Spruce Budworms Handbook

Ground-Spray Techniques To Reduce Damage From Western Spruce Budworm
In 1977, the United States Department of Agriculture and the Canada Department of the Environment agreed to cooperate in an expanded and accelerated research and development effort, the Canada/United States Spruce Budworms Program (CANUSA), aimed at the spruce budworm in the East and the western spruce budworm in the West. The objective of CANUSA was to design and evaluate forests, to help forest managers attain their objectives in an economically and environmentally acceptable manner. The work reported in this publication was funded by the Program. This manual is one in a series on the western spruce budworm.
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by Lawrence E. Stipe

Introduction

The western spruce budworm has an annual life cycle of four stages—egg, larva, pupa, and adult (moths). The stages, damage caused by budworm, and host species are described and illustrated in Forest Pest Leaflet 53 by Fellin and Dewey (1982).

Ground sprays will reduce current defoliation and cone damage by budworm larvae and help maintain tree vigor, thus minimizing permanent damage to trees. The strategy is to time the application of the control agent for maximum kill of the insect pest with the least effect on the environment. Cone and seed protection using ground applications has increased Douglas-fir seed yields by nearly 50 percent. Further tests are needed to determine the value of this technique on other species (Stipe and Green 1981). Equipment operated at ground level is used to apply the spray mixture to the foliage when insect larvae are actively searching and feeding. Control during other life stages (for example, moths) is not recommended.

Insecticides, Mixing, and Safety Precautions

Although several pesticides are registered by the U.S. Environmental Protection Agency for control of western spruce budworm, only two chemicals and one microbial insecticide are discussed here. Acephate and carbaryl are generally considered the most effective chemical pesticides for budworm control. Both are available at most retail outlets that handle spray materials. Acephate (Orthene Forest Spray) is an organophosphate insecticide that remains active for about 10 days. It is primarily a contact and stomach poison with limited, residual systemic action. The water-soluble powder formulation (75-percent active ingredient) is mixed at 1/4 pound/100 gallons (600 g/1000 l) of water.

Carbaryl (Sevimol 4), widely used in agriculture and forestry, is a carbamate insecticide that lasts about 14 days. Sevimol 4 is a molasses formulation of carbaryl at 4 lb (1.81 kg) of active ingredient per gallon (3.785 l). It is mixed 1 quart of Sevimol 4 per 100 gallons (2.5 l/1000 l) of water.

Bacillus thuringiensis (Berliner) (Bactospine, Dipel, Futura, and Thuricide) (B.t.) is a naturally occurring bacterium that provides the

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2 The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others that may be suitable.
active ingredient in several commercial formulations of nonchemical insecticides. B.t., which is toxic to larvae of many foliage-feeding moths and butterflies, is effective against western spruce budworm when mixed at the rate of 16 BIU/100 gallons (378.5 l) water for application with high-volume spray equipment. B.t. products are nontoxic to mammals, birds, fish, and humans.

Selection of spray equipment depends on the number of trees to be treated and their height. Use a large tank to save mixing time when many trees are to be sprayed. For tall trees, use a high-pressure, orchard-type unit; the insecticide must be applied to all the foliage. If trees are small, a hand-operated, compressed-air sprayer can be used; garden-hose siphon types are not recommended.

Because most cone crops are concentrated in the upper crown, hydraulic equipment is needed. Gas-powered hydraulic pump sprayers are probably best. They have large tanks and, when operated at 400 lb/in² (27.2 atm), can reach over 50 ft (15.2 m) high.

Use extreme caution with open containers of chemical insecticides. Wear proper protective equipment. To minimize handling, mix the formulation in the equipment holding tank. Verify tank calibration markings before use. Measure water as it is added, especially when preparing less than a full load. Begin agitation and add the proper amount of concentrated insecticide to the water. If the equipment does not have continuous mechanical agitation, stop and remix by hand frequently during application.

3 BIU = international unit of potency of a preparation of Bacillus thuringiensis with reference to an international standard (HD-1 or E-61). The potency of the standard was assigned a value of 1,000 international units per milligram. For field use, the units are expressed in billions (BIU’s).

4 Stelzer, Milton J. Field evaluation of Bacillus thuringiensis and baculovirus for control of western spruce budworm: ground application trials. Unpublished final report. September 1980. Available from USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, P.O. Box 3890, Portland, OR 97208.
Timing and Application

Select the application schedule according to your objectives.

- **To protect foliage:** Spray when bud caps have fallen as the shoot expands to at least an inch (2.54 cm) long (fig. 1, top right). Late treatment—after larvae have consumed considerable foliage—provides little foliage protection (fig. 1, bottom). Early treatment—before shoot elongation (fig. 1, top left)—will not reach the larvae concealed in the young shoots.

- **To protect cones and seeds:** Apply chemical pesticides much earlier than for foliage protection. Douglas-fir seed cone buds burst several weeks before the vegetative buds. Two applications are required. Time the first application to coincide with the start of spring larval dispersal. This normally occurs just as the seed cones begin to elongate and before pollination is complete (cones are about 1 inch [2.54 cm] long). Spray again in about 14 days. Two treatments will provide about 30 days of protection during the initial dispersal period. Unless the trees are attacked by other insects, two treatments should reduce damage throughout the budworm feeding period. B.t. is not recommended for seed and cone protection.

Spray the entire tree until the pesticide begins to drip from the needles (about 4 to 6 gallons [15.1 to 22.7 l] per tree). Apply only when the foliage is dry, windspeed is under 6 mi/h (9.65 km/h), and rain is not likely within 12 hours after spraying carbaryl and acephate and 24 hours for B.t.
Figure 1—Douglas-fir shoot development: top left, initial bud expansion; top right, initial shoot expansion; and bottom, expanded new shoot. The new needles, which show here as a lighter gray than the older foliage, are conspicuously bright green on living trees.
Fellin, David G.; Dewey, Jerald E.  

Stipe, Lawrence E.; Green, Alice K.  
Pesticide Statement

Pesticides used improperly can be injurious to humans, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honeybees or other pollinators are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the label.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first-aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary landfill dump, or crush and bury them in a level, isolated place.

Note: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Environmental Protection Agency, consult your county agricultural agent or State extension specialist to be sure the intended use is still registered. Use only pesticides that bear a Federal registration number.