

Defoliation

Three methods of estimating defoliation, excluding aerial assessment, are currently in use: ground assessment with binoculars, the Fettes method, and the Dorais-Hardy method. Information presented here comes directly from Sanders (1980).

- Objective:**
1. To evaluate the current state of a tree or stand.
 2. To assess efficacy of spray applications.
 3. To supplement one of the sampling techniques that directly counts the number of budworms.

Time of Year: The defoliation ranking is determined after the host species foliage is fully flushed out and after most of the budworm feeding has occurred. This is generally from late June through August, depending on location.

Equipment Needed: Binoculars, illustrative key to defoliation categories, data sheets

- Procedure:**
1. **Ground Assessment With Binoculars:** Observations are made from the ground, with the field worker using 7X or 8X binoculars and standing less than 50 m from the sample tree. Defoliation is rated using one of the methods described here.

Method A: Categorize the state of the foliage on the upper two fifths of the crown as follows:

--**Excellent (E):** A rapid look gives the impression that the tree has suffered little or no defoliation; 75% or more of the current growth remains on the tree.

--**Very Good (VG):** A certain amount of red-brown foliage is readily observed, but it is definitely less than the amount of new green foliage. Between 50 and 75% of the current growth remains on the tree.

--**Good (G):** More red-brown foliage than light green foliage is visible, but the new green foliage is readily detected and is more plentiful than that in the poor class. This quantity of new foliage assures limited to fairly good tree vitality. Between 25 and 50% of the new growth remains on the tree.

--**Poor (P):** Some new green foliage can be seen, but it is improbable that the tree could survive many years with so little new foliage added annually. A small quantity of new growth is still present, but it is less than in the Good class.

--**Very Poor (VP):** Only after a careful examination of the crown are any green shoots visible.

--**Nil (N):** Despite a careful examination of the crown, no new foliage can be seen. This represents total defoliation (100%) of the current year's growth.

Method B: An alternate method of binocular assessment, proposed by Mog and Witter (1979), ranks the green portion of the crown (1 to 4) as follows:

1 - **No defoliation:** no observable feeding damage, 0-20% of total foliage missing.

2 - **Light to moderate defoliation:** 20-50% defoliation of total foliage.

3 - **Heavy defoliation:** 50% or greater defoliation with no observable top-kill.

4 - **Severe defoliation:** 50% or greater defoliation with obvious top-kill.

2. **Fettes Method:** This method, first described by Fettes (1950), involves obtaining branches from the mid-crown of balsam fir and then visually estimating the percentage of needles removed from each current-year shoot on the branch (See Figure 3). These are then averaged to provide a percent defoliation for the whole branch.

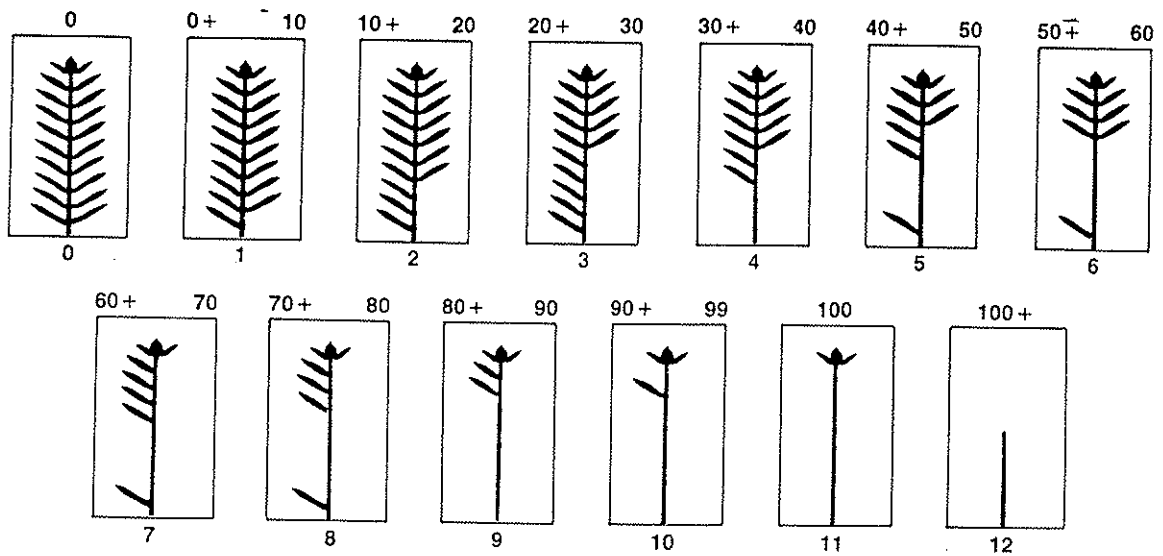


Figure 3. Fettes (1950) method of estimating defoliation. Top figures are % defoliation, bottom are defoliation categories (from Sanders, 1980).

3. **Dorais-Hardy Method:** This method, described by Dorais and Hardy (1976), was devised for balsam fir in which high populations of budworm have prevented normal bud development. It therefore takes into account damage to buds as well as to foliage. The percent of buds missing (%Brg) is recorded in addition to the percent defoliation (%Def). The form (Figure 4) is designed to estimate defoliation before and after spraying.

- (i) **Defoliation before spraying:** This is recorded in the upper half of the form (Figure 4). Only last year's three terminal shoots are considered (those circled by the dotted line in the illustration, Figure 4).
- a) Each shoot normally has three (or occasionally more) terminal buds. These are marked as present (1) or absent (0). Where there are more than three present, a maximum of three is recorded. The number missing is then expressed as a percentage in the top box (%Brg_n), in this case three out of nine = 33%.
- b) Each of the three last year's shoots is then assigned to one of the Fettes defoliation categories (1-12, as in Figure 2). The percent defoliation is then determined by averaging the figures for the midpoint of each category, in this case (85 + 25 + 55)/3 = 55%. This is entered in the lower box (%Def-1).
- (ii) **Defoliation After Spraying:** This is recorded in the lower half of the form, following the same procedure as above. Because of the growth of the tree between pre- and post-spraying, there are now three categories, as shown in Figure 4.

The % defoliation in year (n-1) can then be compared in the two samples to ensure that it is similar. An index of the tree's state of health is then calculated. In this calculation, the presence of buds is weighted by a factor of 3 since the buds represent the potential for recovery in the following year. The index (I) is then

$$\frac{[3 \times \% \text{Brg}_{(n+1)}] + \% \text{Def}}{4}$$

This method does not take into account the production of adventitious buds, which may be produced by heavily defoliated trees.

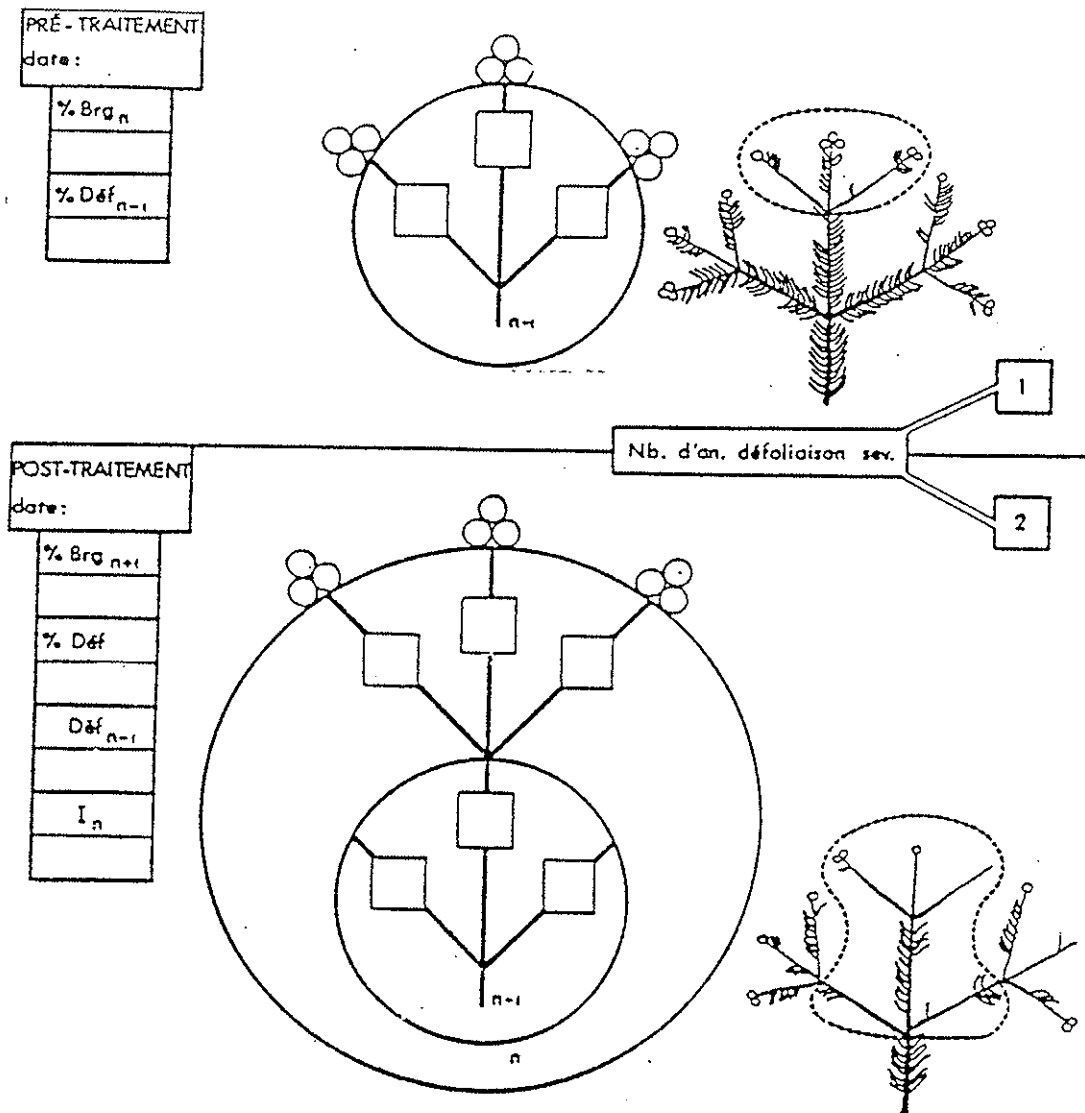


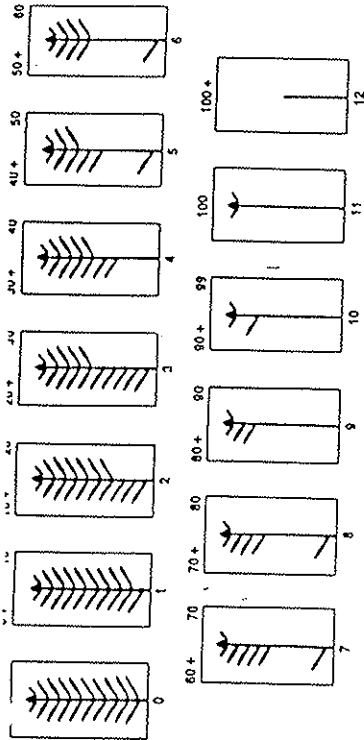
Figure 4. Method of estimating defoliation after Dorais and Hardy (1976) (From Sanders, 1980).

Data Sheets: Data sheets for recording defoliation are provided on pages 66, 67, and 68. For the Dorais-Hardy method, the field worker will also need the data sheets for the Fettes Method.

Comments: Estimates of defoliation are not specific indices for future budworm population levels, since reliable correlation between past, present, and future defoliation does not exist.

Spruce Budworm Defoliation Worksheet Data Sheet
For Use With Fettes Method

Plot Number _____ Date Collected _____



Tree Species _____ Tree Number _____

Branch Tip	Defoliation Category	Percent of Defoliation
1		
2		
3		
4		
5		
6		
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19		
20		

Tree Species _____ Tree Number _____

Branch Tip	Defoliation Category	Percent of Defoliation
1		
2		
3		
4		
5		
6		
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10		
11		
12		
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15		
16		
17		
18		
19		
20		

Branch I _____ V _____
Total Defoliation Percentage _____
Percentage + 20 = _____
Mean Defoliation _____

Branch I _____ V _____
Total Defoliation Percentage _____
Percentage + 20 = _____
Mean Defoliation _____

N Species _____ Tree Number _____

Branch Tip	Defoliation Category	Percent of Defoliation
1		
2		
3		
4		
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20		

Branch I _____ V _____
Total Defoliation Percentage _____
Percentage + 20 = _____
Mean Defoliation _____

Tree Species _____ Tree Number _____

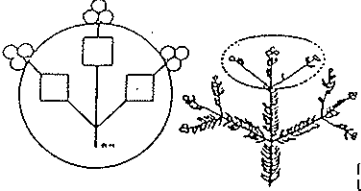
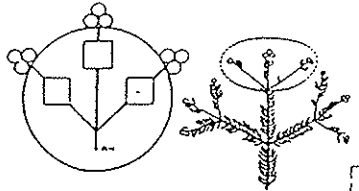
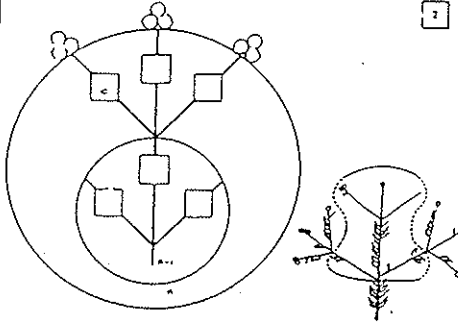
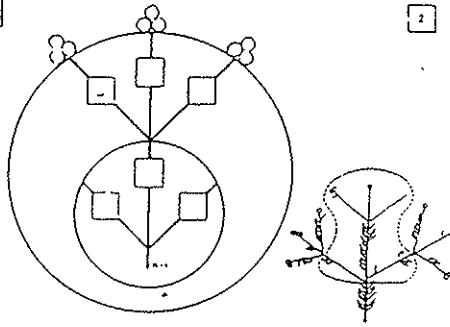
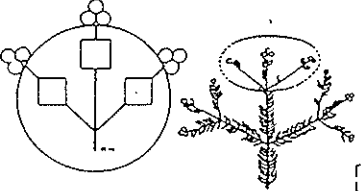
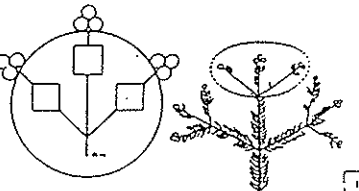
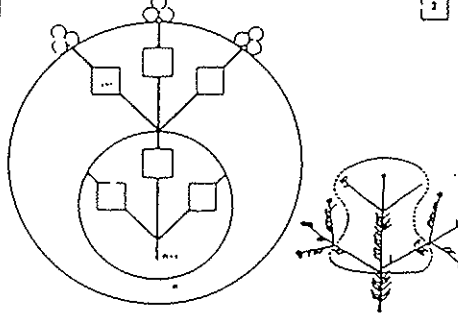
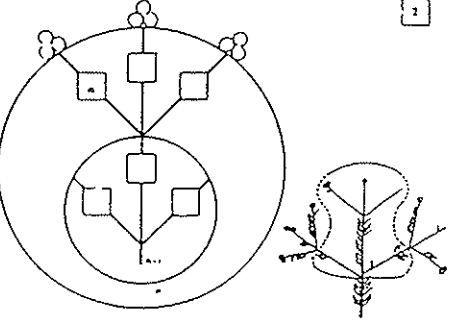
Branch Tip	Defoliation Category	Percent of Defoliation
1		
2		
3		
4		
5		
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7		
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15		
16		
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18		
19		
20		

Branch I _____ V _____
Total Defoliation Percentage _____
Percentage + 20 = _____
Mean Defoliation _____

Tree Species _____ Tree Number _____

Branch Tip	Defoliation Category	Percent of Defoliation
1		

Spruce Budworm Defoliation Data Sheet
For Use With Dorais-Hardy Method

<p>PRE TREATMENT</p> <p>date:</p> <p>% BRG ...</p> <p>% Def ...</p>  <p style="text-align: right;">1</p>	<p>PRE TREATMENT</p> <p>date:</p> <p>% BRG ...</p> <p>% Def ...</p>  <p style="text-align: right;">1</p>
<p>POST TREATMENT</p> <p>date:</p> <p>% BRG ...</p> <p>% Def ...</p> <p>Def ...</p> <p>I_n ...</p>  <p style="text-align: right;">2</p>	<p>POST TREATMENT</p> <p>date:</p> <p>% BRG ...</p> <p>% Def ...</p> <p>Def ...</p> <p>I_n ...</p>  <p style="text-align: right;">2</p>
<p>PRE TREATMENT</p> <p>date:</p> <p>% BRG ...</p> <p>% Def ...</p>  <p style="text-align: right;">1</p>	<p>PRE TREATMENT</p> <p>date:</p> <p>% BRG ...</p> <p>% Def ...</p>  <p style="text-align: right;">1</p>
<p>POST TREATMENT</p> <p>date:</p> <p>% BRG ...</p> <p>% Def ...</p> <p>Def ...</p> <p>I_n ...</p>  <p style="text-align: right;">2</p>	<p>POST TREATMENT</p> <p>date:</p> <p>% BRG ...</p> <p>% Def ...</p> <p>Def ...</p> <p>I_n ...</p>  <p style="text-align: right;">2</p>

$$\text{Index } (I_n) = [3 \times \% \text{ BRG}_{(n-1)}] + \% \text{ Def}$$