TREE PHENOLOGY MONITORING ON MOUNT MANSFIELD - 1994

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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. In general, bud development at both elevations was slower and later than in 1992 and 1993. Conversely, fall color was earlier than normal especially at the 2200' elevation where in some cases full color came 2 weeks earlier than previous years. Three years of sampling leaves for leaf size has shown little within season size difference. Sugar maple leaves averaged 39.6 cm^2 and 40.7 cm^2 at the two elevations, respectively; yellow birch averaged 20.8 and 18.8; and beech averaged 30.9 and 28.3.

INTRODUCTION

Monitoring of bud development, annual leaf size, and fall color and leaf drop began in 1991 on sugar maple at 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 these fundamental tree processes. 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 1a & 1b). Descriptions of sugar maple bud stages (Skinner & Parker, 1994) have been modified for yellow birch and beech to allow between year comparisons of bud and leaf development. Flower bud stages are rated, but there are not enough flower buds on all sampling trees to present results for each year.

EAF 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 are recorded on each tree and sapling in late July to establish a baseline for trees with full foliage. From mid-August through October, trees and saplings are rated for color and leaf drop. Color is rated in 5% categories using the North American Maple Project definitions for discoloration (color other than green). Leaf drop is measured using crown density, dieback and foliage transparency ratings as per the National Forest Health Monitoring Program. A measure of the density of the tree with no foliage (structural crown density) is taken late in the fall once all the leaves are gone, or in the spring before leaf out. Using both the full leaf-on and leaf-off density ratings, the percent leaf drop is calculated.

Leaf drop at each visit (%) =

((full leaf-on density - density at visit) /
(full leaf-off density)) X 100

In 1992 and 1993, dieback and transparency ratings were tested to measure leaf drop. Density was added in 11994, and more accurately measures leaf drop. In future years, density will replace dieback and transparency ratings in monitoring leaf drop.

Table 1a. Vegetative 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

Table 1b. Flowering bud stages for sugar maple, yellow birch and American beech.

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

RESULTS

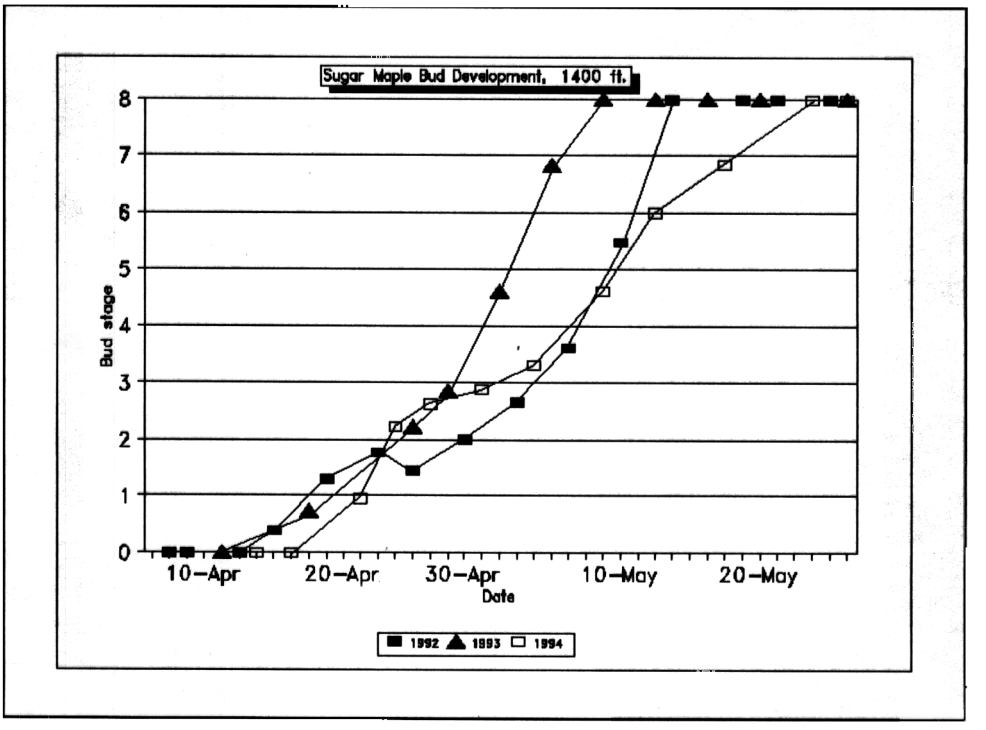
SPRING PHENOLOGY

Bud development in 1994 was in general later than previous years. Sugar maple bud development at 1400' was slow in the early stages of bud swell, and again from budbreak to full leaf expansion (10 days later than in 1992 and 2 weeks later than 1993)[Figure 1]. At the 2200' elevation, buds were slow to reach budbreak, nearly 2 weeks behind 1993, and full leaf expansion was also later than previous years.

Yellow birch buds at 1400' began swelling later than in 1992 and 1993, but by budbreak on May 2, had a similar developmental pattern as in 1992 (Figure 2). Full leaf expansion was observed by May 20. At the higher elevation, 2200', yellow birch bud development was later at all stages than in previous years. Budbreak occurred around May 16, and full leaves were developed by June 3.

Beech bud development at 1400' was much later than previous years (Figure 3). Initial bud swell was similar to 1993, but then in late april and early May, there was a long, slow period of development. Budbreak didn't occur until May 19, but then rapid leaf expansion produced full leaves by June 2. At the higher elevation, 2200', budbreak occurred around May 27, full leaf expansion by June 4, with an overall slower development than in 1992 and 1993.

Figure 1. Sugar maple bud development at 1400 and 2200 feet on Mount Mansfield from 1992-1994.



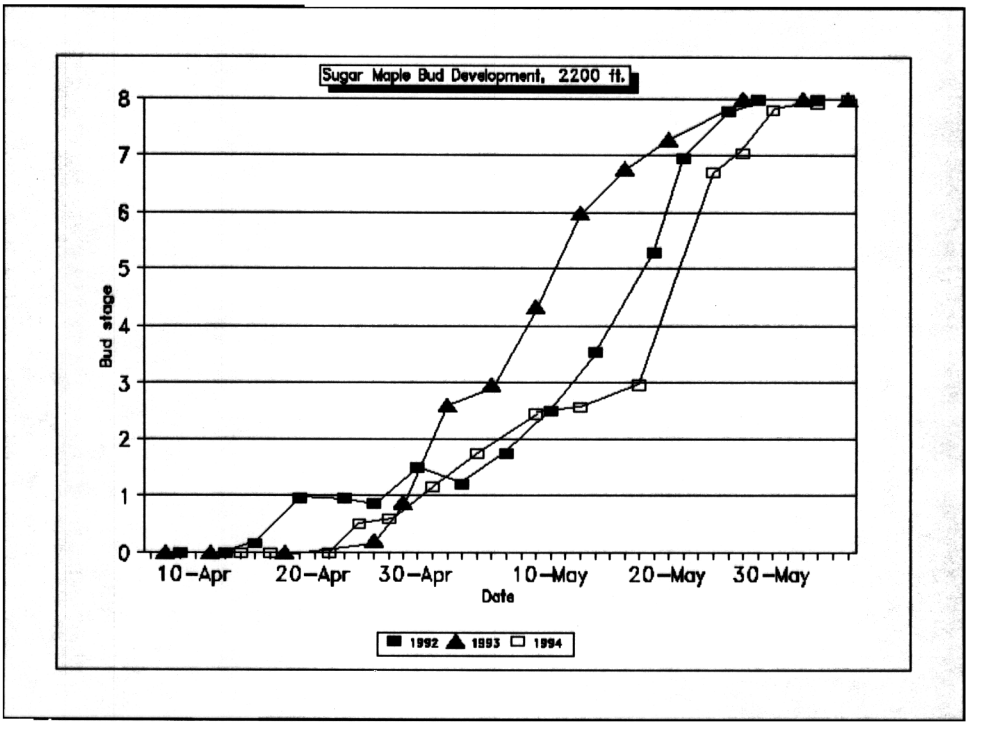
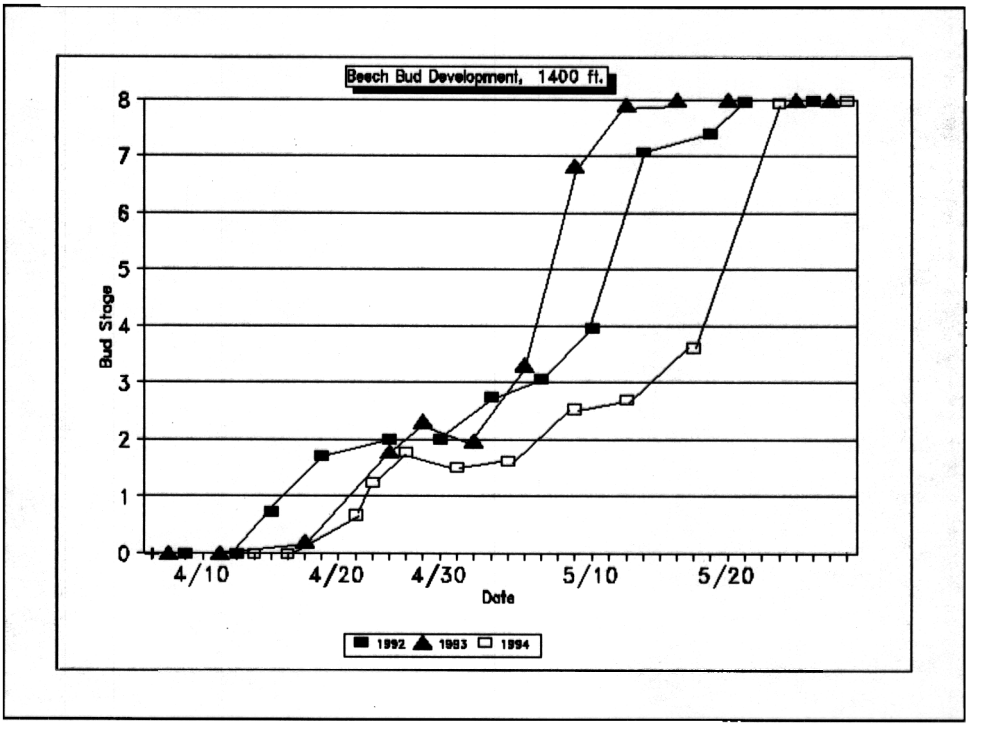


Figure 2. Beech bud development at 1400 and 2200 feet on Mount Mansfield from 1992-1994.



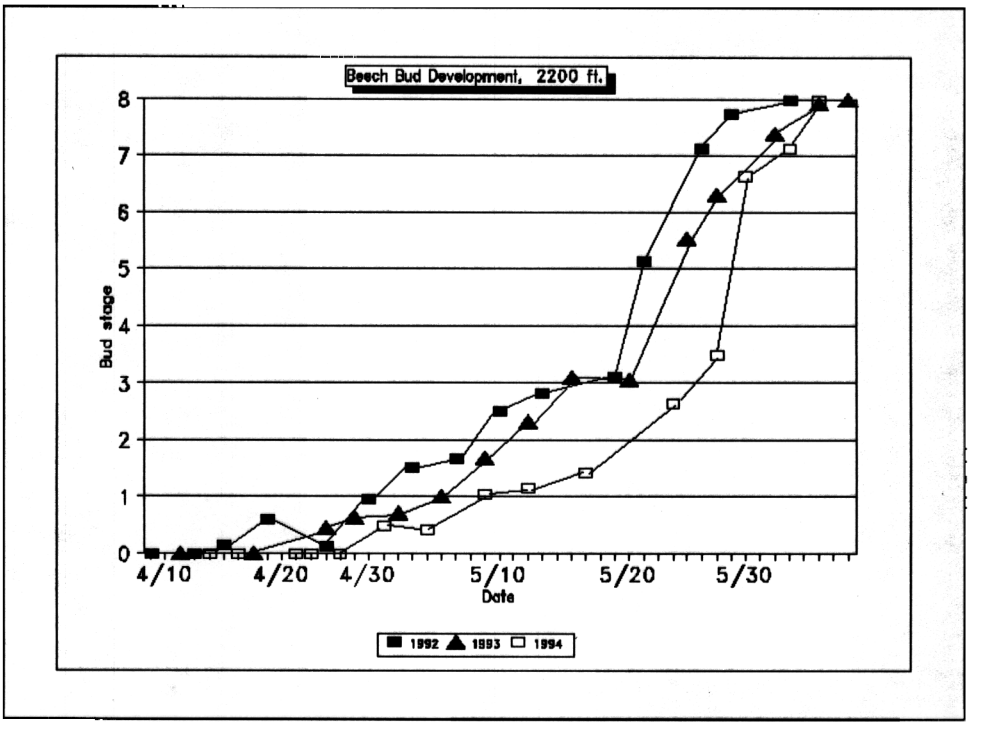
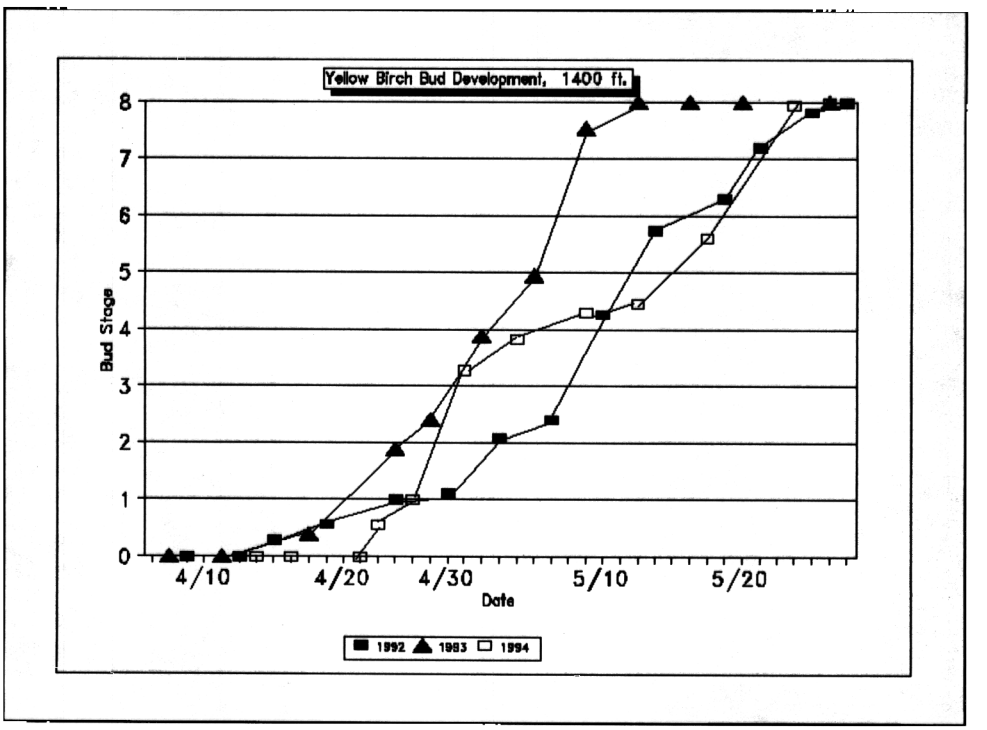
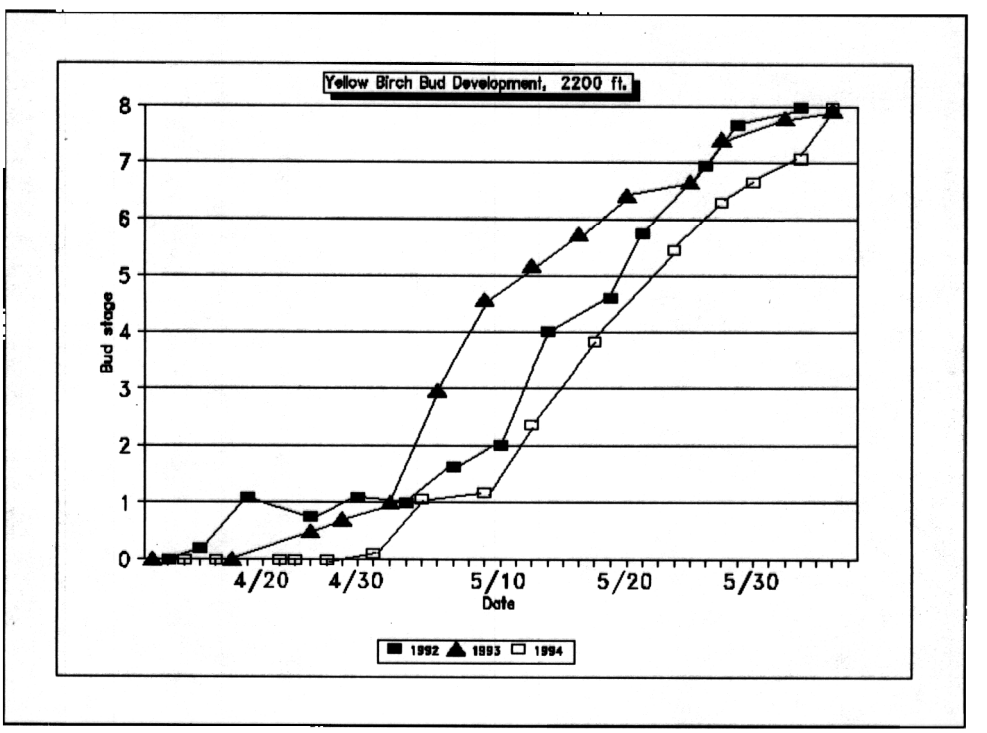


Figure 3. Yellow birch bud development at 1400 and 2200 feet on Mount Mansfield from 1992-1994.





LEAF SIZE

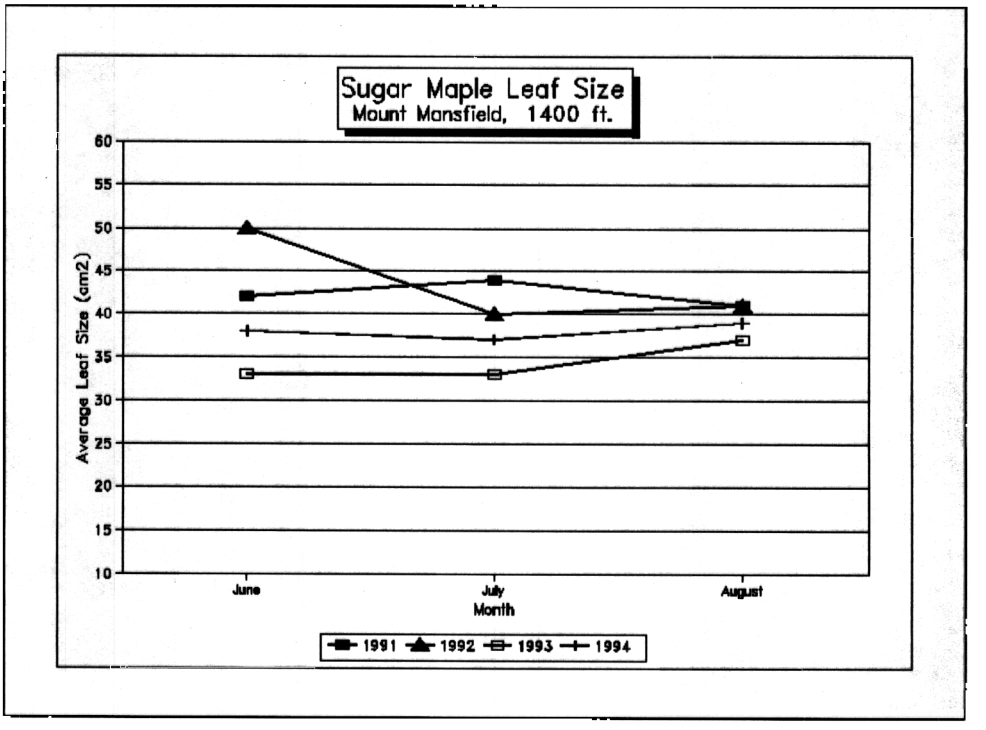
Within season leaf area measurements have shown similarities in between June, July and August (Figures 4-6). Early season sugar maple leaf size at the 1400 foot elevation has varied. Smaller than normal years in 1993 can be attributed to pear thrips damage.

Average leaf area for all years is presented in Table 2. Smaller leaf size was found at the higher elevation for yellow birch and beech, but no significant difference in size by elevation was found for sugar maple.

Table 2. Average leaf area of three hardwood species samples three times each season from 1992 through 1995 (sugar maple at 1400 feet was sampled from 1991-1995).

Species	Average Leaf Area (cm^2)	
	1400 ft.	2200 ft.
Sugar Maple	39.6	40.7
Yellow Birch	20.8	18.8
Beech	30.9	28.3

Figure 4. Sugar maple leaf area of trees growing at 1400 and 2200 feet on Mount Mansfield, measured during June, July and August of 1992-1994.



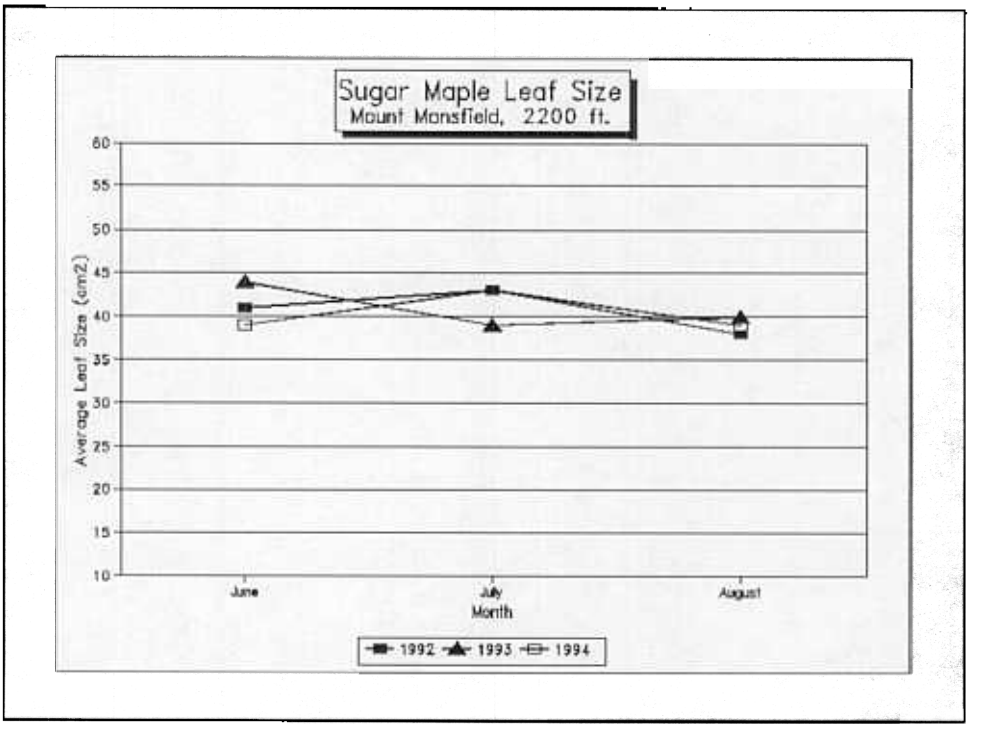
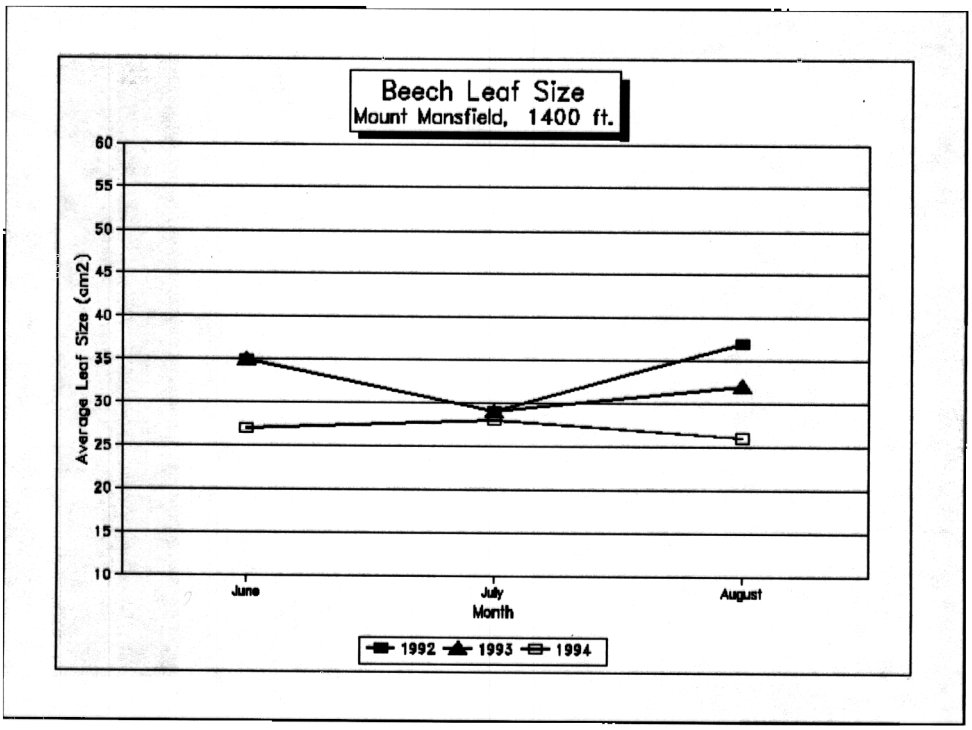


Figure 5. Beech leaf area of trees growing at 1400 and 2200 feet on Mount Mansfield, measured during June, July and August of 1992-1994.



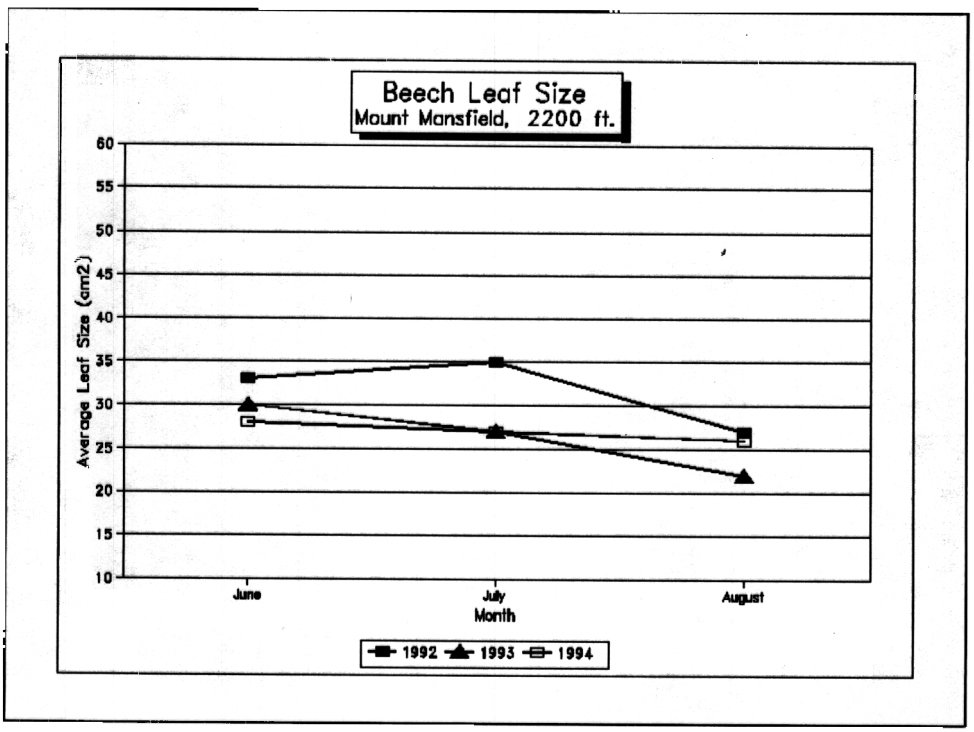
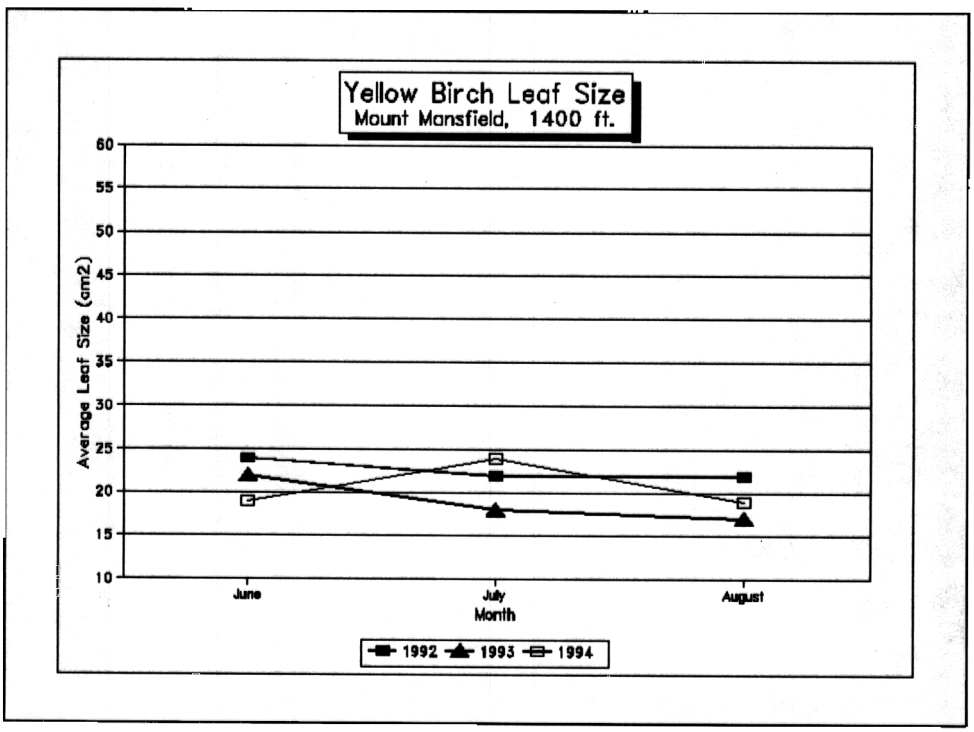
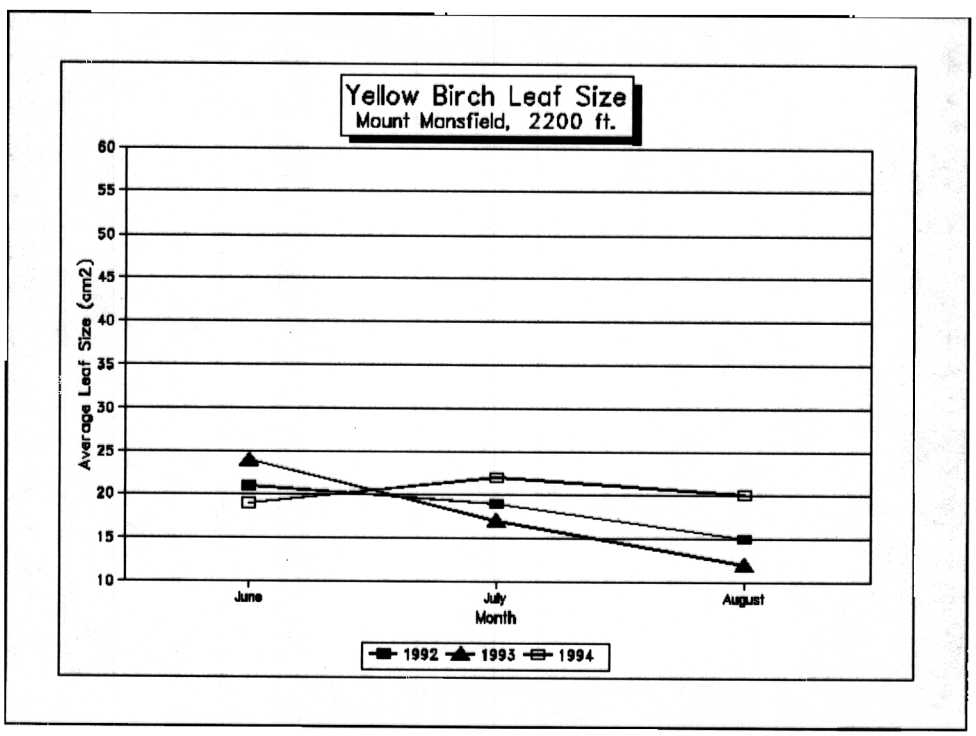


Figure 6. Yellow birch leaf area of trees growing at 1400 and 2200 feet on Mount Mansfield, measured during June, July and August of 1992-1994.





FALL COLOR AND LEAF DROP

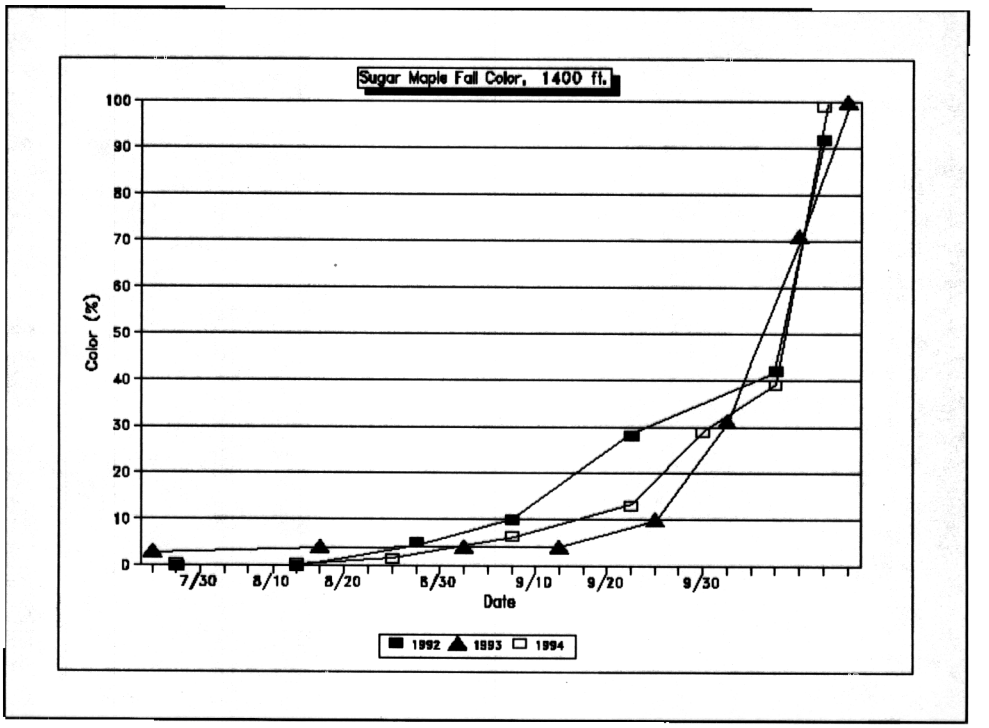
Fall color and leaf drop was earlier than normal for most tree species, especially at the higher elevation.

Sugar maple color at 1400' was similar to other years, with rapid color change the first week of October (Figure 7). At the higher elevation, 50% color was observed by September 20, 10 days earlier than in 1993. Leaf drop at lower elevations was similar to other years, but at the higher elevation, significant leaf drop (50%) was measured when leaves were still below 50% color.

Beech at 1400' reached 50% color slightly ahead of other years, while at the higher elevation, beech had full color nearly 2 weeks earlier than in 1992 and 1993 (Figure 8). Leaf drop began earlier in 1994, especially on higher elevation trees.

Yellow birch color was similar to other years (Figure 9). At 2200', birch had a rapid color change during the third week of September, resulting in 90% color well ahead of other years, 2 weeks earlier than in 1992. Significant leaf drop occurred at higher elevations well before October, with nearly 60% leaf drop on September 20, when only 15% color was measured.

Figure 7. Timing of sugar maple fall color at 1400 and 2200 feet on Mount Mansfield from 1992-1994.



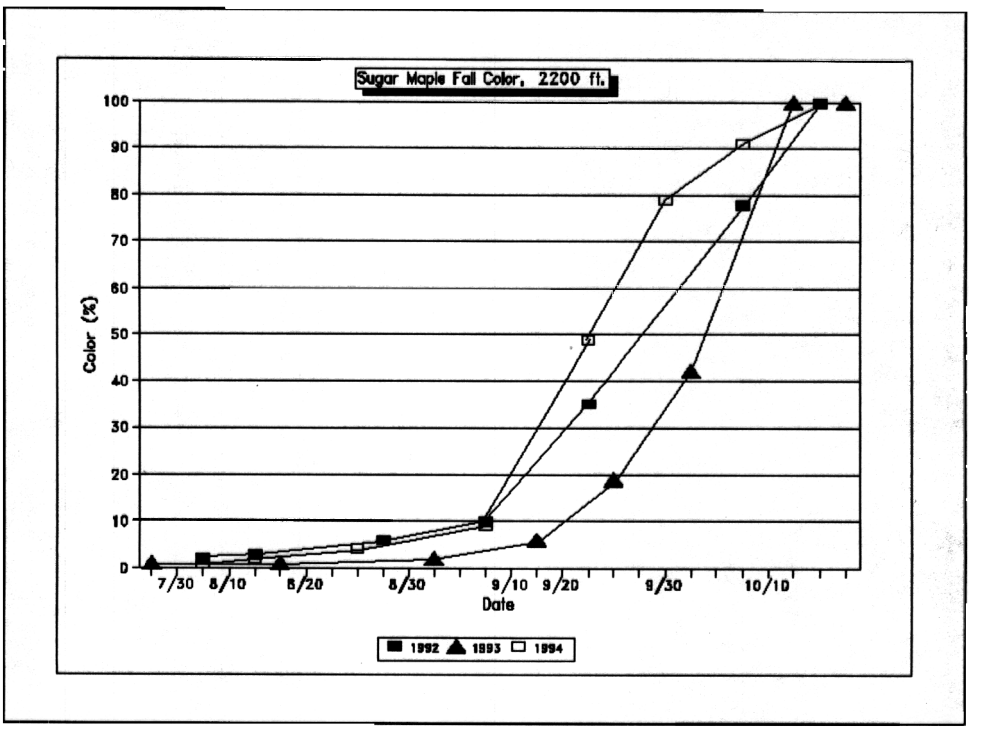
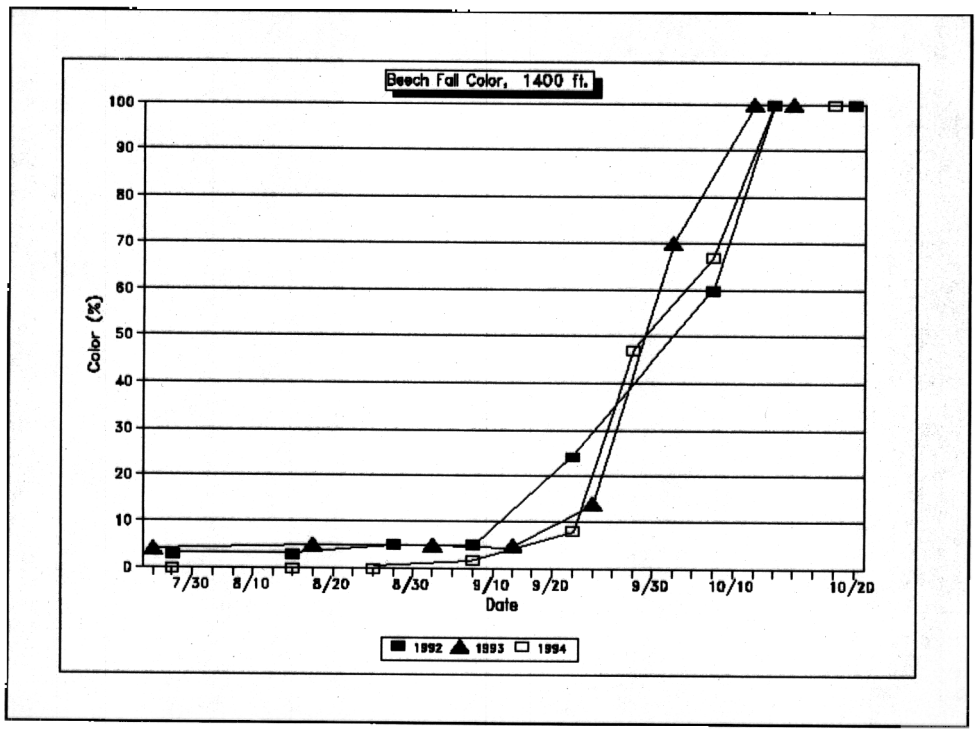


Figure 8. Timing of Beech fall color at 1400 and 2200 feet on Mount Mansfield from 1992-1994.



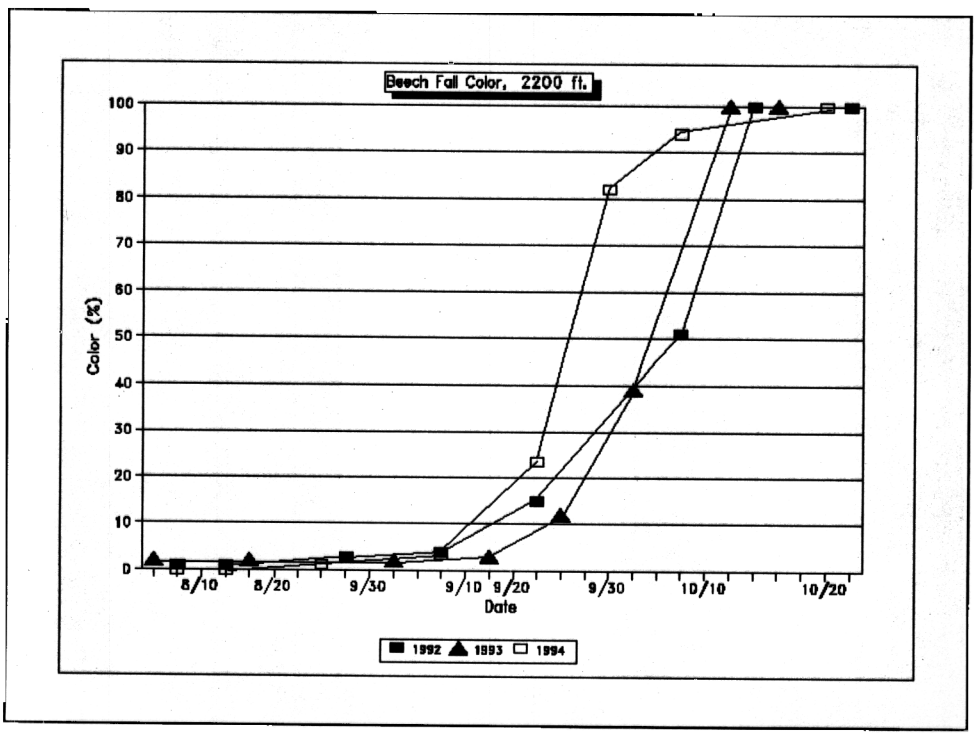
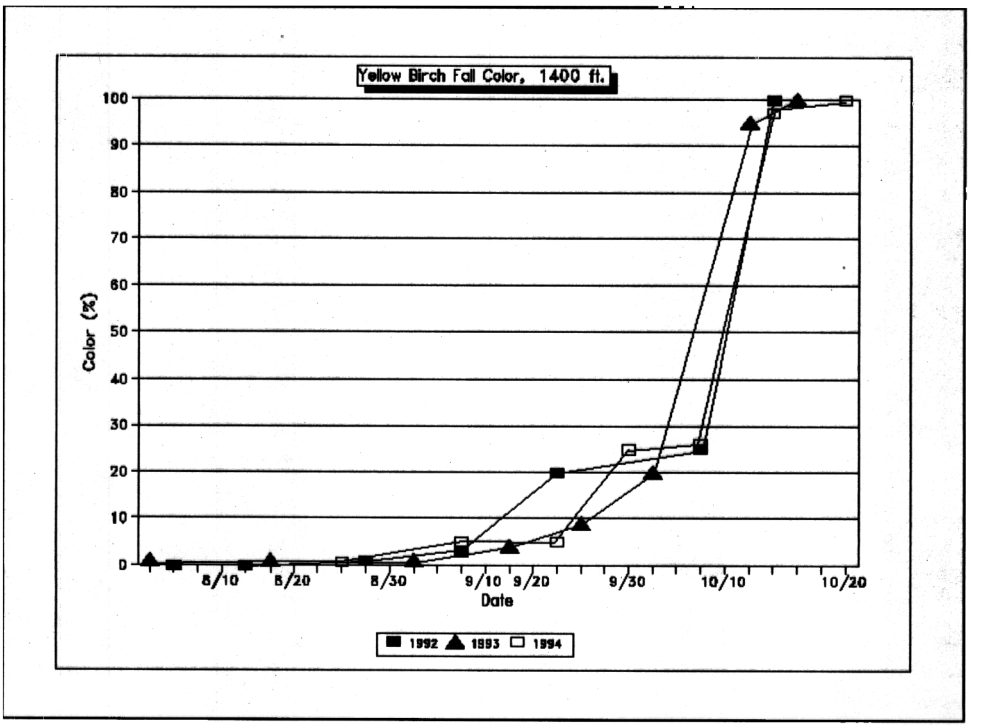


Figure 9. Timing of yellow birch fall color at 1400 and 2200 feet on Mount Mansfield from 1992-1994.



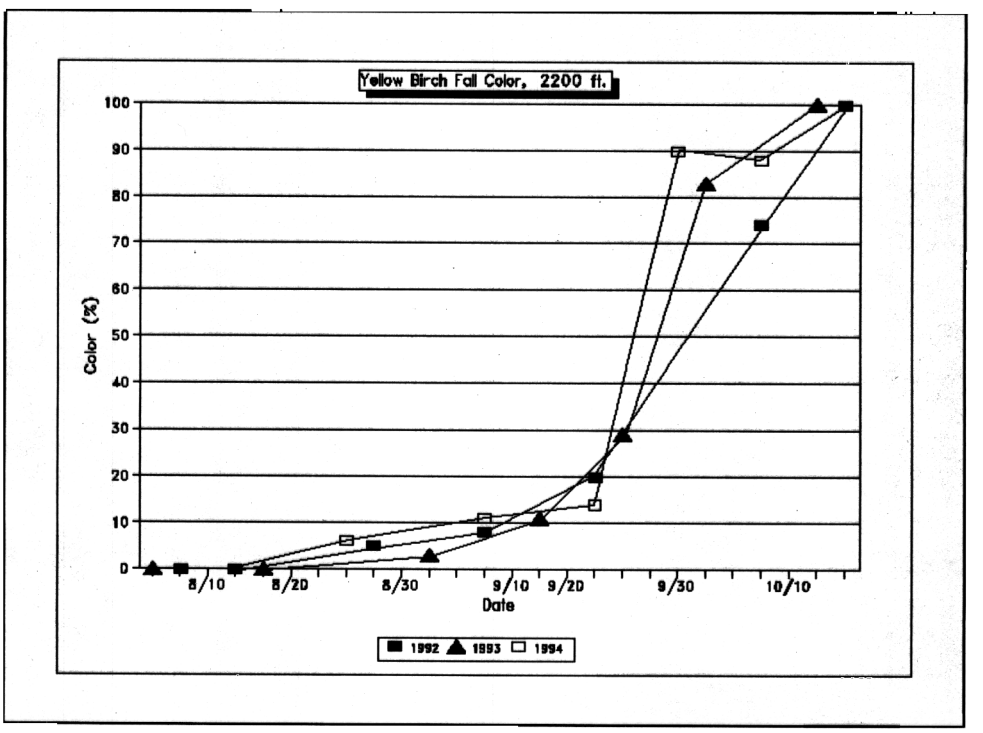
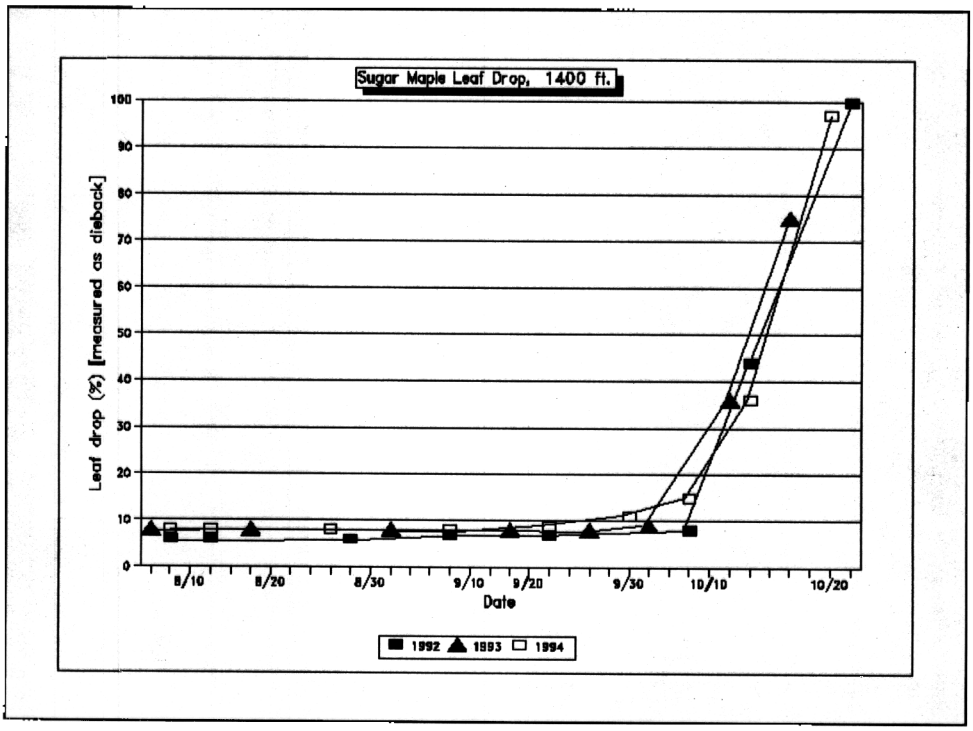


Figure 10. Timing of sugar maple leaf drop at 1400 and 2200 feet on Mount Mansfield from 1992-1994.



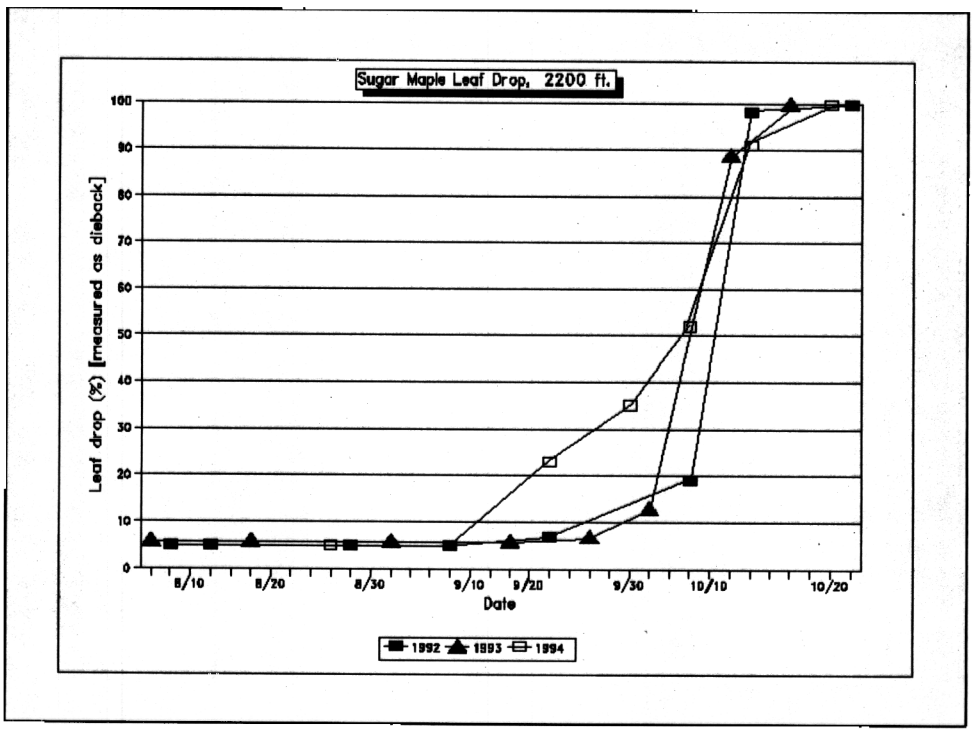
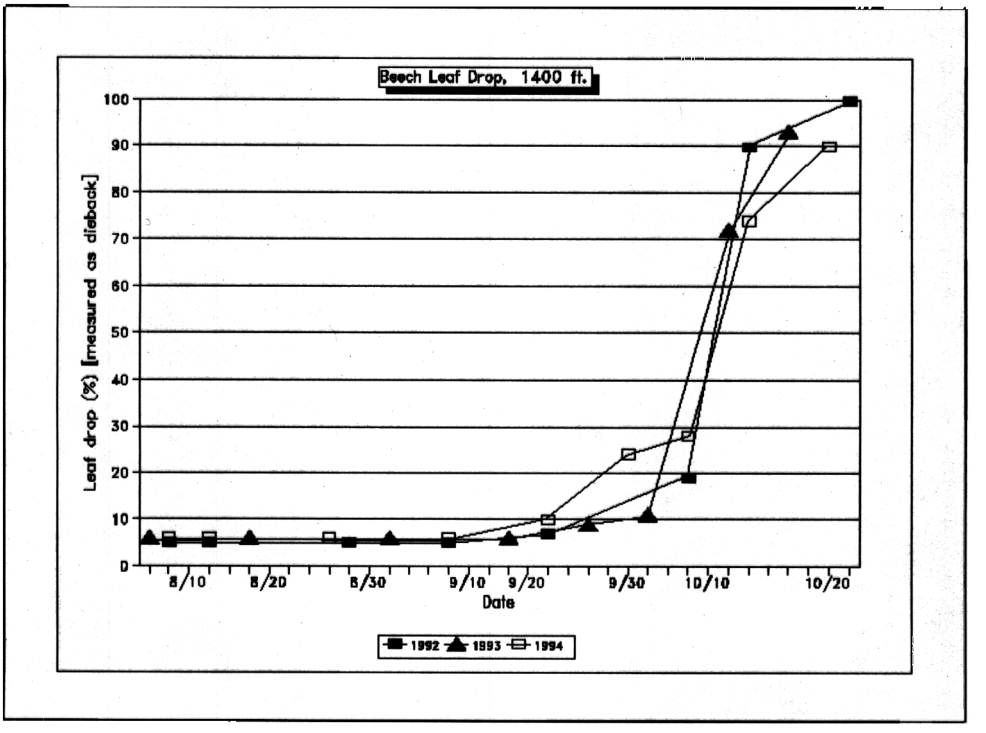


Figure 11. Timing of beech leaf drop at 1400 and 2200 feet on Mount Mansfield from 1992-1994.



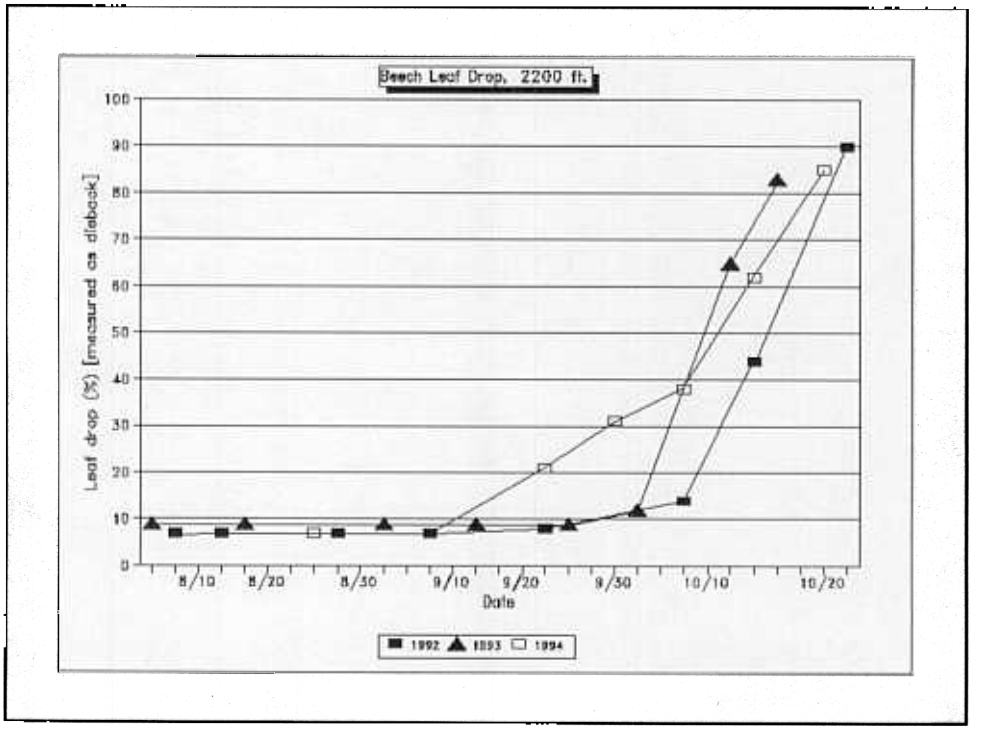
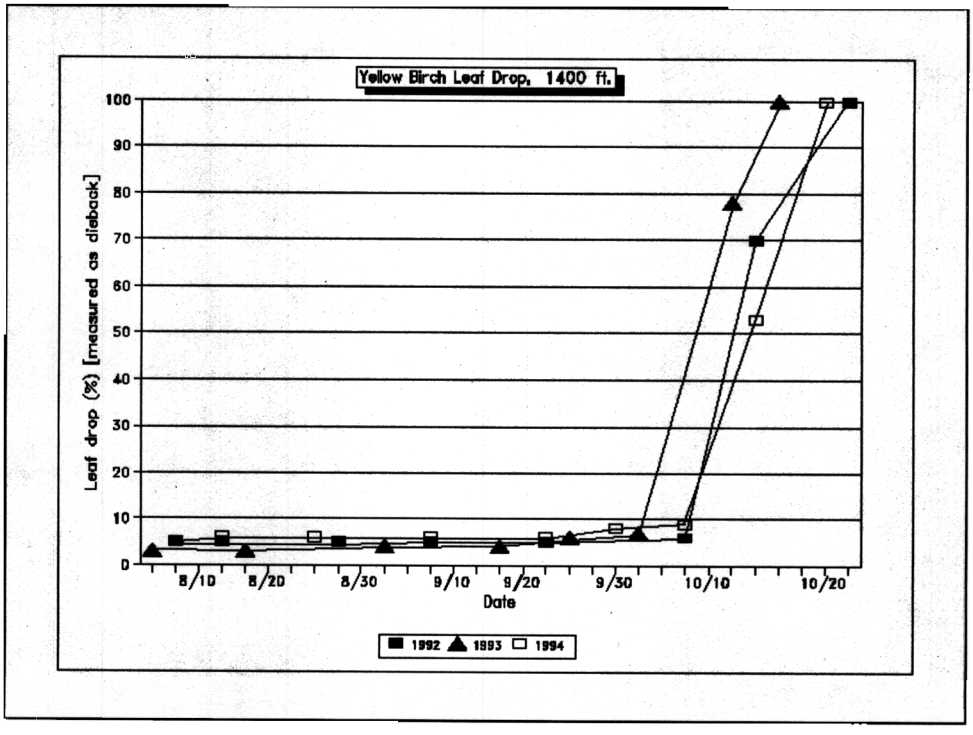
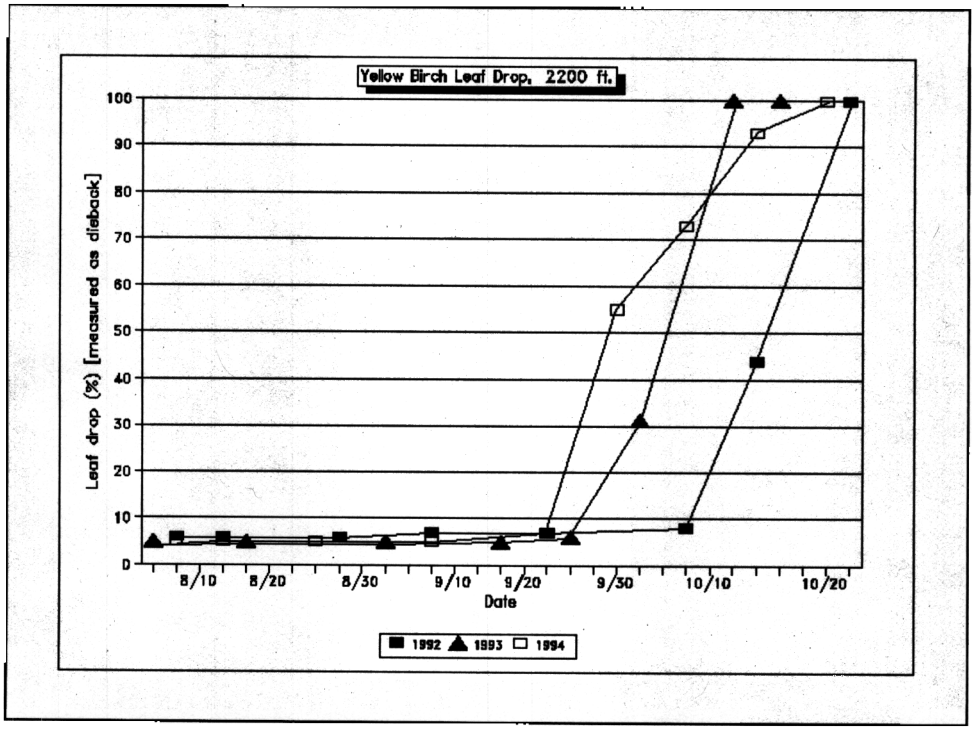


Figure 12. Timing of yellow birch leaf drop at 1400 and 2200 feet on Mount Mansfield from 1992-1994.





DISCUSSION

This growing season was shorter than usual with budbreak later than in the past few years, and fall color earlier than normal. A more extensive evaluation of bud development, fall color and weather relationships is available soon (Wilmot & Simmons, in press).

This concludes our baseline collection of leaf size. These results can be considered normal leaf size for sugar maple, yellow birch and American beech at this site. This baseline will be useful for future comparisons to assess defoliation or poor tree vigor resulting in leaf size reductions.

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