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A BASIN METHOD OF NUT TREE CULTURE

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Nut tree culture in Iowa is confined almost entirely to selected and grafted varieties of the black walnut, *Juglan nigra* L. This tree is one of the dominants of the Elm-Ash-Walnut Associes of the Deciduous Forest Formation of eastern United States. Its native habitat is the upper flood-plains of rivers, creeks and even intermittent streams. In spite of the fact that Iowa is near the western limit of its range, the walnut thrives in the rich alluvial soil of well drained but moist flood-plains throughout the state and attains a size almost as great as it does farther east near the center of its range.

In general the culture of the black walnut as a nut tree in the middle west has been limited to floodplain sites or to comparable sites having deep, fertile, moist but well aerated soils. In the erosion problem area of southeastern Iowa such sites are rare and are in demand for many other crops. On most of the farms in this area there are available three to 10 acres of land which is not suitable for clean cultivation and is not suitable or needed for pasture or wood-lot.

Experiments in progress since 1938 at the Floris Field Station of the Iowa Cooperative Hillculture project show that seedling or grafted black walnut trees can be successfully established on plowed contour strips on eroded Lindley loam of moderate to steep slope. However there are many areas of limited extent or otherwise unsuitable for contouring, as fence corners, fence rows and areas on slopes bordering creeks and ditches, which require other methods of culture. For situations of this kind, the basin method described here, which can be applied to a unit as small as one tree, seems to be suitable.

In the late fall of 1937 and the spring of 1938 the method was devised and adapted for use in laying out a randomized block, integrated planting of walnuts and plums with rows of hazel-filbert hybrids separating the rows of 9-tree plots. The aim was to have the trees evenly spaced, which is impossible in contour planting, and yet conserve water and soil.

The site selected for the experiment is 1.7 acres in extent. It is a narrow strip 10 chains by about 2 chains, somewhat narrower at the ends. This strip lies across the middle of a southwest facing slope which varies in steepness from 10 to 25 per cent. The soil type is Lindley loam which had previously been eroded until only 2 to 3 inches of top soil remained. Lime had been applied to the area in 1936 at the rate of 2½ tons per acre. The vegetative cover in 1938 was in the transition stage; the cover of aster, goldenrod and yarrow being replaced by Canadian and Kentucky bluegrass with sweet clover beginning to invade the mixture.

The design of the experiment is shown in figure 1. The sketch shows a section across the experimental strip which runs in a general east-west direction. The lines between the plots, run north and south and

east and west but the direction of slope is almost exactly southwest. The unit is a block of 9 trees spaced at intervals of 20 links, 13.2 feet. The walnut and plum trees were integrated in the blocks in numbers of 4 and 5. For example the number of nut trees in each block alternates between 4 and 5. The 5-tree arrangement in the block includes the 4 at the corners and 1 in the middle. The 4-tree arrangement includes the trees near the middle of the sides of the block. The intervening strips were planted to F_1 generation plants of a hazel-filbert cross as was also the upper border of the plot. There were at least 5 replications of each walnut and plum variety located in the plot at random; having 4 or 5 trees to a replication.

Each basin was made at right angles to the slope by scalping the sod from the basin area and using it to sod the lower rim of the area which had been built up with the soil taken from the basin. By a lap-

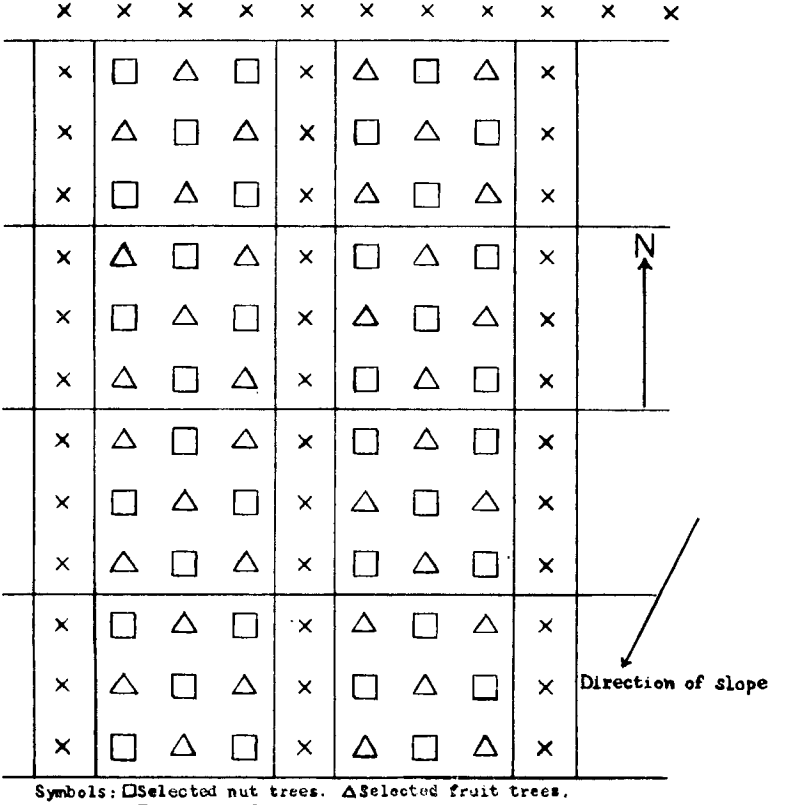

Figure 1. A cross section of the design of the nut tree basin integration experiment. Each species or variety of nut tree and fruit tree is replicated in blocks at least five times in the experimental area.

Scale: 13.2 feet between plants.

ping or "staggered" arrangement on the slope, a given basin was located below the space between two basins in the row above so no perceptible quantity of water was lost from the slope. Each finished basin was rounded in outline on the lower side and in general shape was slightly more than a half-circle except that the ends of the basin were somewhat attenuated. The size of the basins was approximately 6 feet long by 3½ feet wide. Each basin was kept as shallow as possible for the purpose for which it was intended; to catch its proportionate part of water from the slope and hold it till it percolated. Rate of percolation on the general slope and in the basins was at least moderate, so there was no appreciable loss of water and no overflowing of the basins, although most of the basins were only 8 to 10 inches deep, measured from the top of the rim. None of them was over 1 foot deep.

Figure 2. View of the experimental site from the east end of the plot strip, showing the arrangement, comparative size and structure of the basins at planting time, April, 1938. Note the tree covered hills in the background, which afford protection from south and southwest winds.

The hole for planting the tree in the basin was made at the same time as the basin. The sub-soil from the bottom of the hole was used in building the base of the sodded low retaining ridge forming the boundary of the basin on the down-hill side. Some of the top soil underlying the scalped vegetation was used to replace the subsoil in the hole to make a good planting place for the trees. The basin treatments were the same for the entire slope since the chief aim was to test different species and varieties of plants. In figure 2 is shown the shape and general structure of the basins and their arrangement on the slope. The location of the basins at right angles to the slope and their staggered arrangement on the slope are shown in the picture which was taken at planting time in April, 1938.

TABLE I. PERCENTAGE SURVIVAL AND GROWTH INCREMENT (IN INCHES) IN HEIGHT, IN BRANCH GROWTH, AND IN DIAMETER BY YEARS OF GRAFTED 2-1 THOMAS AND STABLER BLACK WALNUTS PLANTED IN HAND-MADE BASINS ON A 10 TO 25 PER CENT, SOUTHWEST FACING SLOPE OF ERODED LINDLEY LOAM. 1938-1942.

	1938. Growth increment			1939. Growth increment			1940. Growth increment				1941. Growth increment				1942. Growth increment			
	Surv. %	Height *	Height	Surv. %	Height	Branch growth	Surv. %	Height	Branch growth	Diam. total	Surv. %	Height	Branch growth	Diam. total	Surv. %	Height	Branch growth	Diam. total
Thomas I, 50 Plants	90	44.2	7.6	82	8.0	43.4	82	10.6	83.2	.9	80	19.2	107	.21	80	18.5	162	.45
Thomas II, 25 Plants	84	36.3	5.6	68	3.3	16.4	60	13.5	46.	.7	60	13.2	100	.23	60	16.5	140	.40
Stabler, 34 Plants	59	25.1	5.4	50	1.8	11.4	41	6.9	45.6	.6	41	6.0	79	.07	41	12.	146	.43

* Average height of trees when planted.

The grafted black walnuts used in the experiment with grafted hickory nuts, pecans, Asiatic chestnuts and selected plum varieties were: Thomas walnut I, 50 grafted, 2-1 trees received from Beltsville, Maryland; Thomas walnut II, 25 grafted, 2-1 trees received from Swarthmore, Pennsylvania; Stabler walnut, 34 grafted, 2-1 trees received from Swarthmore. The trees were somewhat dry when received which accounts, in part, for their low survival rate the first year. The Thomas walnut I trees were in the best condition. The Thomas II and Stabler trees were in about the same condition except several of the Stabler trees were imperfectly grafted and were injured in shipment and possibly in planting.

Survival and growth data are given in table I. New branch growth the first year was meager, averaging only about one-fifth that of the second year. No authenic diameter data were taken till 1940; the average total being given in that column. The growth data show that, although the Thomas II and Stabler trees grew more slowly than the Thomas I the first three years, their rate of growth was as great as that of the Thomas I the fourth year and was even greater, in proportion to the average size of the tree, than that of the Thomas I the fifth year. This difference is especially evident when the total branch growth increment in inches is plotted on time in years. The direction of the growth curve for these two shows a more nearly upright trend as a result of the 1942 measurements than does that for Thomas I. This fact would seem to indicate that the trees would soon be nearly if not quite equal in size with the possible exception of height in the Stabler, although the average height growth for this variety was 100 per cent greater in 1942 than it was in 1941.

No exact check of these trees with matched trees grown under comparable conditions on the floodplain was possible but their growth compares very favorably with that of similiar trees on the floodplain and on plowed contour strips except that their early rate of growth was somewhat less than that of walnuts cultivated on the floodplain. However the data in table I would seem to indicate that adequate growth had been made by the end of the fifth season on previously eroded Lindley loam, on a slope so steep that protective herbaceous cover must be fostered or permitted to develop in the spaces between the basins in order to conserve and build up the soil. Under the conditions of the experiment, the vegetative cover on the slope has greatly improved; having developed into a very luxurient bluegrass cover. In the absence of grazing or mowing this cover is adequate in water and soil conservation and in soil-building properties.

In fruiting, the trees of this experiment seem to be more "precocious" than do trees cultivated on the floodplain. Several of the trees had 4 or 5 mature nuts each in 1940, the third year, and some of the trees bore more than a dozen each in 1941. In 1942 a severe freeze on May 16 completely killed 3 to 5 inches of growth on the developing branches of the trees, killing the fruiting buds but not seemingly retarding the growth to any great extent as evidenced by the high

The results of the experiment would seem to indicate that, by using the basin method, grafted walnuts may be established, with a good chance of final success, in southeastern Iowa on eroded forest soil (Lindley loam), on slopes too steep and badly eroded for clean cultivation. Comparable tests at the station indicate that the plowed contour strip gives at least as favorable results in the establishment of walnuts.

The basin method seems to have one chief advantage over the plowed contour strip method, under like soil and erosion conditions; that areas of limited extent or otherwise unsuitable for contouring, as fence corners, fence rows and steep slopes bordering streams, may be utilized to grow varieties of the black walnut for nut production. However, in our experiments in the establishment and culture of nut trees on slopes, it has seemed advisable not to attempt to utilize the tops of hills or other sites with excessive exposure to drying winds. In both the plowed contour strip and the basin method, smaller trees or shrubs may be integrated with the nut trees and, in both methods, integration of the vegetative cover in the interplanting space is necessary if steep eroded soils are to be untilized for the production of nut trees.

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