable to damage. Tree mortality and top-kill are more likely to occur in these stands.

Jack pine budworm is native to North America and has evolved to play an integral part in perpetuating jack pine ecosystems. Tree mortality and top-kill resulting from budworm defoliation creates fuel for intense wildfires. Dense stands of jack pine typically regenerate after fire, eventually serving as food for future generations of jack pine budworm. Harvesting and other management activities can avoid budworm caused tree mortality and reduce the threat of damaging wildfires yet still provide suitable conditions for jack pine regeneration.

Jack pine provides valuable timber, recreation and wildlife values, and concerns about jack pine budworm should not discourage its management. However, land managers should be aware that jack pine budworm outbreaks will occur on a regular cycle.

Several management strategies can be used to reduce the risk of significant tree mortality and top-kill resulting from periodic budworm outbreaks. These are discussed in the sections titled "Management Strategies" and "Forest Management Recommendations".

Insect Description

Young jack pine budworm caterpillars are yellowish-brown and less than 1/2 inch long (Figure 1). Older caterpillars are reddish-brown with cream-colored spots along the sides (Figure 2). They have a characteristic black head and a

Figure 1. Young budworm caterpillar feeding in a male jack pine flower.

Figure 2. Older jack pine budworm caterpillar.

Figure 3. Jack pine budworm moth.

black plate immediately behind the head. Full-grown caterpillars are about 1 inch long.

Adult moths are 3/4 inch in length and reddish brown in color, with white markings on the front wings (Figure 3). Eggs are green and laid in masses of about 40 eggs on needles. The eggs remain on needles following hatch, becoming translucent white in color (Figure 4).

Insect Life Cycle

The jack pine budworm has one generation per year. Moths are present for only a few days in mid-summer during the mating and egg-laying period. Eggs hatch within 10-14 days. Newly emerged caterpillars do not feed. The young caterpillars spin silk cocoons for overwintering in protected spots such as under bark scales or in needle scars. They become active the following spring, usually between mid-May and early June. Initially, caterpillars feed on pollen in male flowers (Figure 1). Eventually, the caterpillars migrate to the new expanding shoots and web new needles and shoots together to form feeding shelters. Budworm caterpillars will feed on old needles after new needles are consumed. Feeding is completed in about 6 weeks, usually by early July. Pupation occurs on infested needles and shoots. Adult moths emerge from pupae in 6-10 days.

Damage Symptoms

By mid-summer, clipped needles become reddish as they dry (Figure 5). The more brilliant the red within the crown the more severe the defoliation. Defoliation intensity and the red color is often greatest in the upper canopy. Close inspection of infested trees reveals partially eaten needles, frass, shed skins and pupal cases webbed to needles and shoots (Figure 6). Heavy rain and wind eventually remove the red, dry needles and webbing. Defoliated trees are left with thin crowns. Severely damaged trees appear grayish due to the absence of needles. Evidence of previous outbreaks includes the presence of dead and top-killed trees.

Figure 4. Egg mass of about 40 eggs on a jack pine needle.

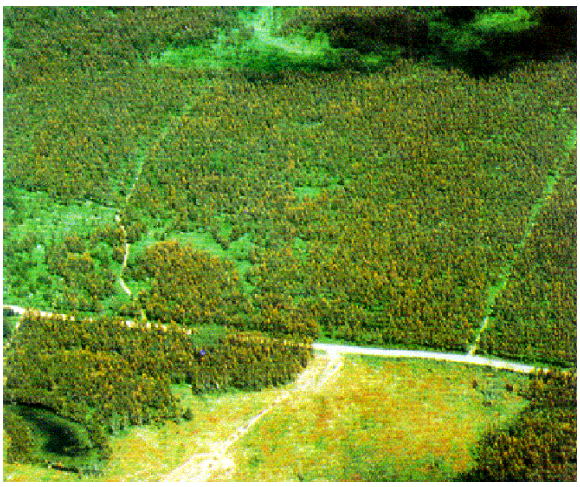

Figure 5. Characteristic reddish color of foliage following budworm outbreaks in July and August.

Management Strategies

Management of jack pine stands to reduce growth loss and mortality from budworm defoliation is based on two principles:

1. **Maintain healthy, vigorous trees**. Tree vigor is affected by several factors including:

   Age - Jack pine is a relatively short-lived species that reaches maturity at an age of 40-55 years. Overmature trees are less capable of surviving stressful events such as defoliation.

   Stand Density - High stand density creates competition for limited light, water and nutrients. Overstocked stands can suffer high mortality from the additional stress of defoliation.

   Site Quality - Growth and survival of jack pine is better on high quality sites. Jack pine does best on well drained loamy sands. Poorer quality sites are excessively sandy and dry.

2. **Minimize male flower production**. Low numbers of male flowers limit survival of budworm caterpillars during outbreaks. Factors that affect male flower production include:

   Stand Density - Low stand density produces trees with large crowns called "orchard" or "wolf" trees (Figure 7). These "orchard" trees produce abundant male flowers throughout full crowns which often extend to the ground.

   Stand Structure - Multi-storied or uneven-aged stands will sustain heavy damage during outbreaks because they have a high percentage of overstory "wolf" trees and many suppressed trees. Both wolf trees and suppressed trees produce male flowers in abundance.

Figure 6. Clipped needles, frass and a pupal case collected in silk webbing.

Figure 7. Open-grown jack pine "orchard tree." These trees often produce an abundant crop of male flowers.

Edge Effect - Trees growing along forest edges produce abundant male flowers and support large numbers of budworm caterpillars.

Forest Management Recommendations

Pre-outbreak Stands: The amount of damage and the intensity of an outbreak can often be reduced by following the recommendations listed below.

1. Most jack pine stands in the Lake States are on poor quality sites and should not be held past maturity (45-50 years). Site index is a measure of site productivity which can be used to determine when to harvest jack pine stands. Tree height after 50 years of normal growth is a measure of site index for that tree species. Thus, if a tree grows 55 feet in 50 years, it has a site index of 55. **A good rule-of-thumb is to harvest jack pine when stand age is equal to the site index minus five years.** For example, a stand with a site index of 50 should be harvested at 45 years of age.

2. **Maintain basal area between 70 and 110 ft^2/acre.** Basal area is a measure of stand density. The greater the number, the higher the stand density. Higher basal area (110-130 ft^2/acre) may be appropriate on very good sites. Stands with basal area below 70 ft^2/acre are at risk of severe budworm damage because they tend to have trees with large crowns producing many male flowers.

3. **Large, contiguous blocks of mature and overmature jack pine (>50 years old) should be avoided.** A mosaic of younger stands of varying ages should be encouraged. A minimum stand size of 40 acres is suggested to reduce the ratio of edge to stand area.

4. Minimize the amount of edge created in jack pine stands. **Avoid leaving or planting narrow strips or islands of jack pine when regenerating a stand.**

5. Avoid creating uneven-aged or multi-storied jack pine stands. **Regenerate jack pine by clearcutting.** Standing dead trees and scattered hardwoods or white pine can be left to enhance diversity. When deciding on the number or density of living trees to leave, keep in mind that jack pine is very shade intolerant.

6. **Conversion of jack pine stands to less susceptible tree species, or to prairie or savannah may be appropriate in areas which experience repeated, severe jack pine budworm outbreaks.** Discuss any conversion plan with a professional resource manager. Management options for conversion are greatly influenced by site productivity, and by existing and surrounding vegetation.

Outbreak and Post-outbreak Stands: Generally, tree mortality and top-kill occur only after severe defoliation. To evaluate defoliation, wait until the red needles have fallen from infested trees. If at that time, few green needles are visible in the upper crowns of the majority of trees in a stand, consider the following:

1. **Salvage sales should be initiated quickly in mature and overmature stands following severe defoliation** if trees appear gray and have little or no foliage in the upper canopy. Trees killed by budworm are no longer merchantable within 18-20 months after death and are also a fire risk. Evaluating the condition of any mature jack pine stand defoliated by the jack pine budworm is an important part of protecting your timber resource investment.

2. **Insecticide treatments are rarely justified economically.** Exceptions include individual high value trees in recreation areas or in ornamental settings. Occasionally, if timber values are heavily emphasized and outbreaks are unusually intense, insecticide applications may be economically justifiable for stands that are 25-30 years old. A DNR, Forest Service or Extension entomologist should be consulted prior to any insecticide applications.

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For more information contact your State Department of Natural Resources or the USDA Forest Service, State and Private Forestry. In Michigan, you may also contact your MSU Extension agent.

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