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Changes in Hardwood Growing-Stock Tree Grades

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Abstract

Describes changes in provisional tree grades for 351 young, mixed upland hardwood trees 6 years after thinning. Treatments of 30, 50, and 70 percent stocking plus a crop-tree release were applied. Results indicate that light thinning and crop-tree thinning produced higher quality and better grade trees than heavy thinning.

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Introduction

The United States has an estimated 230 billion cubic feet of hardwood growing-stock volume. With this much raw material, some measure of potential quality and associated grade change is needed to eventually predict the value. But to do this, we must first: (1) identify the potential quality trees, and (2) determine the type of cultural treatment needed to produce good-quality growth in the future. Recognizing these requirements, Boyce and Carpenter (1968) developed provisional grade specifications for young hardwood growing-stock trees. The grade specifications were assigned according to the probability of a young tree yielding a Grade 1, Grade 2, or Grade 3 butt log when it reached 16 inches in diameter at breast height (d.b.h.). The grades were developed from tree-growth characteristics and stem defects located on the butt 16-foot log section. Many of the same growth characteristics and defect indicators were further quantified by Sonderman and Brisbin (1978), who developed a quality classification system that describes the relative quality of individual trees. More recently, Dale and Sonderman (1984) investigated growth and quality changes resulting from the effects of different thinning methods on white oak trees. These studies have produced a data base that can be used for future research on predicting tree quality in young growing-stock trees.

This study compares quality and growth changes over time of hardwood growing-stock trees by the provisional tree grades. Data on tree-grade changes provide a standard for evaluating how different tree species perform under different thinning treatments, and aid the forester and land manager in selecting the best thinning method.

The Stands

The study trees were located on four forest stands at the Vinton Furnace Experimental Forest in southeastern Ohio. The original stands contained mixtures of mature, even-aged, upland hardwood species on medium to good sites. One of the stands was clearcut in 1954 and the other three between 1959 and 1963. Before cutting, all of the stands were uniform with respect to site class, species composition, and quality. They differed only in age, which at the time of thinning was between 14 and 23 years. In 1977, the stands were thinned to 30, 50, and 70 percent of full stocking according to Gingrich (1967), and a crop-tree release was established. All 88 plots, including the controls, were 1/10-acre in size. A 1/2-chain-wide isolation strip was placed around each treatment boundary and treated the same as the respective plots; 351 trees were measured in this study. At the time of thinning, species composition included mixed oaks, aspen, yellow-poplar, red maple, black cherry, black walnut, blackgum, butternut, beech, red elm,

and hickory. Four species that represented the majority of the stands were grouped and used for the analyses. They were oak, yellow-poplar, red maple, and aspen. Miscellaneous species were not included in the analyses because of a small number of sample trees.

Methods

The selected trees were graded twice (1977 and 1983) by the provisional grade specifications for hardwood growing-stock trees (Boyce and Carpenter 1968). Specifications required tree d.b.h. to be 6.0 inches or larger and that each tree have a potential 12-, 14-, or 16-foot butt log. Each tree was graded and assigned to one of four provisional growing-stock tree grades (the fourth grade was added for trees not qualifying as Grade 1, 2, or 3, but still meeting criteria for butt-log length). All of the grades were assigned according to the probability that a tree will yield a Grade 1, 2, or 3 butt log when it reaches 16 inches in d.b.h. The provisional tree grades were defined as:

- Grade 1: Crown class must be dominant or codominant, up to 4 inches of sweep allowed, and up to four defects permitted.¹
- Grade 2: Crown class must be dominant or codominant, up to 6 inches of sweep allowed, and 5 to 17 defects permitted.¹
- Grade 3: Admit all crown classes, up to 8 inches of sweep, and 18 to 30 defects permitted.¹
- Grade 4: Include all trees not meeting Grade 1, 2, or 3 specifications but still meeting criteria for butt-log length.¹

For the analyses, the trees were grouped by species, treatment, provisional grade, and year measured. The differences in potential grade change between growth periods (years) were the basis for this paper.

¹Defects include limbs, overgrowths, knots, bud clusters, and bark distortions. Trees with any amount of rot or forks are automatically Grade 4.

Results and Discussion

This paper focuses on stem quality as reflected in potential tree-grade changes over time under different thinning treatments. However, tree growth is as important as tree quality since both are taking place at the same time. For instance, as a tree grows, the branches may develop into live limbs, the live limbs die, and the dead limbs become overgrowths. The speed of this process is controlled partially by stand density, age, and site.

Oak

The oaks species generally developed more stem defects from heavy thinnings and consequently had lower grades than some of the other species in this report. In fact, the open crown condition of the 30 percent treatment had an adverse effect on oak stem quality and grade (Fig. 1).

Because of the many stem defects, there were no Grade 1 oak trees in the 30 percent treatment. The percentage of Grade 2 oak trees declined and the proportion of Grade 3 and Grade 4 trees increased. The percent decline in Grade 2 trees was due to an increase in the number of stem defects resulting from excessive sunlight that caused many of the suppressed buds to sprout and "feather out" as new epicormic branches. At the same time, some of the existing live limbs continue to thrive in the sunlight and grow larger, adding to the number and seriousness of the stem defects.

There were no Grade 1 oak trees in the 50 percent treatment for the same reasons as in the 30 percent treatment—excessive stem defects. The percentage of Grade 2 oak trees did not change, but there was a slight increase in Grade 3 trees in this treatment.

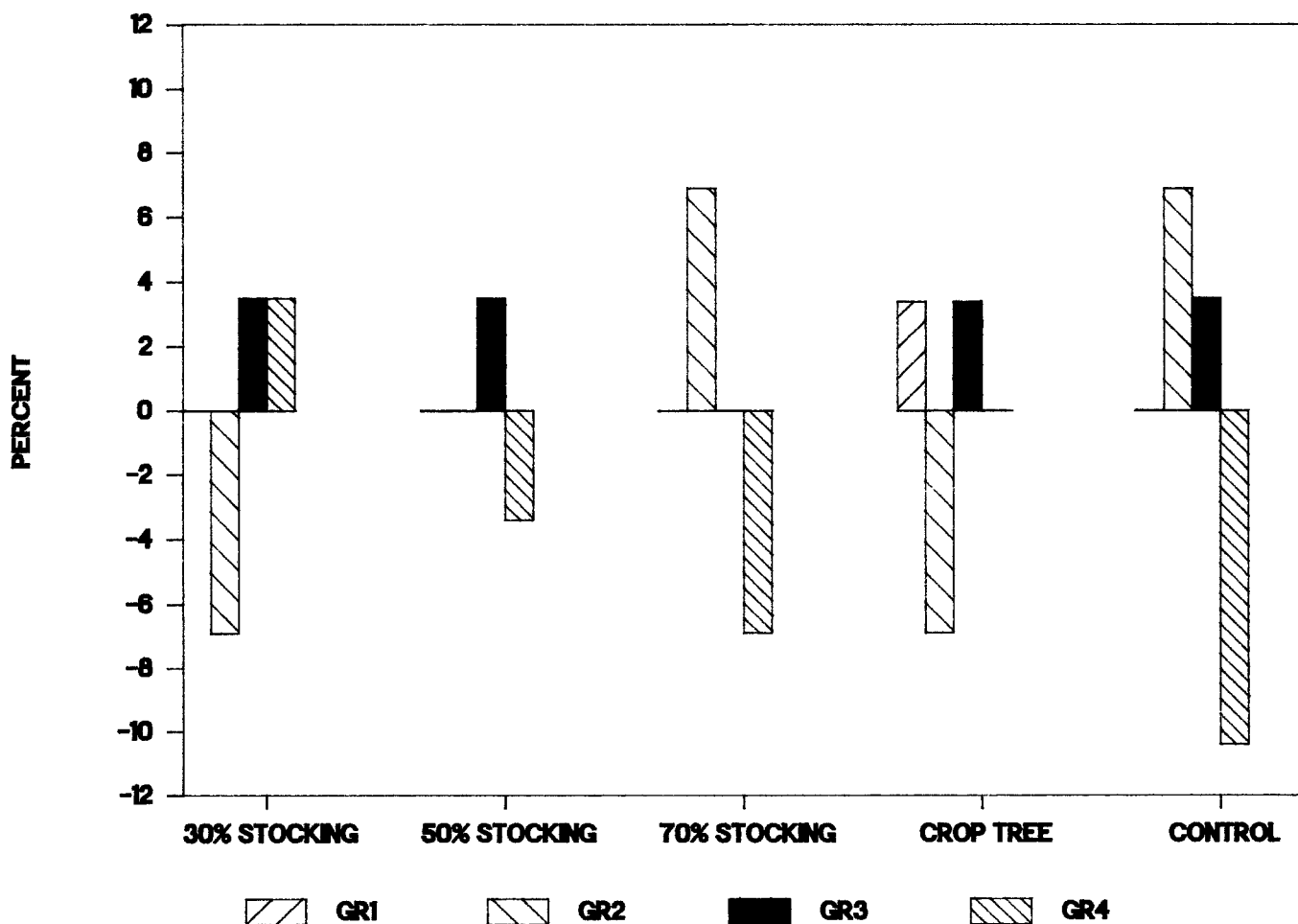


Figure 1.—Percent change in oak provisional tree grades, by treatment, 1977-83.

For the same reasons cited, there were no Grade 1 oak trees in the 70 percent treatment; however, the proportion of Grade 2 oaks increased by about 7 percent, the Grade 3 oak trees remained constant, and the Grade 4 trees decreased. As thinning intensities decreased, there was a trend toward better tree grades for the oak species.

The crop-tree release resulted in the greatest improvement, a 3-percent increase in Grade 1 trees and a 7-percent decrease in Grade 2 trees. Grade 3 crop trees increased slightly, but there was no change in the percentage of Grade 4 trees. The crop-tree treatment, which favors dominant and codominant trees in the final stand, resulted in fewer epicormic branches from reduced sprouting that is associated with better crown classes. This supports previous studies that show an inverse relationship between crown dominance and sprouting.

In the control plots, the natural pruning of the dead limbs resulted in fewer stem defects and a 10-percent decrease in Grade 4 oak trees. This percentage change was redistributed among Grade 2 and Grade 3 trees as an increase. There were no Grade 1 trees in the control.

Many of these results are similar to those of a thinning-intensity study (Sonderman 1984) that showed a loss of stem quality as a result of heavy thinning in 80-year-old white oaks.

Yellow-Poplar

Previous research has shown that yellow-poplar trees sprout with epicormic branches if exposed to heavy thinning. During this 6-year study period, several yellow-poplar in the 30 percent treatment (Fig. 2) did increase in quality to Grade 1. However, a larger proportion, more than 13 per-

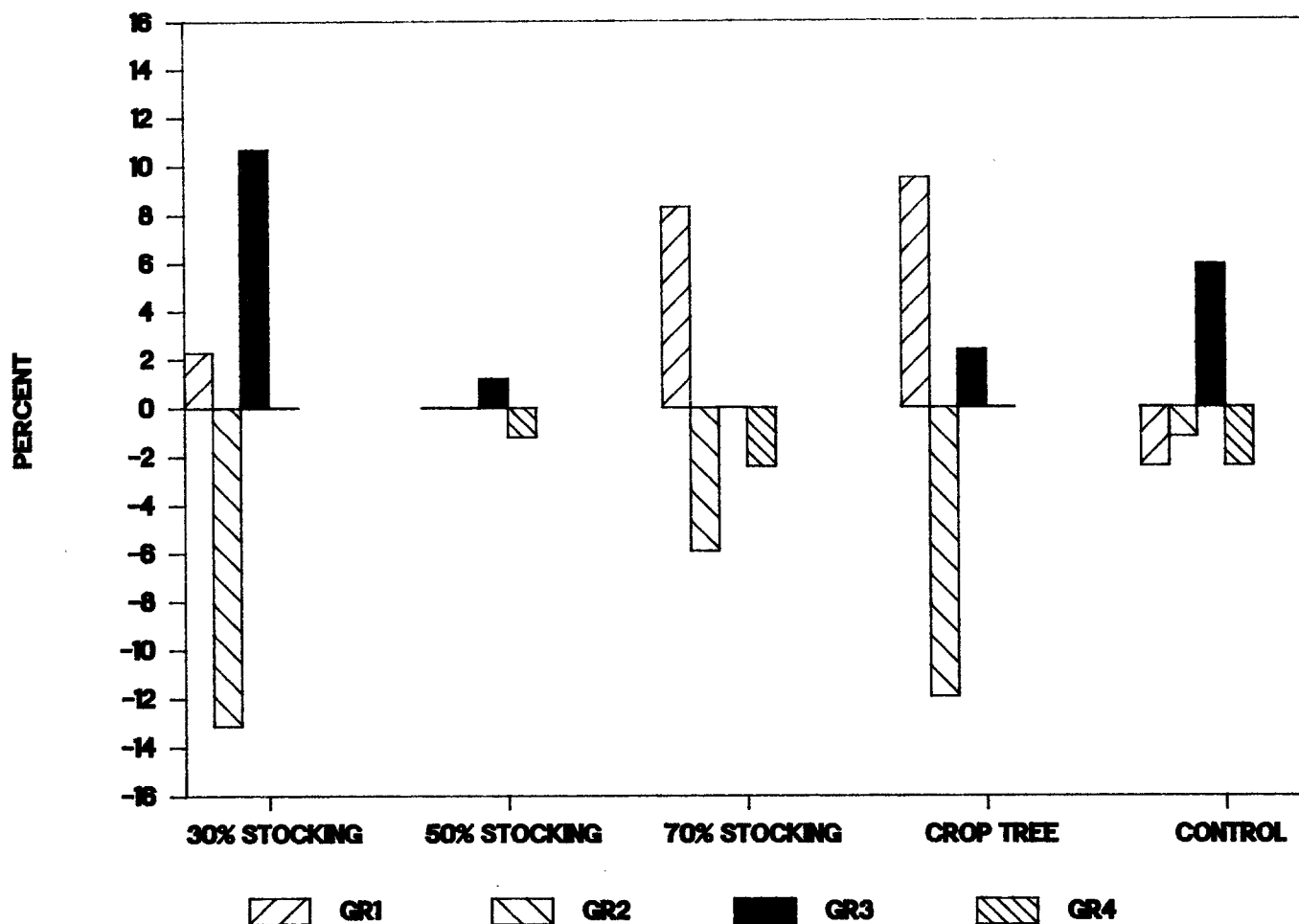


Figure 2.—Percent change in yellow-poplar provisional tree grades, by treatment, 1977-83.

cent, decreased from Grade 2 to Grade 3. Many of the original Grade 2 trees became Grade 3 trees because of an increase in the number of stem defects resulting from heavy thinning. The Grade 4 yellow-poplar trees in the 30 percent treatment were unchanged.

There were no Grade 1 yellow-poplar trees in the 50 percent treatment. However, the effects of this thinning treatment resulted in no change in the proportion of Grade 2 trees, and only a slight increase in Grade 3 trees. This small increase in Grade 3 trees resulted from fewer stem defects in the Grade 4 trees after 6 years.

The 70 percent treatment had a dramatic effect on the percentage of yellow-poplar Grade 1 trees—the proportion of these trees increased by 8 percent from 1977 to 1983. Many of these originally were Grade 2 trees that developed better quality and grade over time by losing a number of limb defects. There was no change in the proportion of Grade 3 trees and a slight decrease in the proportion of Grade 4 trees in the 70 percent treatment.

The effects of crop-tree thinning on yellow-poplar resulted in a substantial increase in Grade 1 trees, with an almost equal loss in Grade 2 trees. Obviously, they changed grade because of fewer stem defects. Yellow-poplar responded well to crop-tree thinning with very little sprouting of epicormic branches. The proportion of Grade 3 trees increased by about 2 percent and there were no Grade 4 trees.

The results of the controls on yellow-poplar had an opposite effect from that of the crop-tree treatment. A small percentage loss of Grade 1 and Grade 2 trees was noted along with a 6-percent increase in Grade 3 trees. Most of the young trees in the control treatment grew closer together and were more uniform than in the other treatments, resulting in an overall lower crown dominance, smaller crown ratios, and fewer vigorous stems. These factors contributed to the increase in the proportion of Grade 3 trees, most of which originated from a combined change of Grade 1, 2, and 4 trees. It should be noted that the self-pruning that did occur was offset by the growth factors cited.

Red Maple

Red maple trees usually are considered prolific epicormic sprouters when subjected to heavy thinnings. These heavy thinnings can be expected to deteriorate red maple quality (grade) over time as a result of an increase in the size and number of limb-related defects. The many defects that

resulted from this sprouting help explain why there were no Grade 1 trees in the 30 percent treatment and why Grade 2 and Grade 3 red maple trees (Fig. 3) increased only about 2 percent each. Heavy thinning causes young red maple crowns to expand and extend downward, resulting in an increase in crown ratios. Over time, increases in crown ratio reflect the degrading effect that results from the development of excessive epicormic branches and live limbs. In addition to these changes in crown ratio, the losses in the percentage of Grade 4 red maple trees may also result from a change in crown class that was created by the heavy thinning and, thus, reflected in the grading specifications.

There were no graded red maple trees in the 50 percent treatment.

There were no Grade 1 red maple trees in the 70 percent treatment, but there was a 4-percent increase in Grade 2 trees. The percentage of Grade 3 and Grade 4 trees decreased, probably as a result of the decrease in the number of limb defects. The combination of all of these changes resulted in better overall tree quality in the 70 percent treatment.

Crop-tree thinning of red maples resulted in good volume growth and quality development. The increase in the percentage of Grade 1 trees was a direct result of less sprouting from dominant and codominant trees as opposed to the intermediate and suppressed trees. It is believed that genetically inferior trees (with regard to growth rate) tend to be found in the intermediate and suppressed crown classes, and that these trees tend to sprout more prolifically than the genetically superior trees (dominant and codominants).

There were no Grade 1 red maple trees in the control. The percentage of Grade 2 red maples decreased and the percentage of Grade 3 red maples increased correspondingly. The formation of new epicormic branches, along with existing large live and dead limbs that do not prune-off easily or quickly, contributed to lower grades for red maple trees. Besides the number of limbs, some of the lower grades were caused by poorer crown classes in the control plots. Many of these crown classes were in the codominant and intermediate categories, which have lower quality factors in the provisional tree-grading specifications.

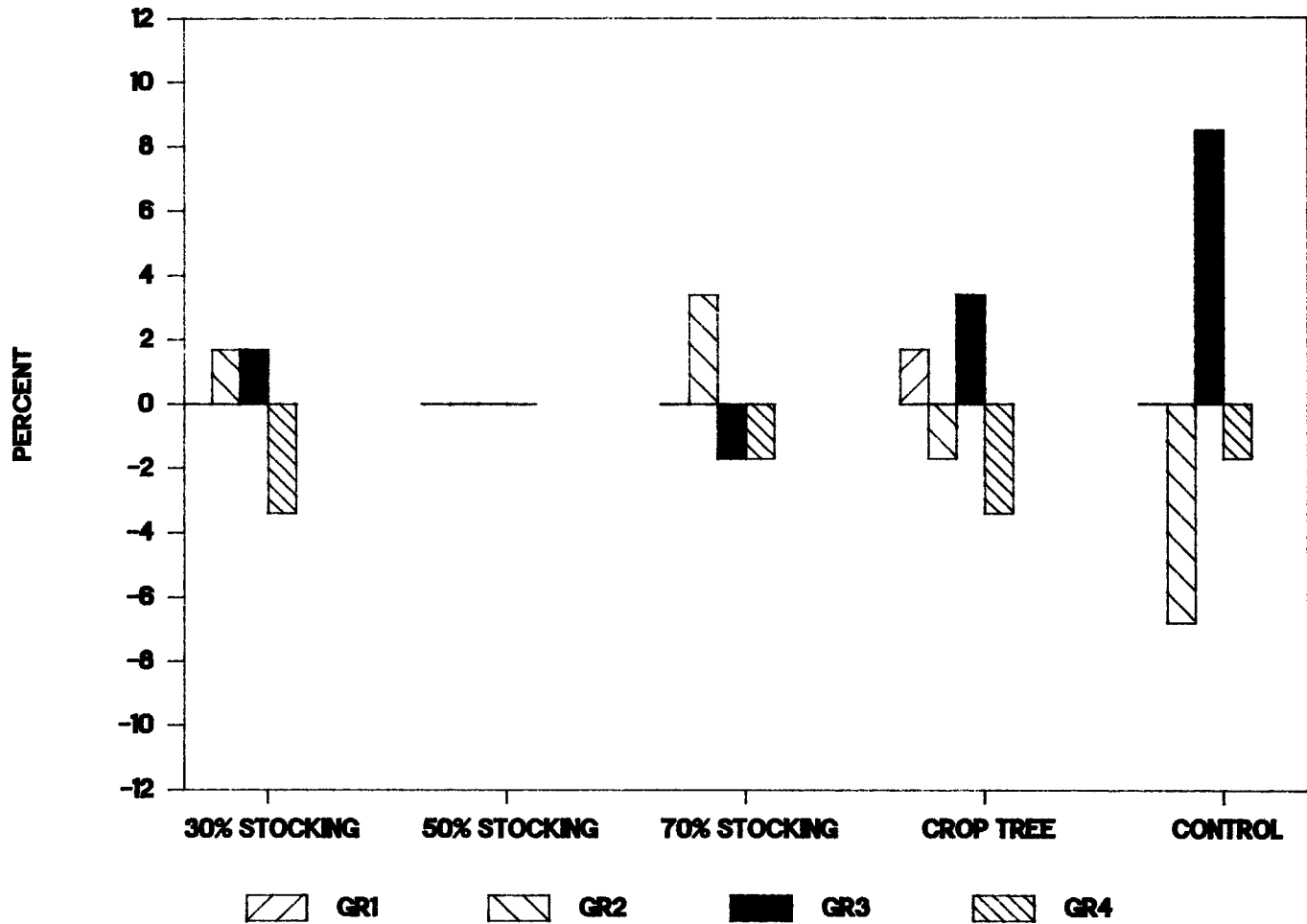


Figure 3.—Percent change in red maple provisional tree grades, by treatment, 1977-83.

Aspen

Aspen is a short-lived species that does not respond well to thinning—whether heavy or light. Results from the 30 percent treatment (Fig. 4) show no Grade 1 trees and a 3-percent increase in Grade 2 trees. Many of the aspens in the poorer grades lost limbs during the 6-year study period, accounting for most of the changes.

Aspen, however, did show an increase in Grade 1 trees in the 50 percent, 70 percent, crop-tree treatments, and control, but the grade increases resulted more from loss of limbs from age than from the effects of thinning. Limbs on aspen trees between 20 and 30 years of age tend to die early or persist only for a few years under any stocking treatment.

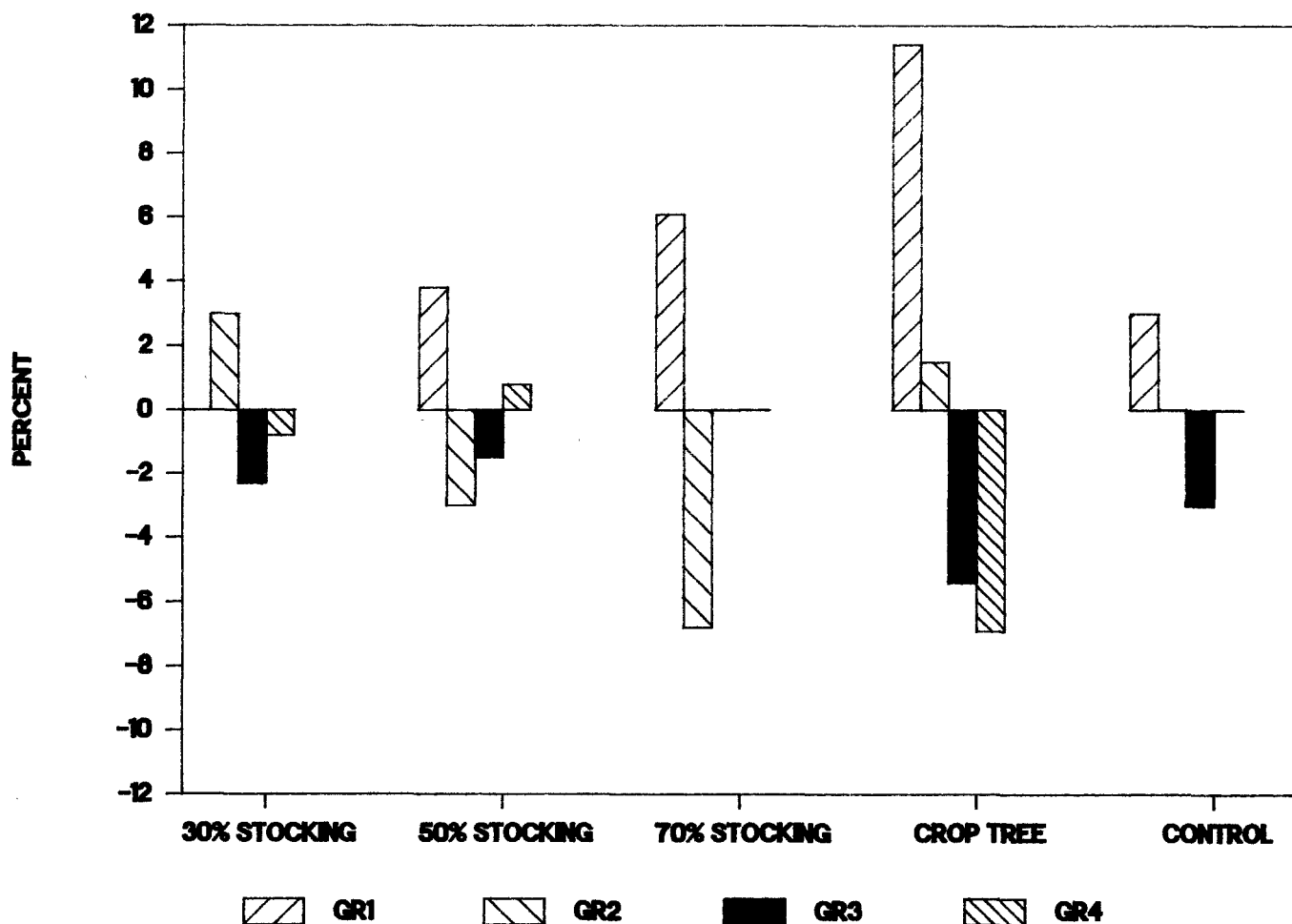


Figure 4.—Percent change in aspen provisional tree grades, by treatment, 1977-83.

Summary and Conclusions

The provisional tree-grade specifications for young growing-stock trees were based on crown position, stem form, and the number of surface-defect indicators. Comparing the data from 1977 and 1983 has shown a number of interesting changes. For example, the crown classes of many trees were changed by the thinning method applied. Heavy thinning tended to favor dominant and codominant trees in the residual stands, many of which suffered from excessive epicormic branching and heavy limb retention. In the 30 and 50 percent treatments, for example, the additional limb defects resulted in lower overall tree quality and grade than those in the 70 percent treatment. In the crop-

tree treatment, the greatest improvement was in the percentage of Grade 1 trees. Thinning around young potential crop trees had a positive effect on the proportion of Grade 1 trees because enough crown cover was maintained to partially shade the stem and still allow sufficient light for good growth. By contrast, the young trees in the control plots showed much slower diameter growth, almost equal height growth, more natural pruning of smaller limbs, and poorer but more evenly distributed crowns. This resulted in the larger limbs remaining on the stem, fewer epicormic branches, slightly straighter boles, and little positive effect on grade change for the trees in the control.

An overall look at all species combined by treatments (Fig. 5) shows the largest increase in Grade 1 trees in the crop-tree treatment and the smallest change in the control. There was a gradual increase in Grade 1 trees as percent stocking increased.

Other findings were:

- In the oak group, only the crop-tree release contained Grade 1 trees.
- Yellow-poplar was the only species with Grade 1 trees in the 30 percent treatment.
- There were no Grade 4 yellow-poplar trees in the 30 percent or crop-tree treatments.

- In the red maple group, only the crop-tree treatment contained Grade 1 trees.
- There were Grade 1 aspen trees in all treatments except for the 30 percent treatment.

The results indicate that the potential for growing Grade 1, high-quality, young hardwood trees increases with a decrease in thinning intensity. Thinning below 60 percent stocking has a detrimental effect on tree quality and grade. At this stocking level, a sufficient number of young trees will be able to fully utilize the site while maintaining good growth and quality.

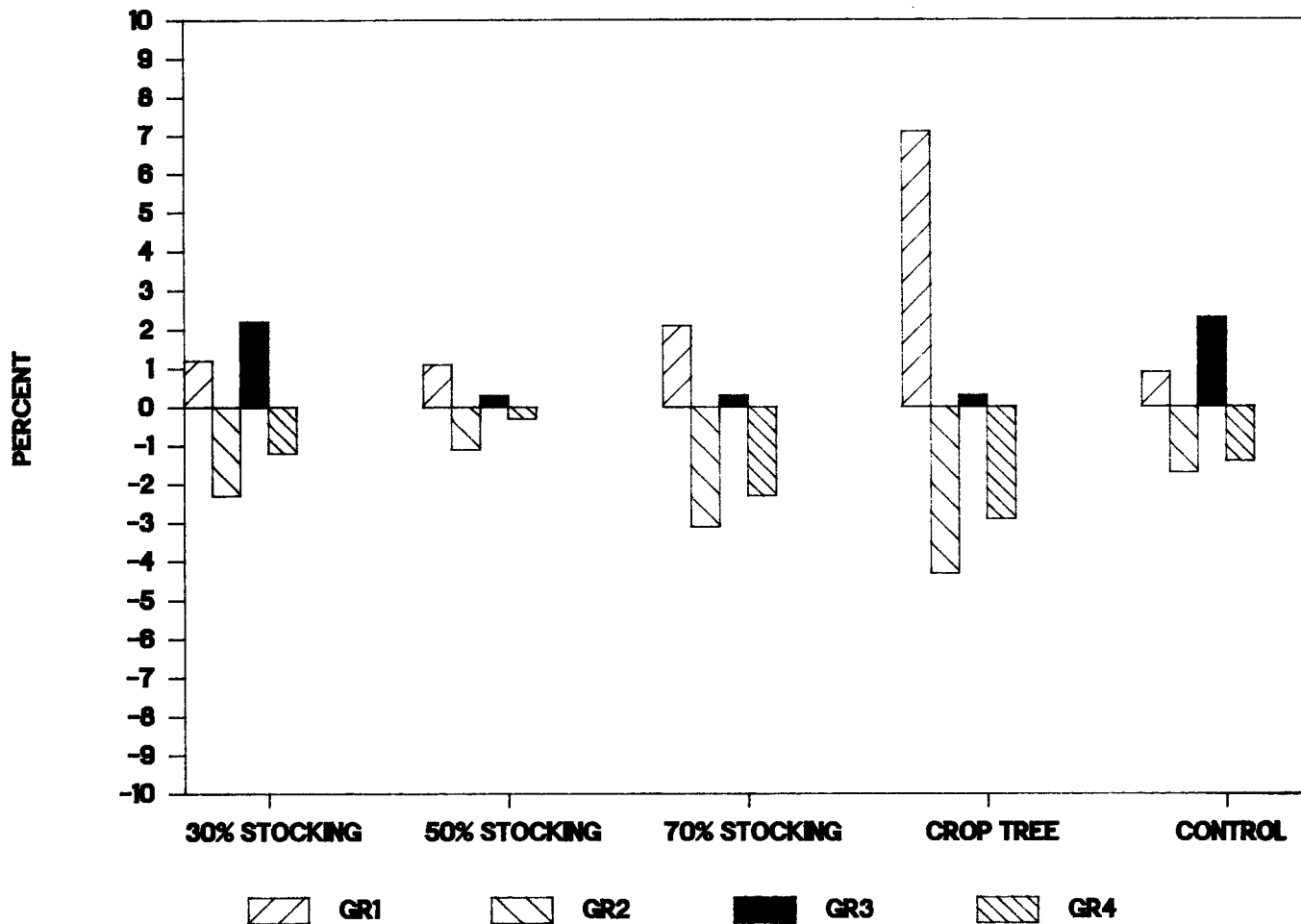


Figure 5.—Percent change in provisional tree grades for all species combined, by treatment, 1977-83.

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