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EFFECT OF CALCIUM CYANAMIDE ON THE GROWTH OF PLANTED HARDWOODS

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ABSTRACT.—Calcium cyanamide, a nitrogenous fertilizer, was evaluated in new plantings of black walnut, white ash, and white oak seedlings and 2- and 3-year-old white oak and white ash trees, respectively. Only the growth of black walnut seedlings and white ash trees was improved by $CaCN_2$. Some weeds were controlled by $CaCN_2$, but the amount of weed control was not significantly influenced by the rate of $CaCN_2$. Only the survival of white oak seedlings was affected by $CaCN_2$.

KEY WORDS: weed control, fertilization, seedling survival, old field, mulch.

Black walnut (*Juglans nigra* L.), white ash (*Fraxinus americana* L.), and white oak (*Quercus alba* L.), like most hardwood species, have specific site requirements and demand intensive care to produce satisfactory growth. Their growth on abandoned agricultural land is often poor, possibly because of low fertility and weed competition for nutrients and moisture.

Fertilization of planted hardwood seedlings often intensifies weed competition, offsetting fertilizer benefits (von Althen 1976). If plantations of these three species are to be successful, weeds must be controlled at least the first 2 years. Both mechanical and chemical weed control methods have proven to be successful, but some can be expensive. Some chemicals used for weed control may also be toxic to hardwoods.

Calcium cyanamide ($CaCN_2$), an alkaline nitrogenous fertilizer containing about 22 percent nitrogen and 20 percent lime, may also act as a herbicide (Auchmoody and Wendel 1973). In the soil, $CaCN_2$ hydrolyzes principally to calcium hydroxide and urea with the formation of unstable intermediate compounds that are toxic to some seeds and plants.

In the spring of 1976, we began a study on abandoned fields in southern Illinois to evaluate the effects of $CaCN_2$ on weeds and on growth of black walnut, white ash, and white oak when applied immediately after planting and in established plantations.

METHODS

Two abandoned fields, one adjacent to Hutchins Creek and the other to Kinkaid Lake in southern Illinois, were selected as planting sites for black walnut, white ash, and white oak seedlings. A dense cover of broadleaf weeds was well established in both fields. Soils in the Hutchins Creek planting are Cape and Piopolis silty clay loams. These bottomland soils have slow permeability and high available moisture content. Soil in the Kinkaid planting is moderately well drained Ava silt loam. In addition, we located plantations of white ash and white oak that had received $CaCN_2$ at rates ranging from 0 to 1,120 kg/ha.

N. C. ARCHIVES

The fields were tilled and 150 seedlings of each species were planted at a 3.7 x 3.7 meter spacing. The following treatments were immediately applied in a completely randomized design: (1) control, (2) hoeing three times per season and (3) $CaCN_2$ at rates of 448 kg/ha, 672 kg/ha, 896 kg/ha, and 1,120 kg/ha. $CaCN_2$ and hoeing were applied over a 1.2 m diameter area and repeated before weed growth began (about March 15) in the second and third years. Hoeing was repeated again about mid-June each year of treatment.

For the trees, 150 3-year-old white ash and 150 2-year-old white oak were selected. Both plantings had been cultivated twice a year for the previous 2 years. Tall fescue (*Festuca arundinacea*) had invaded the white ash planting and broadleaf weeds had invaded the white oak planting. Spacing was similar to that of the seedlings. Soil in the white ash planting is Wakeland silt loam. This site is nearly level and has poor to moderate drainage. The white oak planting is on a moderately well drained, gently sloping site with Alford silt loam soil. The trees averaged 1.5 and 1.4 m tall and 2.1 and 1.3 cm in diameter at 15 cm above ground for white ash and white oak, respectively.

Instead of hoeing, we placed a 1.2 m square of black plastic around each tree and anchored it with soil. Otherwise, the treatments and time of application were the same as those used for the seedlings.

Height and diameter (15 cm above ground) for seedlings and trees were measured at the beginning of the study and at the end of each growing season for 4 years. Weed cover was estimated about June 1 and August 1 of each year. Treatment effects were examined by an analysis of variance and Scheffe technique (Snedecor and Cochran 1967).

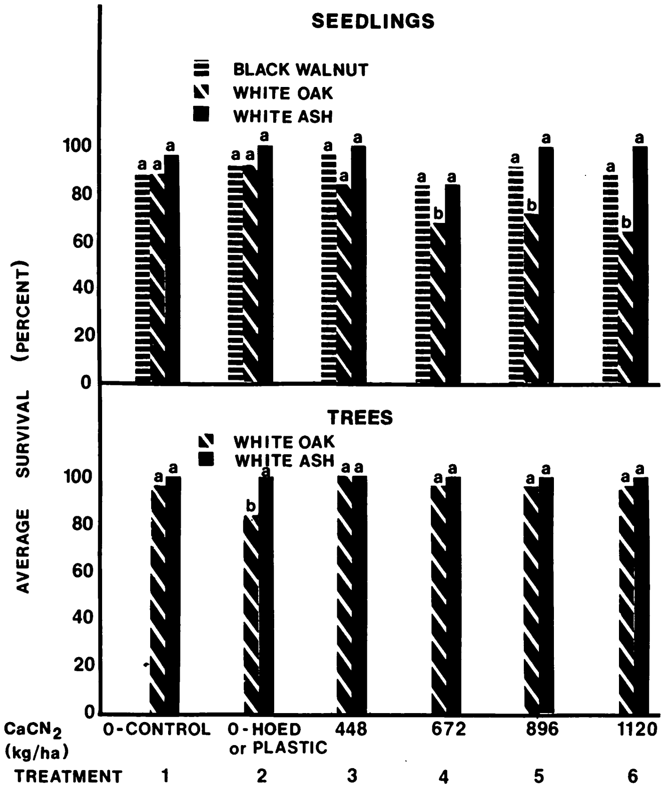

Figure 1.—*Average survival of seedlings and trees 4 years after initiation of $CaCN_2$ treatment. Species statistically analyzed separately; a is different from b for the same species at the 0.05 level.*

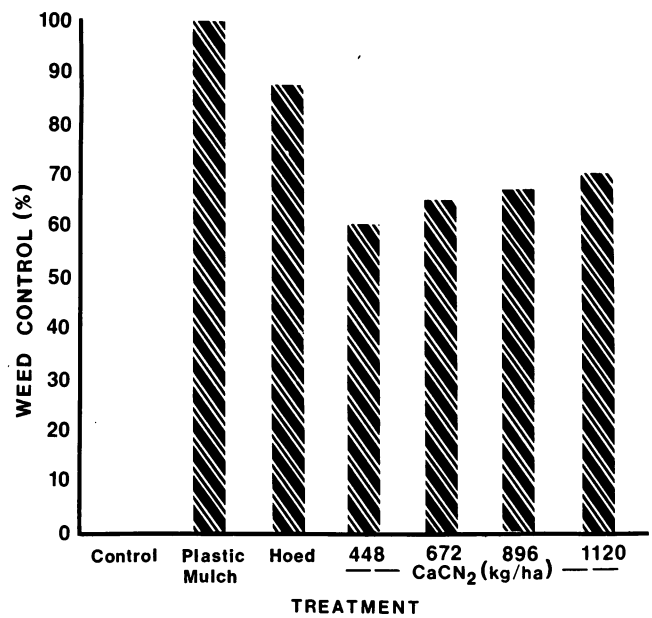

Figure 2.—*Average weed control provided by treatment in three hardwood species in June 1978.*

RESULTS AND DISCUSSION

Survival

Survival differences were small. Only white oak seedlings were adversely affected by $CaCN_2$, generally the higher the rate of application the lower the survival (fig. 1). Many of the surviving seedlings suffered repeated dieback. Survival of the white oak trees was not affected, suggesting white oak is more tolerant when older.

Weed Control

Both hoeing and black plastic mulch provided much better weed control than $CaCN_2$ at any rate (fig. 2). The most noticeably suppressed weeds on all sites were ragweed (*Ambrosia artemesulfolia* L.), yellow nutgrass (*Cyperus esculentus* L.), goldenrod (*Solidago ulmifolia* Muhl.), bitter dock (*Rumex obtusifolius* L.), and plantain (*Plantago* sp.). The amount of annual weeds present increased toward the end of the season in all plantings. The amount of fescue in the white ash tree planting was reduced by $CaCN_2$ at all rates during the second and third growing season.

Weeds that develop from underground parts were suppressed by $CaCN_2$ during the early part of the growing season, but by late July grew vigorously, perhaps in response to reduced competition and additional nutrients. These species included bermuda grass (*Cynodon dactylon* (L.) Pers.), dewberry (*Rubus* sp.), ground cherry (*Physalis heterophylla* Ness), trumpet creeper (*Campsis radicans* (L.) Pers.), and wild potato vine (*Ipomoea pandurate* L.).

Growth

Hoeing and plastic mulching generally produced the greatest height growth, except for black walnut in the Kinkaid planting and white oak trees. We suspect that plastic caused a heat buildup in the soil that retarded white oak growth, because there were no visible symptons of stress or poor nutrition. $CaCN_2$ did not increase diameter growth except for white oak seedlings at the 448 kg/ha rate (tables 1 and 2).

Walnut grew faster at Hutchins Creek than at Kinkaid, probably because of better soil fertility and moisture conditions. However, $CaCN_2$ at the two highest rates did increase the height growth of walnut at Kinkaid significantly over the control. The combination of weed control and nutrients supplied by $CaCN_2$ seemed to be more beneficial in the Kinkaid planting than at Hutchins Creek, where only the hoed treatment was significantly different from other treatments.

The poor overall growth of white oak seedlings was probably due to the stunting effect of $CaCN_2$ on many of the surviving seedlings (table 1). Further, the height growth of white oak trees was not significantly affected by $CaCN_2$.

Height growth of white ash seedlings treated with $CaCN_2$ was on the average no better than the control, but the higher rates of $CaCN_2$ significantly increased height growth of white ash trees over the control (table 2). $CaCN_2$ treated trees had greener foliage than other trees, suggesting better nutrition.

No attempt was made to separate the contributions of fertilizer and weed control to height growth. But

Table 1.—*Average height and diameter of 4-year-old black walnut (2 locations), white ash, and white oak seedling treated with $CaCN_2$ for 3 years after planting*[1]

	WALNUT HUTCHINS CREEK		WHITE OAK HUTCHINS CREEK	
Treatment	**Height (m)**	**Diameter (cm)**	**Height (m)**	**Diameter (cm)**
Control	0.96a	1.46a	0.68a	0.58a
Hoed	1.35b	2.73b	1.00a	1.39b
448 kg/ha	1.20a	2.04a	0.57a	1.18b
672 kg/ha	1.19a	2.11a	0.41a	0.54a
896 kg/ha	1.26a	2.11a	0.53a	0.74a
1,120 kg/ha	1.19a	2.10a	0.50a	0.66a
	WALNUT KINKAID		**WHITE ASH HUTCHINS CREEK**	
Control	0.87a	1.14a	1.45a	2.03a
Hoed	1.16ab	1.74a	1.82a	2.83a
448 kg/ha	1.04ab	1.34a	1.55a	2.24a
672 kg/ha	1.09ab	1.54a	1.42a	2.13a
896 kg/ha	1.41b	1.91a	1.55a	2.39a
1,120 kg/ha	1.36b	1.99a	1.49a	2.24a

[1]Values for each species in the same column followed by the same letter are not significantly different (0.05 level) as determined by the Scheffe technique.

Table 2.—*Average height and diameter of 6-year-old white oak and 7-year-old white ash trees treated with $CaCN_2$ at ages 2 thru 4 and 3 thru 5*[1]

	WHITE OAK	
Treatment	**Height (m)**	**Diameter (cm)**
Control	2.49a	3.89a
Plastic	2.39a	4.11a
448 kg/ha	2.49a	3.81a
672 kg/ha	2.62a	4.14a
896 kg/ha	2.62a	4.35a
1,120 kg/ha	2.66a	4.47a
	WHITE ASH	
Control	3.16a	5.94a
Plastic	4.06b	7.26a
448 kg/ha	3.42a	6.24a
672 kg/ha	3.59a	6.77a
896 kg/ha	3.81ab	7.32a
1,120 kg/ha	3.93ab	7.29a

[1]Values for each species in the same column followed by the same letter are not significantly different (0.05 level) as determined by the Scheffe technique.

because the higher rates of $CaCN_2$ were usually associated with better growth and there was not much difference in weed control, we concluded that height growth above that reported for the 448 kg/ha rate may be attributed to $CaCN_2$ as a fertilizer.

Summary

Black walnut seedlings and white ash trees grew faster in response to broadcast $CaCN_2$ treatments than white ash and white oak seedlings or white oak trees. The faster height growth was usually associated with the higher rates of $CaCN_2$ application (886 and 1,120 kg/ha). Both growth and survival of white oak seedlings were reduced when treated with $CaCN_2$. Results also suggest that white ash seedlings may be sensitive to $CaCN_2$.

Both the amount of weed control and weed growth varied according to site conditions. Differences in weed control between the lowest and highest rates of $CaCN_2$ were insignificant. Residual weed control was equal to about half the weed control of the previous year.

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