

TREE PHENOLOGY MONITORING ON MOUNT MANSFIELD

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ABSTRACT

Monitoring of bud development, leaf size, and fall color and leaf drop is conducted on three tree species growing at two elevations on Mount Mansfield. Yellow birch, American beech and sugar maple trees are monitored at 1400 and 2200' on the west slope of the mountain. The purpose of this monitoring effort is to begin gathering baseline information on these fundamental tree processes. Three years of sugar maple bud monitoring at the Proctor Maple Research Center (1400' elevation) has shown differences in the timing of budbreak of up to 9 days between years, with average budbreak in 1991 occurring on April 29, in 1992 on May 8 and in 1993 on May 2. Full leaf expansion in 1991 occurred around May 12, in 1992 on May 15 and in 1993 on May 9. Full leaf size does not occur, however, until early June. Most trees had similar leaf size in 1993 and 1992, except sugar maples growing at the 1400' elevation, which had smaller leaves in 1993 than in the two previous years. Yellow birch trees growing at 2200' had reduced leaf areas from June to August, due to wind damage and insect defoliation.

INTRODUCTION

Monitoring of bud development, annual leaf size, and fall color and leaf drop began in 1991 on sugar maple and one elevation (1400') on Mount Mansfield. The following year, a higher elevation was added (2200') and two additional hardwood species, yellow birch and American beech. The purpose of this monitoring effort is to begin gathering baseline information on this fundamental tree process. Understanding the timing of developmental stages in relation to weather phenomena (such as early fall frost) and insect pest activity (such as pear thrips feeding in sugar maple buds) improves our knowledge of interrelations between tree physiology and stress events.

METHODS

BUD DEVELOPMENT

Bud development is recorded twice weekly from early April through mid-June using visual ratings as seen through a high powered spotting scope. Five mature trees and 5 saplings of sugar maple, yellow birch and American beech are monitored at two elevations (1400 and 2200') for a total of 30 trees and 30 saplings. Bud stages are recorded from the upper canopy, lower canopy and regeneration from dormancy through full leaf expansion (Table 1). Descriptions of sugar maple bud stages have been modified for yellow birch and beech to allow between year comparisons of bud and leaf development.

LEAF SIZE

Three mid-canopy leaf collections are made annually in late-June, -July, and -August using pole pruners. Ten leaves from 2 sides of each tree are collected, pressed, and measured for leaf area using a leaf area meter.

FALL COLOR AND LEAF DROP

Initial crown ratings were recorded on each tree and sapling in late July to establish a baseline for trees with full foliage. These ratings include crown dieback, foliage transparency and discoloration. From mid-August through October, trees and saplings

Table 1. System for rating vegetative and flowering bud stages for sugar maple, yellow birch and American beech.

VEGETATIVE STAGE	SUGAR MAPLE	YELLOW BIRCH	BEECH
V0	dormant	dormant	dormant
V1	initial swell	initial swell	lengthening
V2	bud elongation		wide at bud base, exaggerated point at tip
V3	green tip stage		scales separating and bending back slightly
V4	bud break, leaf tips expanded beyond the bud tip	bud break, leaf tip exposed	bud break, leaf tips exposed
V5	extended bud break, leaves not yet spread apart	extended bud break	extended bud break
V6	initial leaf expansion	initial leaf expansion	initial leaf expansion
V7	leaves unfolded slightly, but individual leaves not yet expanded	leaves unfolded slightly	leaves unfolded slightly
V8	leaves expanded, may not be full size yet	leaves expanded, may not be full size yet	leaves expanded, may not be full size yet

FLOWER STAGES	SUGAR MAPLE	YELLOW BIRCH	BEECH
F0	dormant	dormant	dormant
F1	initial bud swell		
F2	bud elongation, buds more rounded at tip than vegetative buds	bud elongation	
F3	green tip stage	full bud elongation	
F4	bud break, flower tips show expanded beyond bud tip		
F5	initial flower expansion, flower bundle expands beyond bud scales	initial flower expansion	
F6	full flower expansion and pollen dispersal	full flower expansion and pollen dispersal	full flower expansion and pollen dispersal
F7	flower senescence and drop	flower senescence and drop	flower senescence and drop

were rated for color and leaf drop. Color was rated in 5% categories using the North American Maple Project definitions for discoloration. Leaf drop was measured using crown dieback and foliage transparency ratings as per the National Forest Health Monitoring Program.

RESULTS

SPRING PHENOLOGY

Three years of sugar maple bud monitoring at the Proctor Maple Research Center (1400' elevation) has shown differences in the timing of budbreak between years (Table 2). Average budbreak in 1991 occurred on April 29, in 1992 on May 8 and in 1993 on May 2. Full leaf expansion in 1991 occurred around May 12, in 1992 on May 15 and in 1993 on May 9. Full leaf size does not occur, however, until early June.

Monitoring of sugar maples at the 2200' elevation showed later bud development and leaf expansion. Bud break occurred on May 16 in 1992 and on May 8 in 1993. Full leaf expansion, however, occurred on similar dates in the two years, May 28 and May 26, respectively.

Table 2. Bud development for sugar maple, yellow birch and American beech growing at two elevations on Mount Mansfield, Vermont.

SPECIES	ELEV.	DATE OF BUDBREAK BY YEAR			DATE OF FULL LEAF EXPANSION BY YEAR		
		1991	1992	1993	1991	1992	1993
Sugar Maple	1400	April 29	May 8	May 2	May 12	May 15	May 9
Sugar Maple	2200		May 16	May 8		May 28	May 26
Yellow Birch	1400		May 9	May 3		May 28	May 13
Yellow Birch	2200		May 14	May 8		June 2	June 10
Beech	1400		May 11	May 8		May 20	May 17
Beech	2200		May 19	May 23		June 2	June 10

LEAF SIZE

Most trees had similar leaf size in 1993 and 1992, except sugar maples growing at the 1400' elevation, which had smaller leaves in 1993 than in the two previous years (Table 3). Yellow birch trees growing at 2200' had reduced leaf areas from June to August, due to wind damage and insect defoliation.

Table 3. Average leaf size for 1993 of sugar maple, yellow birch and American beech growing at two elevations on Mount Mansfield, VT.

SPECIES	ELEVATION	AVERAGE LEAF SIZE (cm ²) BY DATE		
		June	July	August
SUGAR MAPLE	1400'	33.13	32.92	36.73
	2200'	43.64	39.23	40.41
YELLOW BIRCH	1400'	22.00	17.54	17.11
	2200'	23.62	17.08	11.98
BEECH	1400'	34.71	29.45	31.58
	2200'	30.08	27.15	22.37

FALL COLOR AND LEAF DROP

Initial fall coloration was 1-2 weeks later in 1993 than in 1991 and 1992 (Table 4). Peak color (>50% color) for yellow birch and beech at both elevations was the same as 1992, and lower elevation sugar maple was within a few days of 1991 and 1992. Only the high elevation sugar maple (2200') reach peak color more than one week later in 1993 than in 1992.

The timing of leaf drop was similar between years for all species and elevations (Table 5). Between October 6 and 14, all species and elevations had lost half their leaves, and by October 18, 75% of leaf drop had occurred for all species and elevations.

Table 4. Timing of fall color for three hardwood species at two elevations on Mount Mansfield, VT.

SPECIES	ELEVATION	DATE OF 25% COLOR BY YEAR			DATE OF 50% COLOR BY YEAR		
		1991	1992	1993	1991	1992	1993
SUGAR MAPLE	1400'	Sept. 22	Sept. 19	Oct. 2	Sept. 29	Oct. 6	Oct. 8
	2200'		Sept. 15	Sept. 29		Sept. 26	Oct. 6
YELLOW BIRCH	1400'		Oct. 5	Oct. 5		Oct. 8	Oct. 8
	2200'		Sept. 22	Sept. 24		Sept. 29	Sept. 30
BEECH	1400'		Sept. 22	Sept. 28		Oct. 1	Oct. 1
	2200'		Sept. 25	Oct. 1		Oct. 5	Oct. 6

Table 5. Timing of fall leaf drop for three hardwood species at two elevations on Mount Mansfield, VT.

SPECIES	ELEVATION	DATE OF 50% LEAF DROP BY YEAR			DATE OF 75% LEAF DROP BY YEAR		
		1991	1992	1993	1991	1992	1993
SUGAR MAPLE	1400'	Oct. 12	Oct. 14	Oct. 14	Oct. 13	Oct. 18	Oct. 18
	2200'		Oct. 8	Oct. 8		Oct. 10	Oct. 10
YELLOW BIRCH	1400'		Oct. 11	Oct. 9		Oct. 14	Oct. 13
	2200'		Oct. 8	Oct. 6		Oct. 11	Oct. 10
BEECH	1400'		Oct. 8	Oct. 9		Oct. 11	Oct. 13
	2200'		Oct. 14	Oct. 10			Oct. 16

DISCUSSION

The number and description of bud developmental stages differs between the three hardwood species examined. We have modified the sugar maple bud development rating system to accommodate the development characteristics of the other species. While we will continue to rate bud development according to this system, a further modification could be done to simplify the process and make fewer field visits necessary in monitoring key bud developmental stages. In general, bud development was slightly earlier in 1993 than in 1992. Further analysis of bud development in relation to biologically significant weather events will be made in future years.

One additional year of leaf size information will be collected to establish a solid baseline leaf area for all species and elevations.

In 1993, fall coloration began later than other years. But peak color and leaf drop were closer in timing to 1992.

REFERENCES

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