INCREASING AMOUNTS OF CHEMICAL WEED CONTROL INCREASE GROWTH OF WHITE ASH, WHITE OAK, AND BLACK WALNUT SAPLINGS IN A TALL FESCUE SOD

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Effective weed control in young deciduous plantations is often prescribed to enhance survivability and growth (Bey and others 1975). Chemical weed control often employs broadcast, strip, and spot applications that markedly affect the ground surface area treated. Our study investigates the effect of four levels of treated surface area of a tank mix of glyphosate and simazine and their potential accumulation in the soil on the growth and survival of black walnut (*Juglans nigra* L.), white oak (*Quercus alba* L.), and white ash (*Fraxinus americana* L.) saplings.

The study area is located at the SIU Tree Improvement Center in Carbondale, Illinois. Soil type is a Hosner silt loam soil with a plowpan and a fragipan 18 to 24 inches deep. While not favorable for long-term growth of trees, these soils are appropriate for testing the effects of cultural practices on establishment and early growth of hardwoods. Our study was superimposed on a 4-year-old hardwood planting established in a tall fescue sod. Of the original planting, 28 rows spaced 5 feet apart were selected. Seedlings were spaced 8 feet apart in each row that was planted with three walnuts, then three oaks, and finally three white ash seedlings.

The weed control treatments, listed in increasing amount of controlled area, were no-treatment—0 percent (no-spray), 3-foot diameter circles—17 percent (spot), 24-inch wide strips—40 percent (strip), and broadcast—100 percent (complete). The demonstration area was bi-sected into 2 blocks for treatment replication. Each treatment was assigned to four consecutive rows in block 1 and three rows in block 2. At age 6, 3 walnuts and 19 oak saplings were removed to install a walking trail through the demonstration plot. In addition, 7 ashes, 23 oaks, and 7 walnuts were severely damaged by animals and excluded from the dataset for statistical analysis. A tank mix of glyphosate (2.75 lbs active ingredient per acre) and simazine (4 lbs active ingredient per acre) plus a surfactant was applied under the sapling canopy each spring for 4 years starting at tree age 4, and bi-annually thereafter until the trees were 14 years old. A backpack sprayer with a fan type nozzle applied the tank mix at a rate of approximately 100 gallons per acre.

Seedling (sapling) heights were measured and mortality recorded at tree ages 3 through 7 and 11. During year 5, all saplings were scored for visible herbicide damage on the foliage. Due to the shallow soils and competitive effects following crown closure, height data from year 11 was excluded from the analysis but is shown in the figures to indicate height growth trajectories. Survival is based only on saplings alive at age 3 although mortality in the planting at the time of the first treatment averaged 27 percent for ash, 8 percent for oak, and 11 percent for walnut.

Each species was analyzed separately due to limitations in the experimental design. Height data for each species was analyzed by analysis of variance (ANOVA) as a randomized complete block with covariance. Mean heights for each treatment were adjusted for the variation in sapling heights at the time of the first treatment. Differences between treatments were identified by equality tests of the least squares estimates. This analysis assumes randomness although treatments were not assigned randomly. Survival and herbicide damage data for each species was analyzed utilizing Chi-square tests.

Seedling survival was not statistically different among treatments for any of the three species

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except the spot treatment on the oaks at age 7 ($p = 0.005$). No sapling mortality occurred in the no-spray treatment for white ash, white oak, or black walnut (fig. 1). When averaged over herbicide treatments, sapling survival averaged 96 percent for walnut, 89 percent for white ash, and 79 percent for white oak.

Sapling heights for white oak showed no differences among weed control treatments (fig. 1). Lack of statistical separation of the treatment means is likely due to the small number of trees remaining after those in the walking trail and with animal damage were removed.

Height of black walnut saplings after the second herbicide treatment was greater with complete weed control (4.0 ft, $p = 0.0012$) than the other treatments with no differences among the other treatments. At age 6 and 7, walnut saplings with complete weed control had significantly better growth than with lesser amounts of weed control. After fourth herbicide application at age 7, sapling heights in strip (6.6 ft) were significantly greater than sapling heights in the no-spray (4.6 ft) and spot (4.3 ft) ($p = 0.02$ and 0.04, respectively). The strip and no-spray treatments had a similar effect on height growth.

The percentage of trees with visible herbicide damage (abnormal foliage) in the spray treatments ranged from 17 to 55 percent for white ash, 27 to 66 percent for white oak, and 11 to 33 percent for black walnut but differences among the herbicide treatments (spot, strip, and complete) were not significant.

Saplings with herbicide damage grew more slowly than those without damage in treated areas (fig. 2). At age 5, damaged saplings were 27, 58, and 64 percent shorter than those treated but not damaged for white ash, white oak, and black walnut, respectively. By age 7 damaged trees were still shorter than those treated but not damaged by 30 percent for white ash, 32 percent for white oak, and 51 percent for black walnut. Saplings without weed control were similar in height to saplings that showed herbicide damage at ages 5 to 7 for white ash and white oak. For black walnut herbicide damaged seedlings were shorter than seedlings with no weed control at ages 5 and 6 but not at age 7.

There was little evidence that application of glyphosate and simazine resulted in chronic toxicity leading to increased mortality even with white ash generally considered more sensitive to herbicides than oak or walnut. Except for the spot treatment on the oaks at age 7, there was no increase in mortality between treatments with and without use of herbicides. In contrast, saplings with herbicide damage had slower growth than undamaged saplings through age 7.

In summary, the area covered by herbicides to control tall fescue did affect sapling growth. The complete treatment afforded the best growth for black walnut and white ash saplings. Increased growth in response to increasing treated surface area was first observed after two applications for black walnut and three applications for white ash. Treatment effects for white oaks were inconclusive. When compared to no-spray, the spot treatment did not improve sapling height growth in any of the species. Complete weed control was somewhat more effective at improving tree growth than the strip treatment for both black walnut and white ash. Because of the potential soil erosion that can occur with complete weed control treatment, it cannot be unconditionally recommended.

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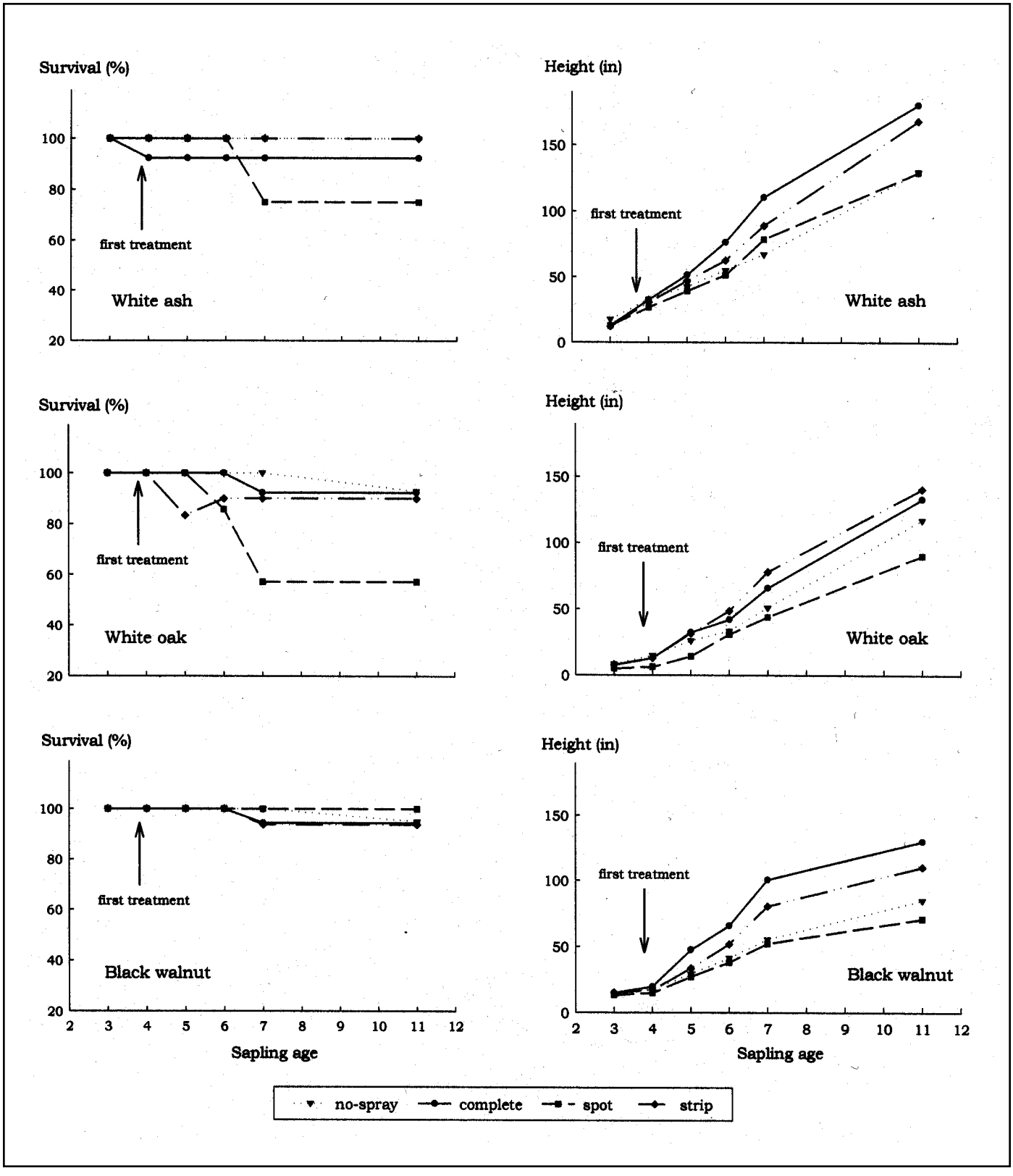

Figure 1.—*Survival percentages and height for white ash, white oak, and black walnut saplings following initiation at age 4 of four weed control treatments that affected percentage of surface area treated.*

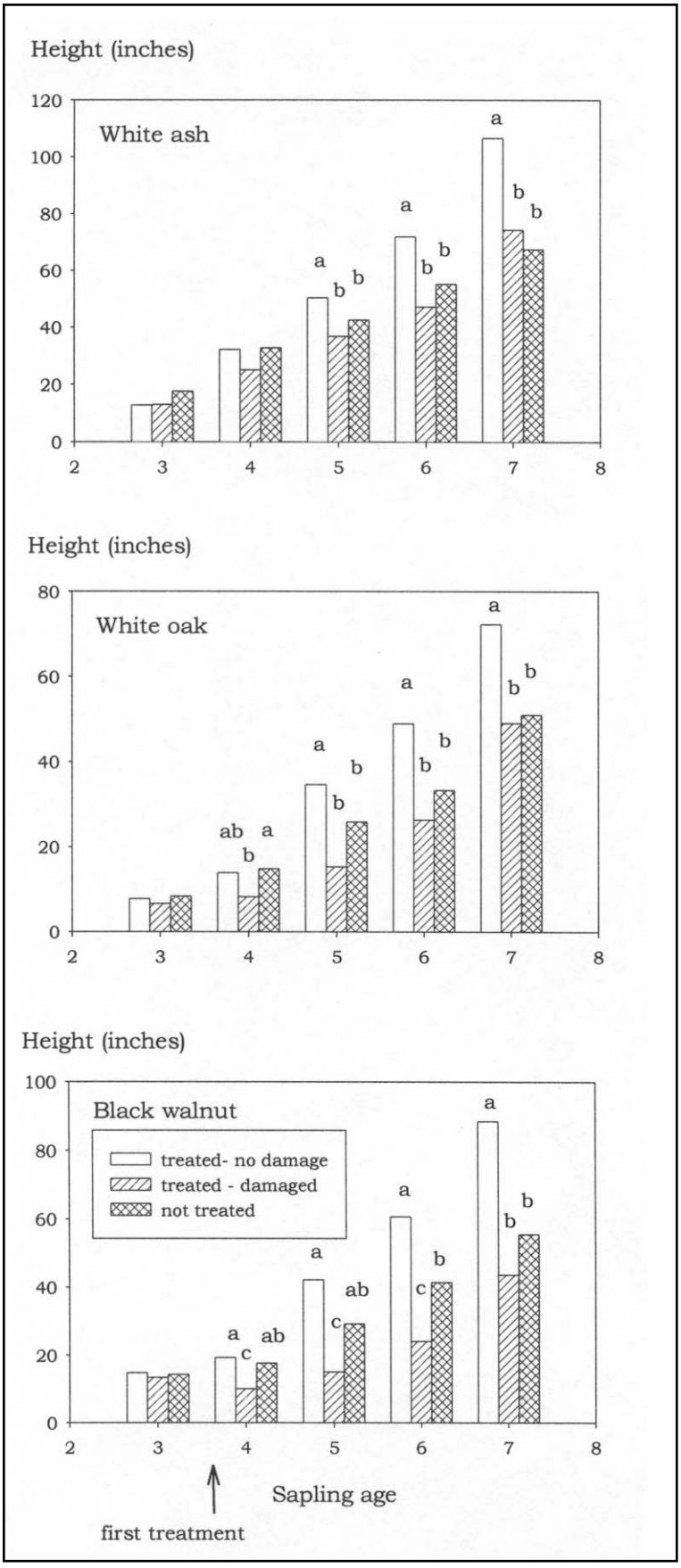

Figure 2.—*Height for white ash, white oak, and black walnut saplings with and without visible herbicide damage at age 5 compared to saplings without chemical weed control. Bars with the same letter are not significantly different at the p = 0.05 level.*