SURVIVAL AND GROWTH OF DIRECT-SEEDED AND NATURAL NORTHERN RED OAK AFTER CLEARCUTTING A MATURE RED PINE PLANTATION

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Abstract: Initiated in 1985, a study was designed to evaluate the effects of site preparation (rototilling) and logging slash on 5-year survival and growth of natural and direct-seeded northern red oak (*Quercus rubra* L.) after clearcutting a mature, 45-year-old red pine (*Pinus resinosa* Ait.) plantation in central Pennsylvania. The study area, approximately 2.2 ha in size, is flanked on the northeast and southeast by dense stands of Norway spruce (*Picea abies* (L.) Karst.) and on the southwest by 60-70 year-old mixed oak stands. Soils supporting the red pine plantation are mainly well-drained, moderately acid (pH 4.5-5.6) silty clay loams, derived from weathered shale and shaly limestone.

A 100 percent, before and after harvest inventory of all naturally occurring economically important tree seedlings, noncommercial shrubs and herbaceous species was conducted during September, 1984 and April, 1985 respectively. Following inventory, all natural (advanced) red oak seedlings beneath the red pine overstory were hand-sheered back to the groundline to facilitate later identification of direct-seeded red oak seedlings. An uncut "control" block was inventoried, but received no additional pre-harvest treatments.

Four duplicate site preparation treatments, each approximately .04 ha in size were established on the study area: (1) Rototill-no slash (2) Rototill-slash (3) No rototill-no slash and (4) No rototill-slash. In preparation for oak seeding, one-half of the treatments received a mechanical pre-harvest scarification of the forest floor and surface soil layers with a 4 h.p. gasoline engine rototiller between 8-foot spaced red pine tree rows. On the remaining blocks, "fresh" slash (tops and branches) 0.5 to 1.2 m thick, was left undisturbed on the forest floor after removal of the merchantable pine logs. Previously stratified red oak acorns, collected from five trees of the same seed source were planted on April 6, 1985. Acorns were sown in each treatment between consecutive red pine "stump" rows, 1.8 m apart. Within each row, acorns were spaced .45 m apart at a depth of 2.5 to 5.0 cm using a metal "V"-tipped planting pole, creating holes in the mineral soil. Two acorns were sown in each hole, covered by soil and surface litter, and tramped over by foot. Shoot emergence of the germinating seed first occurred in mid-May, 1985.

Variation in survival and growth of direct-seeded and naturally occurring northern red oak seedlings was evaluated after the first and fifth growing seasons. Chi-square analysis and pairwise comparisons were used to test significant differences among and between site preparation treatments. After the first growing season, survival of both direct-seeded and

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naturally occurring red oak seedlings with the rototill/slash and no rototill/slash treatments were significantly higher (P=0.05) than the rototill/no slash and no rototill/no slash treatments. However after five growing seasons, scarifying with a rototiller, in combination with intact logging slash, showed significantly greater total numbers of seedlings/ha than the remaining treatments. Mean 5-year height growth of acorns sown on slash-covered areas with or without rototilling were both significantly superior to seedlings grown on plots without logging slash (Fig. 1). Germination and early survival of direct-seeded acorns was most pronounced on rototilled blocks. Although the presence of slash also enhanced germination and survival, an added benefit of slash cover was to protect young red oak seedlings from browse damage.

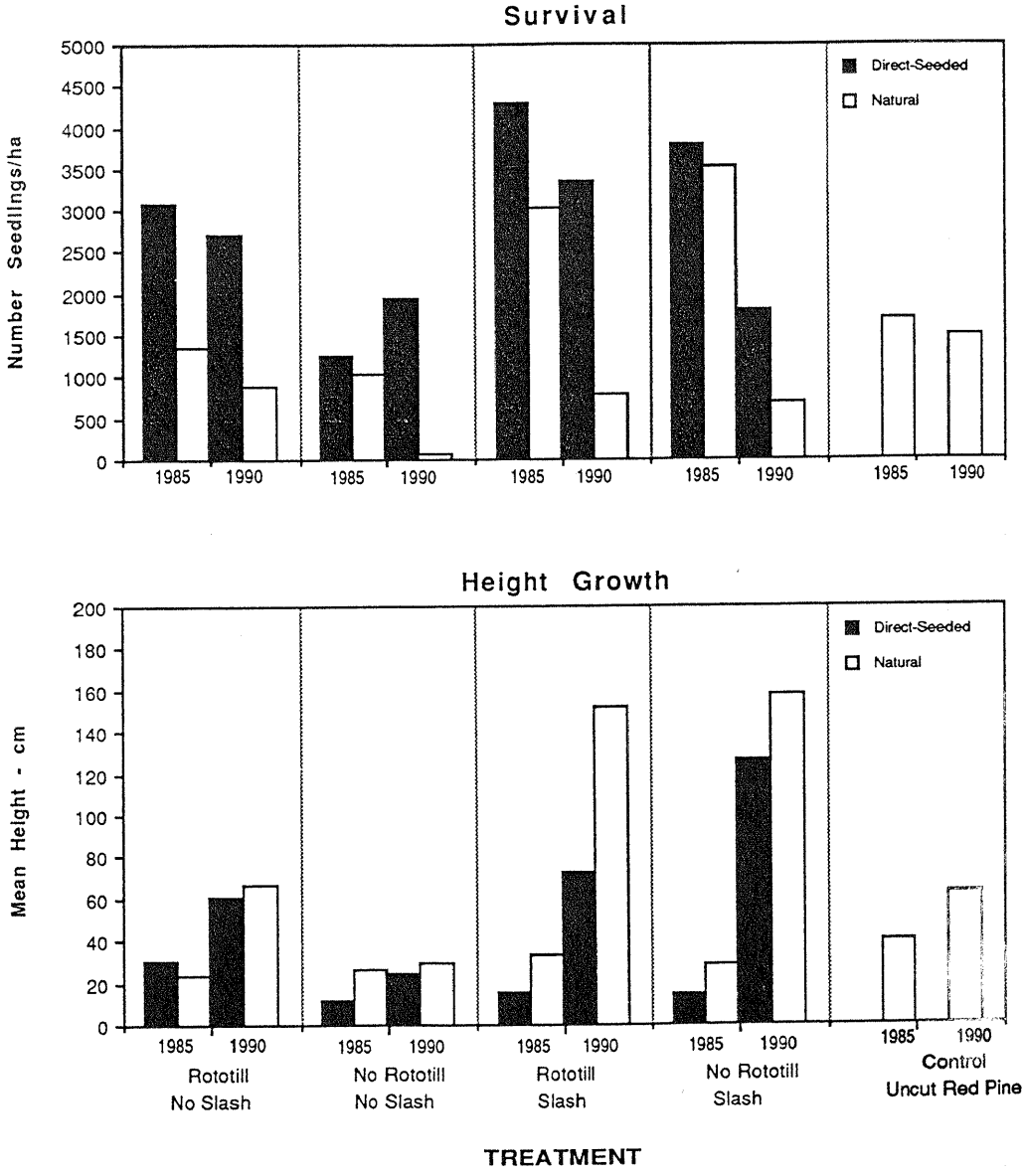

Figure 1. Effects of site preparation on northern red oak seedlings after clearcutting red pine.