NATURAL IMPROVEMENT IN BLACK WALNUT STEM FORM

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ABSTRACT

Corrective pruning and coppicing can improve form but are time consuming, and if over-done can create additional problems.

One promising alternative is to do nothing. Thirty-two young trees, selected for type and severity of crooks in the first 2.5 m, were measured and photographed from a fixed point annually for 3 years. Most improved considerably in stem straightness.

The average deviation of the stems from the vertical was originally 30 cm, but only 13 cm after three growing seasons. Most trees showed a strong central stem tendency. Questions of wood quality and recognition of trees that will straighten naturally need to be resolved.

Log quality in black walnut (Juglans nigra L.) depends on straightness and freedom from branches and scars. The lower bole or first log has the greatest dollar value, so cultural techniques to improve form generally are applied to young trees as the stem takes shape. Although corrective pruning, coppicing, and staking have all been used successfully to correct crooked and forked trees, there have been some problems with these cultural methods that we can't ignore.

Overzealous pruning in some plantations has resulted in excessive terminal growth followed by breakage. Reduction in leaf area during the establishment phase has likely reduced total growth. In addition, early cultural operations are time consuming and costly. One alternative to early culture is to do nothing. We, therefore, have been observing natural changes in young walnut stem form to see if we could eliminate early care and still realize the ultimate goal of straight trees.

PROCEDURE

Thirty-two trees 5 to 7 years old (end of 1974) were selected on a variety of sites in southern Illinois. Numerous types of curvature, crook, and multiple forking problems were included in the sample. No cultural treatments were applied during the study period. The trees were at least 2.5 m apart and adjacent crowns were not touching. Each tree was photographed from a fixed point at right angles to the maximum lean or crook, and the deviation from a vertical pole centered at the base of the tree was recorded for the leader appearing most likely to become the central stem (Figure 1). The height at which the deviation measurement was made was different for different trees, but was constant for a given tree from year to year. Photographs and measurements were repeated during the dormant season each year.

After three growing seasons the measured deviations from the vertical were analyzed by regression using original deviation, original diameter, and diameter growth during the study period as independent variables. The principal means of assessing change was visual comparison of the repeat photographs and silhouettes made by projecting the photographic negatives through an enlarger.

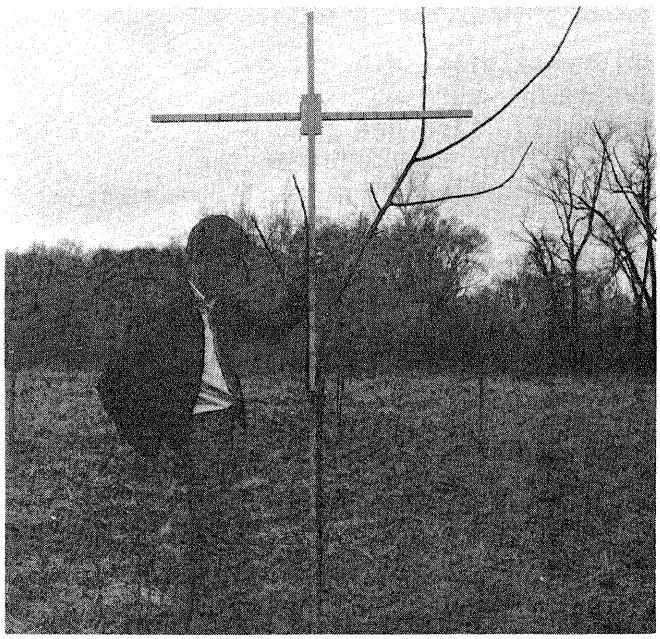

Figure 1.--Use of vertically held pole for measurement and for photographic scale.

RESULTS

At the time of the first measurement, the potential central stems were, on the average, 30 cm from vertical (Table 1). After three growing seasons, the average deviation was only 13 cm, an improvement of 60 percent. Of the 32 trees, 4 were over 80 percent closer to a vertical position, 9 were 60 to 80 percent closer, 12 between 40 and 60 percent, and 6 between 20 and 40 percent. Only one tree was less than 20 percent improved.

The three independent variables--original d.b.h., d.b.h. growth, and absolute amount of deviation--were not strongly correlated with the percent improvement. Each had simple correlation coefficients of less than 0.25, and together they accounted for only 45 percent of the variation in percent movement toward a vertical position.

Visual comparisons show many of the features of the improvement process. In the following Figures (a-j) the original silhouettes are on the left and those after three growing seasons are on the right.

DISCUSSION AND CONCLUSIONS

It is not surprising that stem straightening, as quantified by change in deviation from the vertical at a single height, was not strongly correlated with tree size, growth, or original deviation. The silhouettes show that stem straightening is a complex process involving balancing of the crown for the entire tree. Stem movement, however, was the primary reason for improved form in these small trees. For larger trees, differential radial growth may become a more important factor in natural straightening (Schlesinger 1972).

Although many of these trees were crooked and unbalanced, after 3 years they tended to form a strong central stem and more balanced crowns. Even trees considered as "hopeless" now show promise for making quality logs in the future. It is easy to imagine that in competition for survival in natural stands, the tendency to form a central stem is a desirable characteristic.

Form correction techniques will continue to have a place in black walnut culture but with less emphasis than previously noted (Clark 1966, Bey 1976, Beineke 1977). Pruning will be needed most where original spacing is wide and most or all of the trees are needed for the final crop. At normal or close spacing where more than half of the trees will be removed in a precommercial thinning, pruning, coppicing, or staking may not be necessary. Selective removal of the slow growing or poorly formed trees, in conjunction with natural straightening, would be a wise alternative to corrective measures.

One reason for minimizing or avoiding pruning on young trees is the loss of leaf area. To a certain extent, pruning is a dwarfing practice (McDaniels 1973). Especially on small trees, removal of one or two branches can greatly reduce the size of the crown and will likely reduce growth. As the trees get larger, there is less concern that lower branch pruning will reduce growth. Funk (In prep.) reduced the live crown of saplings to 60 percent without decreasing bole diameter growth. Clark and Seidel (1961) found no reduction in bole growth following removal of the lower 50 percent of the live crown of pole-size trees.

After 3 years, most of the originally poorly formed trees have developed into promising, or actual, straight, single-stemmed trees. This study shows a surprising degree of apical control (sensu Brown et al. 1967) in young black walnut, and thus many form problems will correct themselves, given time.

Straightening is still continuing in these trees, but quality of the wood produced during the straightening period still needs to be assessed. And which trees will improve naturally and which may require pruning, coppicing, or staking needs to be defined. In the meantime, we need to remember that "as the twig is bent, the tree is not necessarily inclined".

Table 1.--Study tree d.b.h. growth and deviations from vertical

Item	Average	Range
	cm	cm
D.b.h. in 1974	2.5	1.3 to 4.5
D.b.h. in 1977	5.2	2.5 to 7.4
D.b.h. growth	2.7	1.1 to 5.6
Deviation from vertical 1974	30	8 to 66
Deviation from vertical 1977	13	1 to 32
Change in deviation	17	-3 to 43

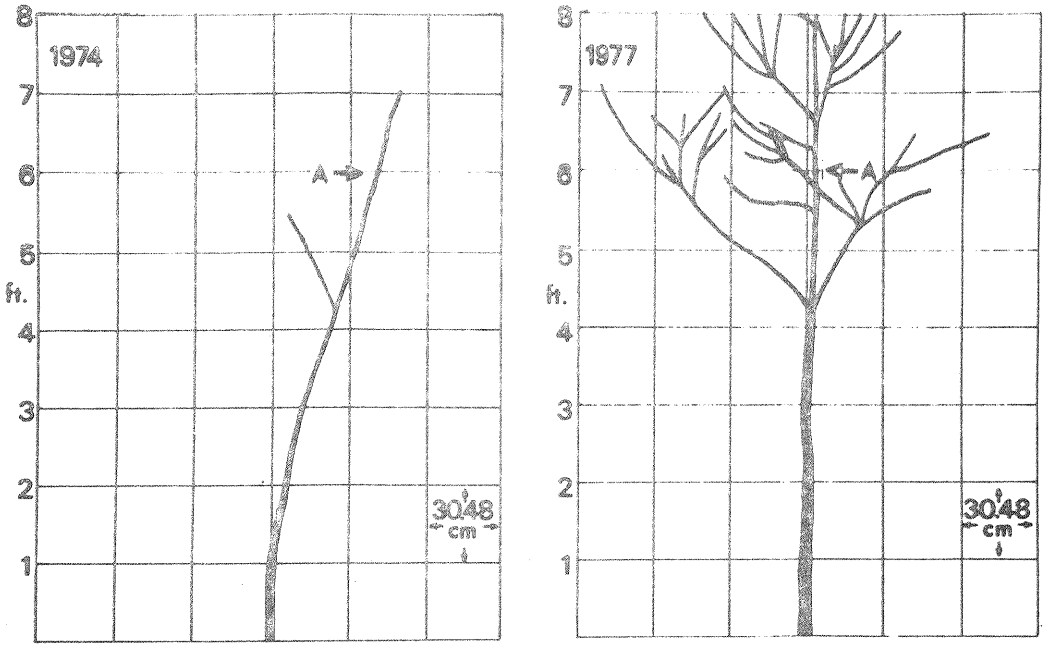

Figure a.--This tree is now only 4 cm from the vertical at 6 ft (1.8 m), having moved 38 cm in 3 years (A). The original branch at 4.3 ft (1.3 m), which might have been considered a potential competitor in 1974, has developed into a supporting lateral only.

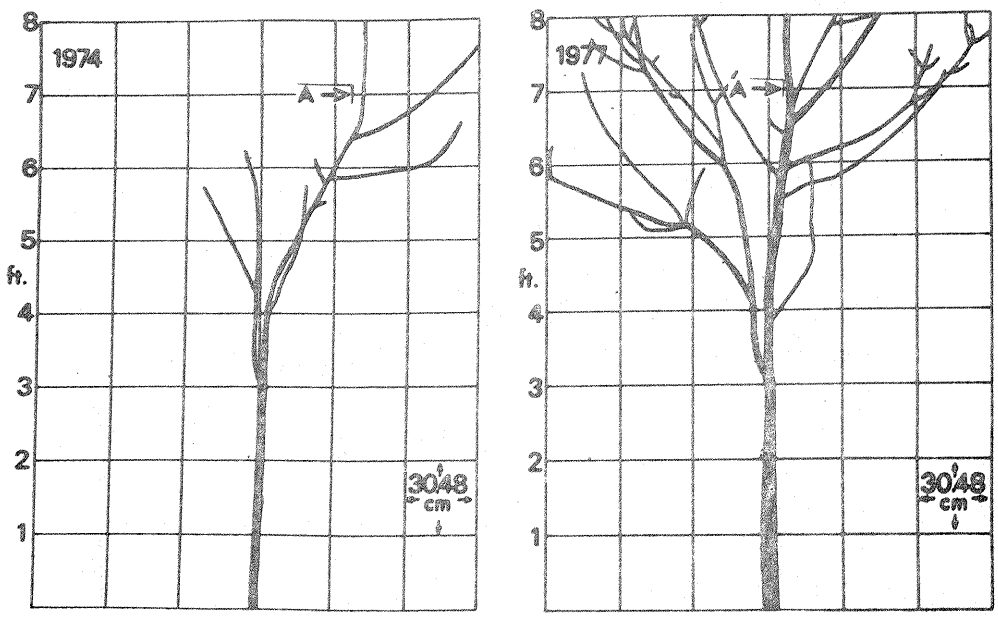

Figure b.--At 7 ft (2.1 m) above ground (A), the main stem has moved from 44 cm away from vertical to within 10 cm. D.b.h. growth has averaged 1 cm per year, slightly above average for the study trees. This tree appears well on its way toward a straight, single stem.

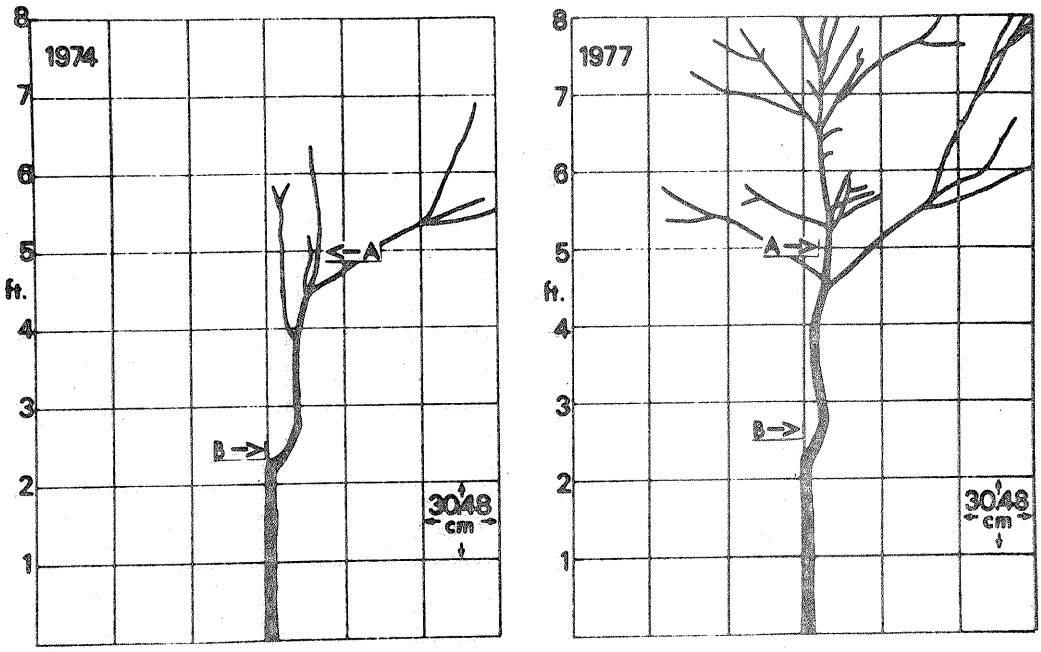

Figure c.--There is still considerable crook in the stem of this tree, though stem movement has reduced the deviation from vertical at 5 ft (1.5 m) (A) by 60 percent. Some stem movement has occurred at 2.5 ft (0.8 m) (B), and differential radial growth may continue the straightening process. Note that the large lateral at 4.6 ft (1.4 m) did not develop into a competitor for terminal dominance.

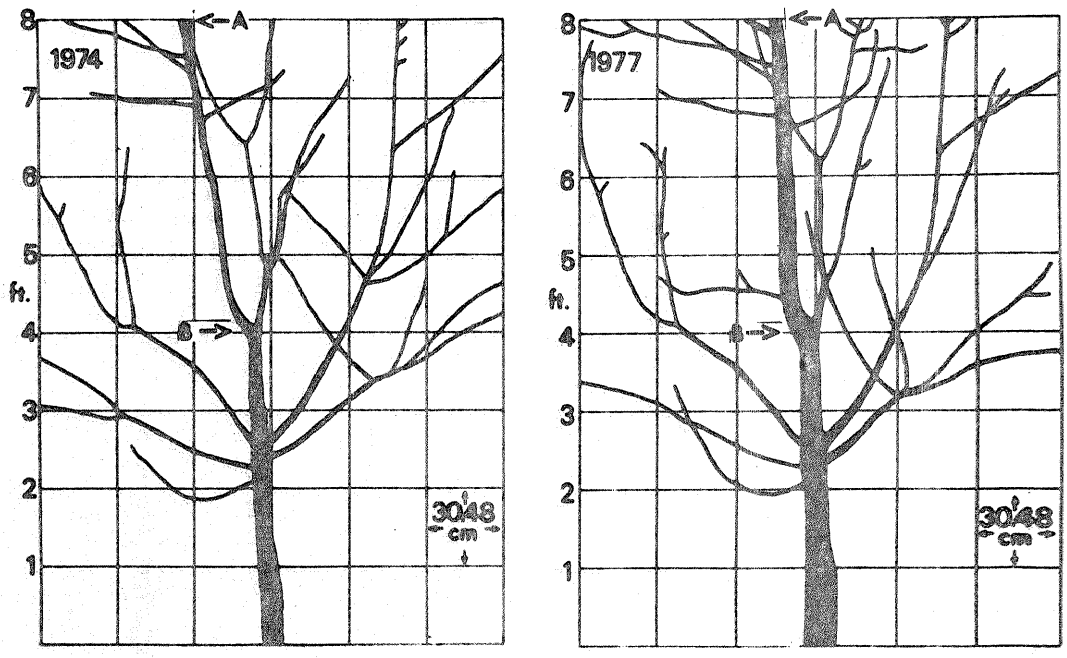

Figure d.--Even a relatively large stem (4 cm at d.b.h. in 1974) shows some movement. At 8 ft (2.4 m) (A), the stem is now 15 cm from vertical after moving 21 cm. Fom the main crook (B), there has been some movement, and the diameter growth of the branches has been far less than that of the main stem.

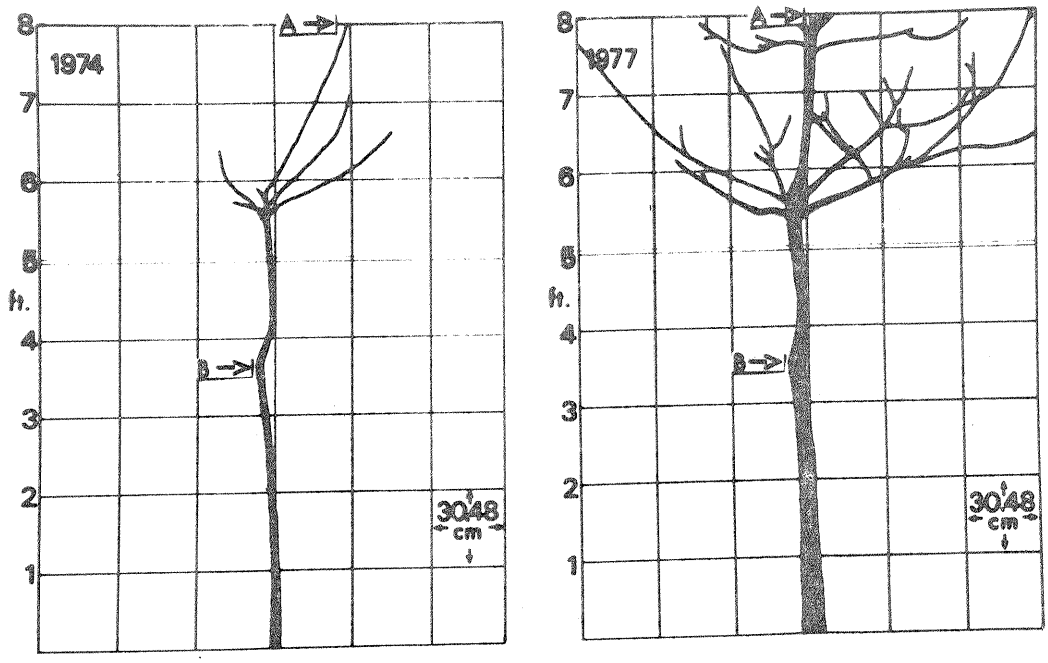

Figure e.--The upper stem has moved within 5 cm of vertical at 8 ft (2.4 m) (A). This tree was correctively pruned at 7 ft (2.1 m) prior to this study, and still shows some crook at that point. The improvement in the stem at 3.5 ft (1.1 m) (B) could be primarily the result of differential radial growth, but at least part of the straightening must be attributed to stem movement.

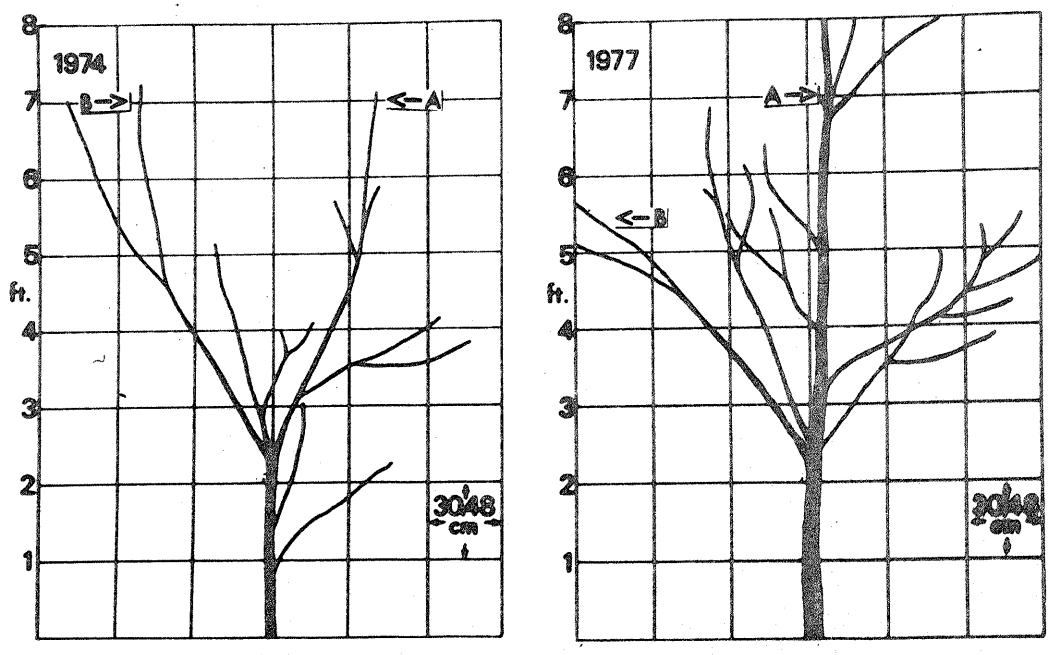

Figure f.--This tree appeared to be a prime candidate for corrective pruning, with two equal stems competing for dominance. Yet the right one has moved to 9 cm from vertical at 7 ft (2.1 m) (A) and has grown 3 cm at 4.3 ft (1.3 m) while the left one (B) has moved toward a horizontal position and grown only slightly.

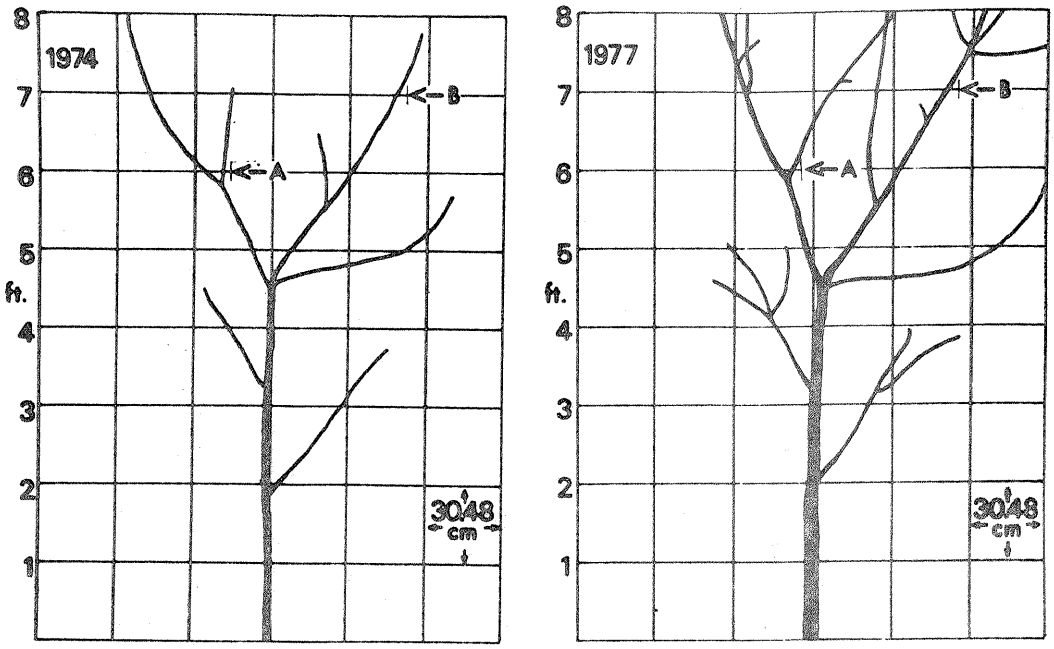

Figure g.--The left fork of this tree has moved 12 cm closer to vertical at 6 ft (1.8 m) (A), but there is as yet no single dominant stem. The right fork, though showing no movement (B), has grown equally well. In this case, pruning would have been best.

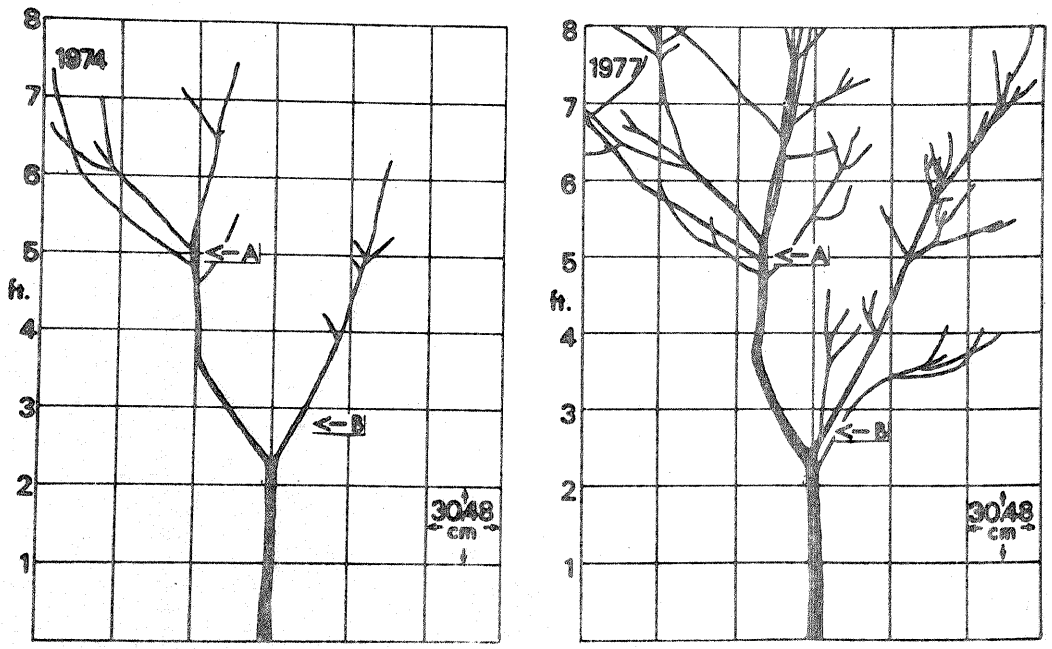

Figure h.--Although stem movement at 5 ft (1.5 m) (A) has reduced the deviation to half its original amount, this tree has not been able to overcome the crook resulting from the strong fork at 2.8 ft (0.7 m) (B). It does not appear that removal of the right fork would have helped, and thus coppicing might have been the best solution in this case.

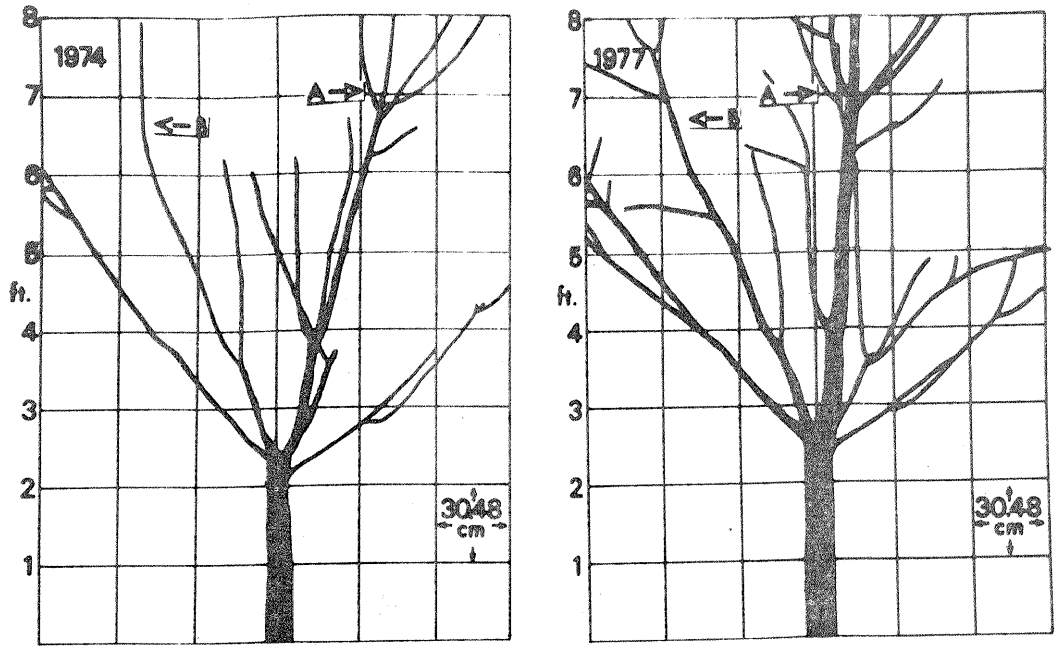

Figure i.--Initially, the largest of the 4 branches originating at 0.7 m appeared to be strongest, and it has moved 24 cm closer to a vertical position at 7 ft (2.1 m) (A). The second largest branch (B) has not moved, nor has it grown as rapidly as the one that has become the principal stem.

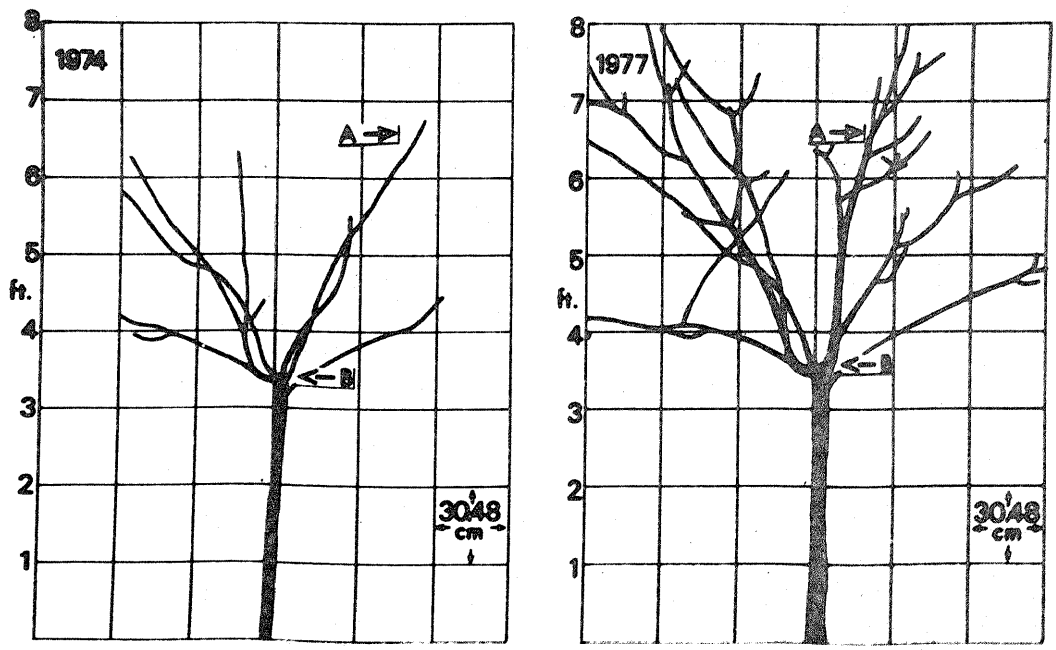

Figure j.--Even this apparently hopeless tree now shows some promise. The right branch has moved from 56 cm out of vertical to 23 cm from vertical at 6.5 ft (2 m) (A). Although not yet clearly dominant, this branch has developed at 3.5 ft (1.1 m) (B) such that it appears to be becoming the dominant stem.

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