Vertical Tillage Fails To Improve Black Walnut Seedling Growth

On Poorly Drained Site

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A soil modification method tested in southern Illinois to determine whether internal drainage of flood plain soils could be improved to promote better black walnut seedling growth provides no practical evidence of growth acceleration after four seasons....

Many areas available for planting black walnut in southern Illinois and western Kentucky have poorly drained soils. On such soils, black walnut grows slower than on well-drained soils. In the hope of accelerating growth on these soils, some landowners might attempt to improve internal soil drainage by artificial means. But the effect of artificial soil drainage upon black walnut growth is not known. Therefore, a method of modifying the soil called "vertical tillage"[2] was studied to determine whether internal soil drainage could be improved.

Methods

This study was conducted on a flood plain site in southern Illinois. The soils of the area are Belknap and Bonnie silt loams, which are mottled within 16 inches of the surface indicating that they are often saturated by a high water table. Within this area, 24 rows (100 feet long) were laid out 10 feet apart and

1 The Laboratory is maintained at Carbondale, III. in cooperation with Southern Illinois University. (This study was initiated by W. H. Carmean, Principal Soil Scientist, North Central Forest Experiment Station, St. Paul., Minn., maintained in cooperation with the University of Minnesota.)

[2]Vavra, J. P., and D. R. Browning. 1965. Vertical tillage: Promise for claypan soils. Crops and Soils 18(1): 15-16.

oriented toward the nearby stream. In each of the four blocks (replications), six treatments were applied.

Vertical Tillage

In each block, the vertical tillage treatments required the excavation of four 100-foot long trenches, each 4 inches wide and 3 feet deep. Two trenches were partially backfilled with 2 feet of topsoil from the immediate area and two trenches were partially backfilled with 2 feet of partly decomposed hardwood sawdust to which 20 pounds of N (as NH_4NO_3) per ton of sawdust was added as a .deterrent to possible N tie-up by soil microorganisms. These four trenches were then completely filled with a foot of the excavated soil and connected to a main drainage ditch at the lower end of the plot. The remaining two rows of each block of six served as controls and were not trenched. The trenching and backfilling operation was completed in the fall of 1966.

Planting Operations

During the planting operations the following spring, one each of the sawdust-trenched, top soil trenched, and untrenched treatment rows was selected to determine the effect of a starter fertilizer (8 ounces of 12-12-12) upon early seedling growth. This fertilizer was mixed with the soil in the bottom of the planting hole.

Twenty graded black walnut seedlings (1-0) were planted 5 feet apart in each row. The seedlings in the trenched rows were planted directly in the backfilled material of the trench. Complete weed control was maintained for the first 3 years and spot weed control during the fourth year.

TABLE 1.—*Four-year growth data of black walnut seedlings*

Treatments	Height[2]	Diameter 4 inches above root collar	Survival
	Feet	*Inches*	*Percent*
Trenched-sawdust filled[1]			
No seedling fertilization	2.0 [a]	0.7	74
Seedling fertilization	2.4 [ab]	.9	78
Untrenched			
No seedling fertilization	3.4 [bc]	1.0	97
Seedling fertilization	3.7 [c]	1.1	93
Trenched-topsoil filled[1]			
No seedling fertilization	3.8 [c]	1.1	91
Seedling fertilization	4.8 [d]	1.2	84

[1] Seedlings were planted in a backfilled 3-foot trench. Backfilling consisted of 2 feet of sawdust (with 20 lbs. N/ton) or topsoil, and 1 foot of the excavated soil.

[2] Mean height growth data with no letters in common differ at the 5 percent level using Duncan's New Multiple Range Test.

Survival and growth data (diameter at 4 inches above the root collar and height) were taken initially and at the conclusion of each growing season. Soil moisture was intermittently monitored by the neutron moderation method in one block of treatments.

Results and Discussion

After 4 years, there was very little evidence that the vertical tillage treatments improved internal drainage of these soils or promoted better seedling growth (tables 1 and 2). Even with the best treatment (topsoil-filled trenches with seedling fertilization), the height growth was only half that normally obtained on well-drained soils in the area. The 4-year height growth of 2.0 to 4.8 feet is not great enough to consider this an established plantation. Annual weed growth on these soils can easily attain a height of 5 feet or more and still could "smother" the planted trees.

Fertilization only improved growth of seedlings planted in trenches backfilled with topsoil, but the increase in height growth was only a little over a foot in 4 years. It is not known whether a larger amount of fertilizer would have produced a greater height growth response.

TABLE 2.—*Soil moisture content near treatment row*[1]

Date	Depth	Water, by volume[2] Trenched-sawdust	Un-trenched	Trenched-topsoil
	Feet	*Percent*	*Percent*	*Percent*
6/6/69	1	28.2	25.4	27.9
	2	32.5	31.4	30.3
	3	——	——	——
10/6/69	1	28.0	20.1	22.7
	2	30.5	24.7	26.8
	3	31.5	28.6	30.6
7/22/70	1	32.0	31.0	31.2
	2	35.8	34.6	33.6
	3	37.8	35.5	35.6
9/11/70	1	37.4	33.5	35.1
	2	43.5+	41.8	41.6
	3	43.5+	43.5+	43.5+

[1] Measurements were made 18 inches from treatment row in undisturbed soil material.

[2] Field capacity (1/3 Atm.) values are:
1 ft. = 24.8 percent by volume
2 ft. = 32.3 percent by volume
3 ft. = 31.7 percent by volume

The poorest survival and growth was obtained on trenches backfilled with sawdust. During the growing season, the foliage of these seedlings was very pale green, suggesting a nitrogen deficiency. If this is so, this deficiency was likely caused by the tie-up of nitrogen by soil micro-organisms decomposing the sawdust. Either more nitrogen should have been added to the sawdust or the seedlings, or a saw dust in a more advanced stage of decomposition should have been used.

Periodic soil moisture measurements confirmed that internal drainage was not improved by the trenching treatments (table 2). The sawdust-filled trenches generally had a higher moisture content than the other treatments. The apparent reason for this is that the sawdust absorbs a very large amount of water. With the sawdust acting as a "sponge," the adjacent soil is kept wet longer than the soil next to the topsoil and in the untrenched treatments.

In summary, this study showed that these soil modification methods did *not* result in greater black walnut seedling growth during the establishment period and thus the landowner should seek other sites with well-drained soils for planting black walnut.