

Weed Control for Better Black Walnut on Strip Mines¹

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Weed control substantially improved establishment and early growth of seeded black walnut on fescue-covered spoil banks. The use of herbicides was more effective than cultivation. Roundup applied for 2 years was the most effective overall.

The Eastern Interior Coal Province has great potential for black walnut plantations on surface-mined land, particularly where little or not grading was done (1). These soils are typically deep and well drained and aerated and often calcareous--factors associated with excellent walnut sites (7). Inconsistent early results from walnut plantings on mined lands held back interest in the use of walnut in forestation; however, the nature and extent of site preparation often adversely affected these results (3, 6).

Current reclamation standards require immediate establishment of a permanent vegetative cover for erosion control following reclamation. Tree seedlings must then be planted into and compete successfully with an often dense cover of grasses and/or legumes. Therefore, the potential for maximum survival and early growth of trees planted on mined sites is not achieved.

The importance of controlling competing vegetation in forestation has been well documented by Forest Service researchers and others (2, 4, 5). Competition for moisture, nutrients, and light and allelopathic interference by grasses and other established vegetation (9, 11) can severely reduce the potential survival and growth of planted tree seedlings. Competition from herbaceous vegetation may be especially detrimental to seedling establishment under present reclamation practices on surface-mined land. We initiated a study in May 1980 to evaluate the effects of chemical and mechanical weed control on the establishment and growth of seeded black walnut on surface-mined land.

Study Area and Methods

Our study area on Sahara Coal Company, Inc., property in Saline County, Ill. was mined in the 1960's. The predominant soil texture was clay loam with appreciable amounts of partially weathered rock. The pH ranged from neutral to medium acid with a few spots being very strongly acid. The tops of the spoil banks had been "struck-off" to a minimum width of 5 meters. Subsequent seeding and development of a mixture of grasses and legumes resulted in a dense vegetative cover primarily of tall fescue, orchard grass, and brome grass. Previous failures of hardwood plantings established by our research group had suggested

that the dense herbaceous vegetation was a limiting factor on this site.

Our experiment consisted of six treatments: (1) control-existing vegetation left intact, (2) hand cultivation-vegetation removed with a mattock at time of planting, (3) Roundup (1 yr)-one application following planting, (4) Roundup and Princep (1 yr)-one application following planting, (5) Roundup (2 yr)-one application after planting and a second the following spring, and (6) Roundup and Princep (2 yr)-one application after planting and a second the following spring.

Eight replicates of each of the six treatments were randomly located in rows within a 0.2-hectare study plot. Each replicate consisted of six planting spots at a 2.5- by 2.5-meter spacing. Two locally collected black walnut seeds were planted per spot using a mattock. Cultivation or herbicide treatments were applied to a 1.5-meters diameter area at each planting spot. The contact herbicide Roundup (41-percent glyphosate) and the residual preemergent herbicide Princep (80-percent simazine) were sprayed at the rates of 9.4 liters per hectare (1 gal/acre) and 5.6 kilograms per hectare (5 lb/acre), respectively, with 940 liters per hectare (100 gal/acre) water. Planting and first-year weed control treatments took place in May 1980. The Roundup (2 yr) and Roundup and Princep (2 yr) follow-up herbicide applications were made in April 1981. Care was taken to avoid spraying established seed-

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lings. Seedlings were thinned to one per spot in July 1981.

Initial establishment and growth data were collected in October 1980, 4 months after planting (8). In September 1981, after 15 months, seedling establishment, height, and diameter data were collected. The 1981 evaluation also included a visual estimate of the percentage of ground cover for the 1.5-meter-diameter area at each planting spot. One-way analysis of variance was performed on all data. Treatment means were compared with Duncan's multiple range test.

Results and Discussion

The establishment of seeded black walnut on the mined sites was significantly improved when cultivation or herbicides were used, with no apparent difference between the weed control treatments after 4 months (8). Hand cultivation of weeds and one application of Roundup or Roundup and Princep resulted in a three-fold increase in the number of live seedlings compared to the control treatment. Germination and survival of the untreated control walnuts were apparently inhibited by competition and/or allelopathic interference from the established vegetation present. Seedling establishment, generally poor in all treatments, may reflect the low seeding rate, late planting date, and an unusually droughty summer experienced in 1980.

Data summaries of degree of ground cover and black walnut seedling establishment and growth after 15 months of this site showed significant differences between treatment means for all the tested variables (table 1).

The number of established walnut seedlings changed markedly by the end of the second growing season. This change reflected the resprouting of seedlings that had died back before the first-season survival counts and seed germination in the second season after planting, both common for black walnut (10). Abundant rainfall in the spring and summer of 1981 contributed to these increases in establishment.

Greatest seedling establishment rates were obtained when Roundup alone was applied for either 1 or 2 years. Establishment was not as

good when Princep was included in the herbicide mix. The residual nature of this herbicide apparently had an inhibitory effect on black walnut germination and resprouting. A lower application rate for Princep may give adequate weed control and better establishment.

The number of seedlings in the hand cultivation treatment decreased by the second measurement. Removal of surrounding vegetation exposed seedlings and soils to winter and summer extremes. Dead plant residues, which were left as a mulch where herbicides were applied, may substantially benefit seedling survival. The control treatment still had the poorest walnut establishment, but had made a considerable increase over the first-year results. Adequate soil moisture in the second growing

Table 1.— *Establishment and growth of seeded black walnut and ground cover on strike-off spoils after two growing seasons*

Treatment	Seedling establishment	Stem height	Stem diameter	Ground cover
	%	Cm	Mm	%
Control	19a ¹	25.7a	5.3a	47a
Hand cultivation	23a	24.8a	7.4ab	18c
Roundup (1 yr)	46bc	30.6a	7.1a	23bc
Roundup and Princep (1 yr)	29ab	44.3b	10.3bc	24b
Round (2 yr)	50c	48.3b	12.5c	9d
Roundup and Princep (2 yr)	38abc	41.9b	12.7c	2e

¹Means with the same letter in the column are not significantly different at the 0.05 level according to Duncan's multiple range test.

season apparently lessened competition with fescue and other grasses on the site.

Height growth of black walnut seedlings on the reclaimed land was significantly greater with two successive Roundup applications or when Princep was included in the mix than it was in the control, hand cultivation, and Roundup (1 yr) treatments. The latter two treatments provided only short-term weed elimination and subsequent walnut growth was no greater than for the control seedlings. Similar results were obtained for stem diameter.

Ground cover of the herbaceous vegetation after two growing seasons corresponded closely to the number of seasons that weed control was administered. The best weed control was obtained when the Roundup and Princep mixture or Roundup was applied for 2 years.

Conclusions

Good early growth of seeded black walnut can be achieved on partially graded surface-mined lands.

Weed control is important in successful establishment and early growth on densely vegetated spoil banks. Chemical control of ground cover proved more effective than hand cultivation in promoting walnut seedling establishment.

Roundup applied once was ineffective in controlling ground cover or enhancing walnut growth. Application for 2 years resulted in good

weed control and walnut growth. Inclusion of the residual herbicide Princep with Roundup resulted in good weed control and walnut growth, but appeared to inhibit germination and establishment.

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