CORRECTIVE PRUNING OF BLACK WALNUT SEEDLINGS INJURED BY A LATE SPRING FROST

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ABSTRACT

Black walnut (*Juglans nigra* L.) seedlings were planted in the spring of 1969 in a former field near Thedford in Middlesex County, Ontario. In the spring of 1973, following severe injury from a frost that occurred in June, 1972, the seedlings were pruned according to the following methods to improve their form: (1) no treatment (control), (2) removal of individual branches, and (3) cutting of the total stem 2.5 cm above the ground (coppicing). Four years after pruning, survival in all treatments was 98% or better. Mean heights after treatments (1), (2), and (3) were 383, 372, and 342 cm, respectively. Coppicing was the most successful treatment in improving tree form with 48.1% of the trees developing excellent or good stem forms. Cutting of individual branches produced excellent or good forms in 31.3% of the trees, while without treatment only 11.3% of the trees had good stem form. While pruning of black walnut seedlings during the first years after planting is recommended for all plantations, it is an absolute necessity for trees which have been injured by a late spring frost.

RÉSUMÉ

On a planté au printemps 1969 des semis de Noyer noir (*Juglans nigra* L.) dans un champ désaffecté près de Thedford dans le comté de Middlesex, Ontario. Au printemps 1973, suite à de sérieux dégâts causés par le gel en juin 1972, les semis furent élagués en vue d'améliorer leur apparence selon les méthodes suivantes: (1) aucun traitement (arbres témoins), (2) enlèvement de branches, (3) coupe de la tige entière, à 2.5 cm au-dessus du sol (recépage). Quatre ans après l'élagage, la survie suite aux trois traitements s'élevait à 98% ou plus. Les hauteurs moyennes après les traitements (1), (2) et (3) faisaient 383, 372 et 342 cm respectivement. Le recépage s'avéra le plus efficace des traitements pour améliorer l'apparence des arbres, 48.1% d'entre eux montrant une forme excellente ou bonne. L'élagage des branches individuelles produisit des tiges d'apparence excellente ou bonne dans 31.3% des cas, alors que sans traitement, les arbres présentaient des tiges d'apparence excellente ou bonne dans une proportion de 11.3% seulement. Alors qu'on recommande l'élage des semis de Noyer noir pendant les premières années suivant leur mise en terre dans toutes les plantations, il s'avère d'une nécessité absolue chez les arbres ayant subi les blessures d'une gelée printanière tardive.

Frontispiece. Removal of the lower branches and any forks within the crown will greatly improve the value of young black walnut trees.

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Cover photo: Tree without leader is cut near the ground to allow a new shoot to grow from the stump.

INTRODUCTION

In southern Ontario, black walnut (*Juglans nigra* L.) grows at the northern boundary of its natural range. The most limiting factor to a northern extension of the range appears to be the shortness of the growing season. However, even within the natural range of distribution late spring frosts often cause serious losses in growth and poor stem form. During the night of 10/11 June, 1972 the temperature in many parts of southern Ontario dropped to as low as -3°C (26°F). The result was widespread damage to agricultural crops, especially tobacco crops and orchards, and to young black walnut and white ash (*Fraxinus americana* L.) plantations.

In a 3-year-old black walnut plantation near Thedford, Middlesex County, the frost killed not only the current year's growth but also the shoots grown in the previous year. When it became apparent that tree form would be extremely poor owing to the dead leaders and extensive sprouting from epicormic buds along the stem and branches, a pruning study was initiated in the spring of 1973 to determine the effects of different pruning treatments on the growth and form of the black walnut seedlings. The 4-year results of this study are reported here.

METHOD

The experimental plantation was located in a former field near Thedford, Middlesex County, Ontario. The soil was a deep, well drained, fine sandy loam of the Ontario Soil Survey Fox Series. The whole field was plowed and disked in April, 1969. Shortly thereafter one-year-old black walnut seedlings obtained from the St. Williams nursery of the Ontario Ministry of Natural Resources were planted by spade at a spacing of 1.5 x 1.5 m (5 x 5 ft).

The experiment was laid out in a randomized block arrangement with 12 trees in each of 27 treatments. Each treatment was replicated three times for a total of 972 trees.

Within one week after planting, ammonium nitrate, triple superphosphate, and potassium sulphate were broadcast in 27 combinations over the surface of individual plots. Simazine at 4.5 kg/ha (4 lb/acre) of active ingredient was broadcast over the total plantation area shortly after planting and in the spring of 1970, 1971, 1973, and 1974.

Owing to the extensive damage caused by the frost of 10/11 June, 1972 the fertilization study had to be terminated. In its place, a pruning study using the same trees was initiated in March, 1973 to determine the effects of different pruning methods on the survival, growth, and form development of the frost-damaged trees. To avoid confounding the results of the pruning study by the original fertilization treatments, the three pruning treatments were applied to four trees each within each fertilization plot of 12 trees.

Pruning treatments consisted of: (1) no treatment (control), (2) removal of individual branches, and (3) cutting of the stem to a 2.5 cm (1 in.) stump (coppicing).

In June, 1973 all stump sprouts in treatment (3) were thinned to a single sprout. In the spring of 1974 and 1975 trees in treatments (2) and (3) received additional light prunings to remove individual branches or one side of a forked leader.

The height of all trees was measured at the start of the study and the height and diameter at breast height were recorded at the end of the fourth year from pruning. At the same time the form of all trees was appraised for stem straightness, dominance of leader, number and size of branches, and freedom from defects or scars. All trees were classified and recorded in one of the following five quality classes and the data were tested for significance by simultaneous statistical inference (Miller 1966).

1. Excellent. A straight tree with a prominent leader and a well shaped crown. Very light or no pruning required (Fig. 1).

2. Good. A straight tree with either a forked leader or an asymmetrical crown. Light pruning required to improve tree form sufficiently to produce a log of veneer quality (Fig. 2).

3. Fair. A tree with a weak leader, an asymmetrical crown or large, coarse branches. Extensive pruning required to correct defects to produce a log of good sawlog quality (Fig. 3).

4. Poor. A tree with either no leader, large, coarse branches, a serious crook, or a large scar. Pruning will probably fail to correct defects and produce a tree of sawlog quality (Fig. 4).

5. Hopeless. A tree with no leader, many large, coarse branches, large scars, or low vigor. Not worth pruning and in all likelihood never producing any merchantable material (Fig. 5).

RESULTS

Survival in all treatments was 98% or better (Table 1). Mean height of the control trees and of those with individual branches pruned was nearly equal after 4 years while the height of the coppiced trees was 41 and 30 cm (1.3 and 1.0 ft) less, respectively, than that of the control and of the individually pruned trees. However, net

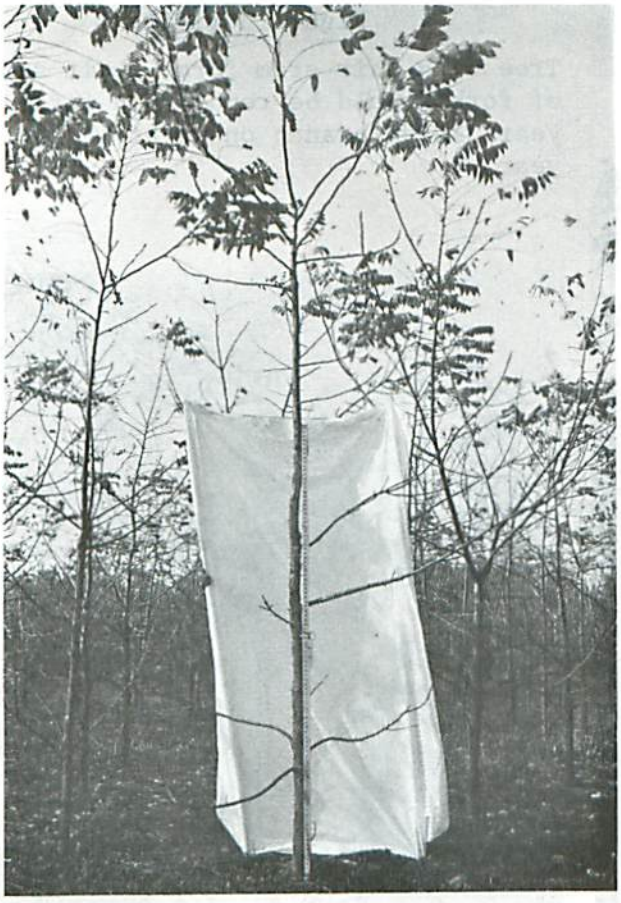

Figure 1 (left)

Tree with excellent stem form. Three small branches on lower stem should be removed.

Figure 2 (right)

Tree with good stem form. Large branch on right side of crown should be removed.

Figure 3 (left)

Tree with fair stem form. Left side of fork should be removed in first year, large branch on right in second year.

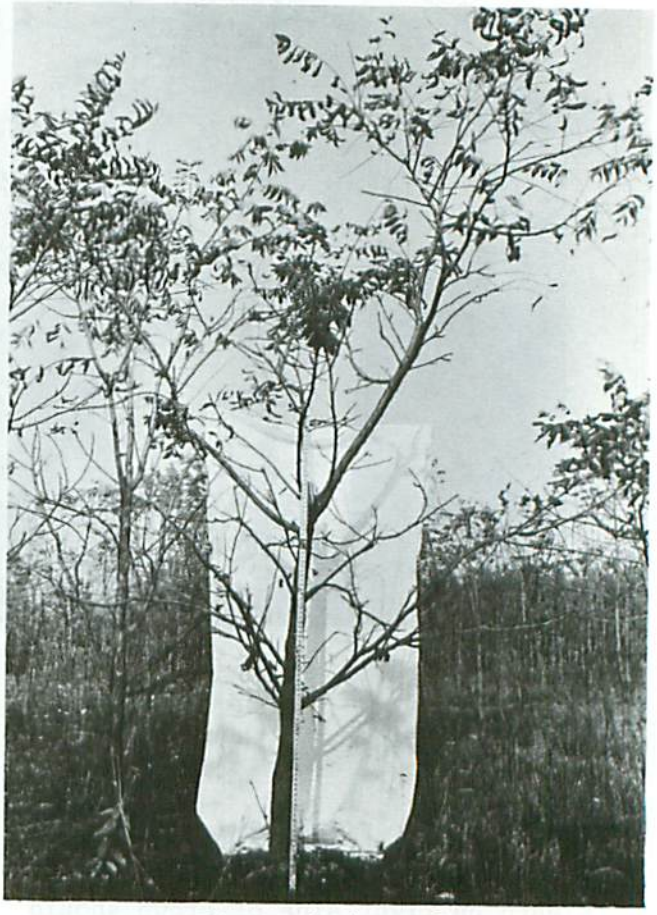

Figure 4 (above)

Tree with poor stem form. Branches on the left side of fork should be removed, or stem should be cut back to ground.

Figure 5 (left)

Tree with hopeless stem form. Stem should be cut back to ground.

Table 1. 1976 survival, height and DBH of black walnut seedlings planted in 1969 and pruned in 1973. (Each value represents the mean of 230 trees.)

Treatment	Survival (%)	Height		Four-year net height increment (cm)	DBH (cm)
		Shortly after treatment (cm)	Four years after treatment (cm)		
Control	99	129	383	254	4.5
Pruning of individual branches	99	120	372	252	4.3
Stem cut to a 2.5 cm stump	98	2	342	340	3.6

height increment of the coppiced trees over the 4-year period was nearly 90 cm (3 ft) higher than that of the control and of individually pruned trees.

The diameter at breast height of the control trees and of those with the individual branches pruned was nearly equal, while that of the coppiced trees was 0.9 and 0.7 cm (0.35 and 0.28 in.) less, respectively, than that of the control and of individually pruned trees.

Coppicing (treatment 3) resulted in 41.8% of the trees developing excellent or good form, while only 20.4% of the trees were classed as either poor or hopeless (Table 2). The pruning of individual branches (treatment 2) was not quite as successful, with 31.3% of the trees developing excellent or good form and 31.3% of the trees either poor or hopeless form. None of the control trees had an excellent stem form, and only 11.3% could be classified as good, while 54.2% were of either poor or hopeless form.

DISCUSSION

The frost of 10/11 June was one of the most severe frosts in recent years occurring at such a late date. However, late spring frosts are by no means rare or isolated occurrences in southern Ontario. A check of the weather data for the Chatham, St. Thomas, and Guelph areas revealed that during the 15 years from 1961 to 1975 the temperature dropped to below 0°C after the middle of May on three nights in Chatham, nine nights in St. Thomas and ten nights in Guelph. Although no records are available for most walnut plantations or woodlots where black walnut has regenerated naturally, it is highly probable that the poor form of many trees is the direct result of injury from late spring frosts.

Table 2. Effect of 1973 pruning after 1972 frost damage of black walnut seedlings planted in 1969. (230 trees per treatment)

Treatment	Tree form in 1976				
	Excellent	Good	Fair (%)	Poor	Hopeless
Control	0	11.3	34.5	49.8	4.4
Individual branches cut	0.4	30.9[a]	37.4	30.4[a]	0.9
Total stem cut to a 2.5 cm stump	3.1	38.7[a]	37.8	18.6[a]	1.8

[a] Significantly different from control at the p .05 level.

Clark (1966) stated that the form of black walnut trees could be improved greatly by pruning. He recommended that, in intensively managed plantations, pruning should begin during the first growing season after planting and for best results should be carried out early in the growing season. In Ontario this means that pruning should be done before the middle of June. For trees with slight imperfections Krajicek and Bey (1969) recommended the pruning of individual branches to balance the crown and favor a single strong leader, while badly misshapen trees should be cut off near the ground line. More recently Bey (1972) has recommended "tape pruning" to train the leader to grow in the desired direction. This technique requires that the trees be pruned in the spring just before growth starts. Timing is important because the tape deteriorates in 2 to 3 months and must be in place during the rapid growth period. Two or more stems of a tree with multiple leaders should be drawn together to straighten the selected leader. The area where the stems cross is wrapped three to six times with 2.5 cm (1 in.) masking tape. Then the tips of all but the selected leader are clipped above the tape.

One of the most difficult problems facing the person who does the pruning is to decide how many branches or what percentage of the crown might be removed without loss of height and diameter growth, or without the development of epicormic branches. Clark and Seidel (1961) found that in older plantations with trees of 8 to 13 cm (3 to 5 in.) in diameter at breast height, up to 50% of the live crown could be removed at one time without reducing diameter or height growth. The limiting factor to the intensity of pruning appears to be the development of epicormic branches. Burke and Williams (1973) recommended that, as a rule of thumb, at least half of the total tree height should be in live crown, because the removal of too many branches from young trees could concentrate too much growth on the terminal shoot and cause the leader to bend under its own weight.

In the plantation described in this report approximately half of the coppiced trees grew more than one stump sprout, of which all but the largest were removed in June. Eighteen percent of the stump sprouts grew to a height of 150 cm (5 ft) or more during the first year. This rapid growth was not wholly desirable, however, because several of the largest sprouts broke off at the stump during a heavy rainstorm when the sprouts were unable to support the heavy foliage. It is probable that even more sprouts would have broken off had the trees not been planted at the rather narrow spacing of 1.5 x 1.5 m (5 x 5 ft) and had the larger, uncut trees not protected the sprouts from the full force of the storm.

Four years after cutting, the coppiced trees were only 41 cm (1.3 ft) shorter than the control trees. Since the pruning treatments were delayed for one year, from June, 1972 to March, 1973, because the full extent of the frost damage was not immediately recognized, it is probable that the height of the coppiced trees would have equalled that of the control trees had the trees been coppiced immediately after the frost. However, despite their smaller size coppicing was the most successful treatment since it produced the largest number of well shaped trees.

Little is known at present about the effect of tree age on sprouting ability following coppicing. Clark (1966) stated that he was successful in coppicing trees 3 to 4 years old, while the trees in the plantation described here were 5 years old from seed at time of coppicing. In a thinning experiment I found that trees up to 10 years old from seed sprouted vigorously, although I did not assess the quality of the sprouts. It therefore appears safe to state that trees up to 5 years old from seed may be coppiced successfully with a high probability that trees up to 10 years old may respond favorably.

Cutting the total stem is also simple and generally less time-consuming than pruning individual branches. It may also be done by inexperienced labor, while the correct removal of forked leaders and individual branches requires training and good judgment.

One disadvantage of the coppicing treatment is the requirement for extended weed control because the stump sprouts cannot compete as well with grasses and forbs as can trees that are 1 to 2 m (3.3 to 6.6 ft) high. Effective weed control is also necessary to protect the succulent stump sprouts from girdling by mice because the sprouts are much more palatable to mice than are the stems of older trees.

CONCLUSIONS

The results of this and similar studies in the United States (Clark and Seidel 1961, Clark 1966, Krajicek and Bey 1969, Bey 1972, Burke and Williams 1973) leave little doubt that the pruning of young

black walnut trees is not only desirable but essential for the production of high-quality veneer and sawlogs. While annual pruning of walnut trees is desirable, the pruning of walnut trees damaged by late frosts is essential to the production of well formed trees. The choice of pruning method will depend on the severity of the deformation, the availability of trained labor, and the aims of management. However, trees with minor defects in form can generally be improved sufficiently by the removal of a few individual branches or one side of a forked leader, while badly misshapen trees must be cut off just above the ground and allowed to grow a strong new shoot.

Every forest manager and plantation owner should also realize that the largest expense has already been incurred in the establishment of the plantation. To save money on pruning or weed control during the early years after planting will not only endanger the success of the planting but will most likely result in long-range financial loss owing to the production of second-grade sawlogs rather than high-value veneer logs.

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