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Black Walnut Stand Growth in Southern Michigan  
Michigan State University Agricultural Experiment Station and Cooperative Extension  
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Research Report

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Issued September 1972

12 pages

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September 1972

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# RESEARCH REPORT 171

FROM THE MICHIGAN STATE UNIVERSITY  
AGRICULTURAL EXPERIMENT STATION EAST LANSING

## NATURAL RESOURCES

### *Black Walnut Stand Growth in Southern Michigan*



# *Black Walnut Stand Growth in Southern Michigan<sup>1</sup>*

by

V. J. Rudolph, W. A. Lemmien and D. P. White<sup>2</sup>

**COVER:** This 30-year-old black walnut plantation in Compartment 15 in the W. K. Kellogg Forest near Augusta, Michigan, has made moderate growth. The trees average 6.3 in. in diameter at breast height, and 47 ft. in total height.

## INTRODUCTION

**I**N 1965, RESEARCHERS in the Department of Forestry at Michigan State University initiated a study to determine optimum site conditions for establishing and growing high quality black walnut (*Juglans nigra*).

Each tree rather than the entire stand is the focal point of these treatments and environmental modifications. Hopefully, the potential value at maturity of each walnut tree will be high enough to justify large

investments in care and cultural treatments. The accelerated growth and improved quality of trees grown under intensive care should produce veneer logs in shorter rotations, possibly in 60 rather than 100 or more years.

With this horticultural approach to timber management, treatments such as site preparation (herbicide application, fertilizer, nurse crop establishment, etc.) may begin long before the tree is planted. Other treatments may follow at frequent intervals or every year until the tree is ready for harvest.

To evaluate better the need for and effects of intensive management, the growth of stands having little cultural treatment or site modification needs to be known. Several walnut plantations and a natural stand in southern Michigan were measured and their growth analyzed.

The study area embraces several counties in southern Michigan. Included are six plantations in the W. K. Kellogg Forest near Battle Creek, one on private land near Richland in Kalamazoo Co., one planting on the Michigan State University campus in East Lansing, two plantations in the Fred Russ Forest in Cass Co., and one naturally established pure even-aged stand in Calhoun Co. near Bellevue.

<sup>1</sup> This study was financed in part by federal funds from the McIntire-Stennis Law (P.L. 87-788).

<sup>2</sup> Rudolph and White are Professors of Forestry; Lemmien is Resident Forester, W. K. Kellogg Forest. The authors are indebted to M. W. Day, Dunbar Forest Experiment Station, Michigan State University, and C. F. Bey, North Central Forest Experiment Station, U. S. Forest Service, for their critical review of the manuscript.

## THE STANDS AND THEIR GROWTH

### W. K. Kellogg Forest Plantings

#### Plantation K-1

This 30-year-old stand of approximately one-third of an acre was established in 1936 on a fairly level abandoned field in Compartment 15 by direct seeding. Spacing was 4 x 6 ft. on Kalamazoo sandy loam soil. The planting is surrounded on three sides by red pine (*Pinus resinosa*) and jack pine (*P. banksiana*) plantings of the same age. Over the years, a fairly dense understory of raspberry (*Rubus spp.*), hog peanut (*Anphicarpa monica*) and Virginia creeper (*Parthenocissus quinquefolia*) developed in the planting.

At 30 years of age, the trees form a pure dense stand. There was very good natural pruning and the clear length on most trees is approximately 20 ft. (Table 1; also see cover photo). The live crowns, however, are short and small in diameter. The average annual diameter growth is .21 in.

TABLE 1. Stand table for 30-year-old black walnut plantation K-1, Compartment 15, W. K. Kellogg Forest — per acre basis-1966

D.B.H. (in.)	No. of trees	Total height (ft.)	Basal area (sq. ft.)
3	4	30	.2
4	30	39	2.6
5	70	42	9.5
6	48	47	9.4
7	78	50	20.8
8	56	51	19.5
9	18	51	8.0
<b>Totals</b>	<b>304</b>		<b>70.0</b>

Avg. d.b.h., 6.3 in.; Avg. total height 47 ft.

#### Plantation K-2

In 1937, this stand of approximately one acre was planted with 1-0 stock on a level abandoned field in Compartment 13a. Spacing was 30 x 40 ft. on Oshtemo sandy loam soil. Strips approximately 20 ft. wide between the rows were tilled and used each year to grow wildlife food crops such as corn and millet.

Volunteer black cherry (*Prunus serotina*) and some American elm (*Ulmus americana*) developed in the uncultivated walnut rows. At age 29, the walnut trees are the "orchard type" — short-boled, heavily crotched, with large spreading crowns. Since these trees were planted largely for nut production, no pruning was applied and the potential for log production is very low (Table 2, Fig. 1). The average annual diameter growth is .27 in.

TABLE 2. Stand table for 29-year-old black walnut plantation K-2, Compartment 13a, W. K. Kellogg Forest — per acre basis-1966

D.B.H. (in.)	No. of trees	Total height (ft.)	Basal area (sq. ft.)
4	1	28	.1
5	1	22	.1
6	3	33	.6
7	7	34	1.9
8	7	39	2.4
9	6	40	2.7
10	4	41	2.2
11	3	43	2.0
<b>Totals</b>	<b>32</b>		<b>12.0</b>

Avg. d.b.h., 8.0 in.; Avg. total height, 37 ft.



Fig. 1. Twenty-nine-year-old black walnut plantation K-2, Compartment 13a, W. K. Kellogg Forest. (About 20 ft. of the 40-ft. strip between rows was used to grow wildlife food crops.)



Fig. 2. Twenty-nine-year-old black walnut plantation K-3, with alternate rows of honey locust, Compartment 11, W. K. Kellogg Forest.

### Plantation K-3

In 1937, this planting of approximately one-tenth of an acre was made on a level abandoned field with 1-0 stock. Spacing was 6 x 8 ft. in row mixtures with honey locust (*Gleditsia triacanthos*) in Compartment 11 on Oshtemo sandy loam soil. The planting is bordered on the west by white pine (*Pinus strobus*) and on the east by pure honey locust of the same ages.

At 30 years of age, the trees are straight, well-formed and have a clear length of approximately 17 ft. (Table 3, Fig. 2). The crowns are narrow and very short due to severe crowding. Some black cherry, American elm, honey locust, sassafras (*Sassafras varifolium*) and a few aspen (*Populus tremuloides*) developed in the plantation through natural seeding. Many of these stems are competing equally with the black walnut. Average annual diameter growth of the walnut is .16 in.

TABLE 3. Stand table for 30-year-old black walnut plantation K-3, mixed with honey locust, Compartment 11, W. K. Kellogg Forest — per acre basis-1966

D.B.H. (in.)	No. of trees	Total height (ft.)	Basal area (sq. ft.)
2	30	15	.7
3	70	32	3.4
4	100	36	8.7
5	130	40	17.7
6	20	46	3.9
7	30	46	8.0
8	10	45	3.5
9	10	56	4.4
10	10	56	5.4
Totals	410		55.7

Avg. d.b.h., 4.7 in.; Avg. total height, 37 ft.

### Plantation K-4

In 1942, this stand of approximately one acre was planted on an abandoned field with a 25% south-facing slope. The planting was a 2-to-1 mixture of 1-0 shagbark hickory (*Carya ovata*) seedlings and black walnut nuts spaced 8 x 8 ft. on Oshtemo sandy loam soil. Due to poor survival, the hickory was replaced with a mixture of 2-0 black locust (*Robinia pseudo-acacia*) and honey locust seedlings the following year.

In 1951, black cherry seedlings were planted in scattered spots throughout the area. At the time of measurement, there were very few hickories or black cherries in the stand. Most of the black locust succumbed to the locust borer, but some sprouts are present. Honey locust outnumbers the black walnut about 3-to-1, and has grown about as well as the walnut.

At age 24, the stand has approximately 85% full crown closure. The basal area of all species other than black walnut is 35.5 sq. ft. per acre. The black walnut trees are vigorous and have good form. Clear length averages about 12 ft. per tree (Table 4, Fig. 3). Average annual diameter growth is .18 in.

TABLE 4. Stand table for 24-year-old black walnut plantation K-4, mixed with black and honey locust, Compartment 24, W. K. Kellogg Forest — per acre basis-1966

D.B.H. (in.)	No. of trees	Total height (ft.)	Basal area (sq. ft.)
2	13	17	.3
3	23	26	1.1
4	18	30	1.6
5	16	34	2.2
6	17	37	3.3
7	5	39	1.3
8	5	40	1.7
Totals	97		11.5

Avg. d.b.h., 4.4 in.; Avg. total height, 30 ft.

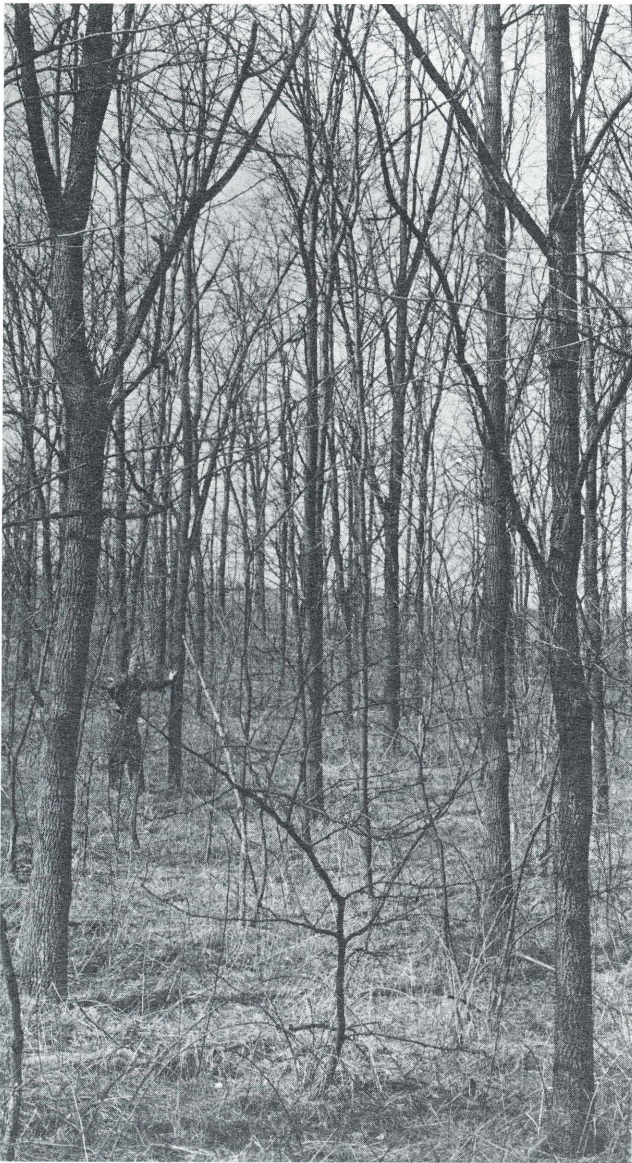


Fig. 3. Twenty-four-year-old black walnut plantation K-4, in mixture with black and honey locust, Compartment 24, W. K. Kellogg Forest.

#### Plantation K-5

This 24-year-old stand of approximately one acre was established in 1942 on an abandoned field with a fairly steep east-facing slope in Compartment 24. The planting was a 2-to-1 mixture of Siberian elm (*Ulmus pumila*) seedlings and black walnut nuts at 6 x 6 ft. spacing on Oshtemo sandy loam soil. Some black cherry seeded in naturally and several of these trees are as well developed as the black walnut.

The elm is of low vigor, while the walnut is moderately vigorous. They have fairly good form, with an average clear bole length of 10 ft. (Table 5, Fig. 4). Average annual diameter growth is .13 in.

TABLE 5. Stand table for 24-year-old black walnut plantation K-5, mixed with Siberian elm, Compartment 24, W. K. Kellogg Forest — per acre basis-1966

D.B.H. (in.)	No. of trees	Total height (ft.)	Basal area (sq. ft.)
1	21	10	.1
2	43	17	.9
3	39	23	1.9
4	10	31	.9
5	16	32	2.2
6	10	37	2.0
7	2	45	.5
8	3	40	1.0
9	2	53	.9
10	—	—	—
11	1	61	.7
Totals	147		11.1

Avg. d.b.h., 3.2 in.; Avg. total height, 23 ft.



Fig. 4. Twenty-four-year-old black walnut plantation K-5, in mixture with Siberian elm, Compartment 24, W. K. Kellogg Forest.

### Plantation K-6

This 24-year-old planting of 1.6 acres was established in 1942 on an abandoned gently-rolling field in Compartment 24. A stem-wise mixture of 1-0 seedlings of shagbark hickory, black walnut, bur oak (*Quercus macrocarpa*) and northern red oak (*Q. rubra*) was planted at an 8 x 8 ft. spacing on Kalamazoo and Oshtemo sandy loam soils. Survival was only fair, and some black cherry, white ash (*Fraxinus americana*) and northern red oak seeded in.

At the time of measurement, open spots had raspberry patches in them. The bur oak has grown best, and several of these trees are larger and taller than the black walnut. Very few northern red oak or hickory survived, and their height and diameter are smaller than the walnut.

The total basal area of all species other than black walnut is 24.7 sq. ft. per acre. Clear bole length averages approximately 4 ft. (Table 6, Fig. 5). For their sizes, the walnut trees have wide, long crowns. Average annual diameter growth is .17 in.

TABLE 6. Stand table for 24-year-old black walnut plantation, K-6, mixed with shagbark hickory, bur oak and northern red oak, Compartment 24, W. K. Kellogg Forest — per acre basis-1966

D.B.H. (in.)	No. of trees	Total height (ft.)	Basal area (sq. ft.)
2	10	15	.2
3	18	19	.9
4	37	22	3.2
5	18	26	2.4
6	7	28	1.4
7	3	29	.8
8	1	39	.3
<b>Totals</b>	<b>94</b>		<b>9.2</b>

Avg. d.b.h., 4.1 in.; Avg. total height, 22 ft.

Data for the six plantings are summarized in Table 7 for the total stand and also for the best 50 trees per acre. Even the plantation which grew best has made only moderate growth. Also, greater height growth and better form of the walnut occur in the densest stands, whether they are of pure black walnut or in mixture with other species.

TABLE 7. Summary of data for six black walnut plantations, the W. K. Kellogg Forest — per acre basis-1966

Plantation Description	Total black walnut stand					50 best black walnut trees				
	Age from seed years	No. of trees	Avg. d.b.h. in.	Avg. annual dia. growth in.	Basal area sq. ft.	Avg. total height ft.	Avg. d.b.h. in.	Avg. annual dia. growth in.	Avg. total height ft.	Basal area sq. ft.
K-1 Pure black walnut	30	304	6.3	.21	70.0	47	8.3	.28	51	19.1
K-2 Pure black walnut, orchard condition	29	32	8.0	.27	12.0	37	(a)	(a)	(a)	(a)
K-3 Black walnut-honey locust mixture	29	410	4.7	.16	55.7	37	7.5	.26	48	18.6
K-4 Black walnut-black locust-honey locust mixture	24	97	4.4	.18	11.5	30	5.8	.24	36	9.1
K-5 Black walnut-Chinese elm mixture	24	147	3.2	.13	11.1	23	5.5	.23	35	8.5
K-6 Black walnut-bur oak-shagbark hickory-red oak mixture	24	94	4.1	.17	9.2	22	5.1	.21	26	6.7

(a) There are 32 trees per acre in this plantation

## The Bellevue Natural Stand



Fig. 5. Twenty-four-year-old black walnut plantation K-6, in mixture with shagbark hickory, bur oak and northern red oak, Compartment 24, W. K. Kellogg Forest.

The former owner of the farm on which this pure 60-year-old stand is located states that the entire area of two acres seeded in naturally over a short period from nuts produced by two medium-sized walnut trees. The parent trees were cut about 20 years ago. The area is level, very rocky, covered with fairly dense sod, and has been heavily grazed for more than 60 years. The soil is a Hillsdale sandy loam.

The stand is somewhat irregular in density. Trees are of medium vigor and many are rough and limby. The smaller trees are being severely crowded in the denser portions of the stand, and some dead trees occur in these spots (Table 8, Fig. 6).

For their age, the trees are quite small. The average annual diameter growth rate is .14 in. The heavy sod condition and the trampling, soil compaction, and related effects of the heavy and continuous cattle grazing are not conducive to rapid tree growth. Some judicious thinning and exclusion of the cattle would be justified in this stand. More than half the present volume is merchantable for small sawlogs.



Fig. 6. A naturally established pure black walnut stand about 60 years old, in a heavily grazed pasture near Bellevue.



**TABLE 8. Stand and stock table for a 60-year-old natural black walnut stand near Bellevue, Michigan — per acre basis-1968**

D.B.H. (in.)	No. of trees	Total height (ft.)	Basal area (sq. ft.)	Volume (cu. ft.)
4	3	38	.3	—
5	10	43	1.4	12
6	30	46	5.8	80
7	27	50	7.2	119
8	19	53	6.8	129
9	30	57	13.2	280
10	21	60	11.4	265
11	16	63	10.8	284
12	10	66	8.2	223
13	10	69	9.6	280
14	4	72	4.8	148
<b>Totals</b>	<b>180</b>		<b>79.5</b>	<b>1,820</b>

Avg. d.b.h., 8.6 in.; Avg. total height, 55 ft.

### The Windisch Plantation

This 29-year-old plantation is located 2 miles northeast of Richland in Kalamazoo Co., Michigan. Part of it consists of grafted trees and inter-mixed butternut trees. An 8.6-acre portion was planted to 1-0 black walnut seedlings in 1938 from the Michigan State University nursery, and is now included in an intensive cultural treatment study.

The trees were hand-planted in furrows at 20 x 40 ft. spacing. The area is level to rolling, with slopes to 12%. The soil is a Fox sandy loam. The present ground

cover is a heavy stand of grasses, clover and weeds. In the past, hay had been cut between the tree rows.

The owner also pruned the lower branches, and mowed the ground cover annually. After pruning, the average clear bole length is about 11 ft. The trees are fairly open grown and there was very little natural pruning.

The stand is vigorous, and would most likely produce short log lengths due to wide spacing resulting in "orchard type" trees (Table 9, Fig. 7). However, the rapid healing of pruning wounds up to 4 in. in diameter under intensive culture may result in the eventual harvest of longer logs from this stand. The average annual diameter growth is .22 in.

**TABLE 9. Stand table for 29-year-old black walnut plantation, Windisch farm near Richland, Michigan — per acre basis-1967**

D.B.H. (in.)	No. of trees	Total height (ft.)	Basal area (sq. ft.)
3	2	17	.1
4	4	21	.4
5	8	26	1.1
6	10	28	2.0
7	10	32	2.7
8	8	36	2.8
9	4	39	1.8
10	2	42	1.7
11	1	48	.7
<b>Totals</b>	<b>49</b>		<b>12.7</b>

Avg. d.b.h., 6.5 in.; Avg. total height, 30 ft.



**Fig. 7. Twenty-nine-year-old black walnut plantation on Windisch Farm near Richland.**



Fig. 8. Twenty-year-old black walnut plantation R-1, in a row mixture with black cherry, northern red oak, yellow poplar and white ash, Compartment D-45, Fred Russ Forest.

### Fred Russ Forest Plantings

#### Plantation R-1

This 20-acre planting consists of a 5-row mixture of black cherry, northern red oak, yellow poplar, white ash and black walnut. It was established in 1945 at a spacing of 8 x 8 ft. The black cherry and white ash were 1-0 seedlings, and the northern red oak and yellow poplar were 2-0 seedlings. Two black walnut seeds were seeded in each spot when the plantation was established. Thus, the black walnut forms one-fifth of the plantation.

The area is fairly level, and was used for agricultural crops for many years until low yields no longer justified cultivation. The soil, Kalamazoo loam, was

plowed and harrowed before planting. The plantation was cultivated several times a year for 2 years after planting; there has been no further cultural work since.

At 20 years of age, the black walnut shows slow growth. The average annual diameter growth rate has been .09 in. More than half the trees are double-stemmed, making potential log length and quality quite low (Table 10, Fig. 8). Growth of the other four species in this row mixture is about the same as that of the walnut. A closed stand condition has not yet developed.

TABLE 10. Stand table for 20-year-old black walnut plantation R-1, in a row mixture with black cherry, northern red oak, yellow poplar and white ash, Fred Russ Forest — per acre basis-1966

D.B.H. (in.)	No. of trees	Total height (ft.)	Basal area (sq. ft.)
1	56	9	.3
2	54	13	1.2
3	16	19	.8
4	4	22	.4
Totals	130		2.7

Avg. d.b.h., 1.8 in.; Avg. total height, 12 ft.

#### Plantation R-2

This 10-acre plantation is similar to Plantation R-1; however, it was made one year later, and white ash was omitted from the 5-species row mixture. The row that should have been planted to white ash was left unplanted. Spacing, soil and other conditions are the same as in the other plantation.



Fig. 9. Nineteen-year-old black walnut plantation R-2, in a row mixture with black cherry, northern red oak and yellow poplar, Compartment D-46, Fred Russ Forest.

At 19 years of age, this plantation also shows very slow growth (Table 11, Fig. 9). The average annual diameter growth rate is .05 in. The black walnut trees have poor form, many multiple stems, and short potential log length. Because the black walnut row adjoins the vacant row where the white ash was to have been planted, there is even less stand closure than in Plantation R-1.

**TABLE 11. Stand table for 19-year-old black walnut plantation R-2, in a row mixture with black cherry, northern red oak and yellow poplar, Fred Russ Forest — per acre basis-1966**

D.B.H. (in.)	No. of trees	Total height (ft.)	Basal area (sq. ft.)
1	150	6	.9
2	17	12	.4
3	3	13	.2
<b>Totals</b>	<b>170</b>		<b>1.5</b>

Avg. d.b.h., 1.1 in.; Avg. total height, 7 ft.

#### The Michigan State University Campus Plantation

This plantation was established in 1910 on .9 of an acre in the north-west corner of the Baker Forest Preserve on the Michigan State University campus. It has gently rolling topography, with poorly drained Barry soil on the lower portions, grading into imperfectly drained Locke soil on the higher portions. The area was cleared of native hardwoods in 1909, plowed, and a tile drain was laid to remove water from the lowest portion of the area.

Northern white cedar (*Thuja occidentalis*) was planted in alternate rows with the black walnut to encourage natural pruning in the walnut. The rows were 4 ft. apart; trees were 4 ft. apart within rows. A total of 1,062 black walnut and an equal number of northern white cedar were planted on a per acre basis. The black walnuts were 1-0 seedlings; and, 3-1 northern white cedar transplants were used. Trees were cultivated the first year, and weeds were cut by hand the next 2 years.

In 1915, the cedar was no longer needed for shading and side-crowding so most of it was removed. Mortality in the black walnut had been high (almost half), with only 576 trees left per acre.

An inventory in 1928, when the trees were 18 years old, showed 531 trees, and a volume of 1,426 cu. ft. per acre (1). Some trees were 9 in. in diameter at that time. The first thinning was made in 1931, leaving 365 trees per acre. In 1934, a second thinning was made removing 141 trees and approximately 600 cu. ft. per acre. The residual stand after this thinning consisted of 220 well spaced trees per acre.

In 1955, when the plantation was 45 years old, an inventory showed 135 trees and 2,073 cu. ft. per acre (2). The trees averaged 10 in. in diameter, and ranged from 3 to 16 in. in diameter. The larger trees were 60 to 70 ft. tall, with about 35 ft. of clear bole for each tree. The crowns were rather narrow and short. The plantation was thinned, removing 22 trees per acre, and leaving 113 trees and 1,878 cu. ft. per acre. Thirty-eight volunteer American elm and black cherry, ranging in size from 1 to 8 in. d.b.h., were also removed when the plantation was thinned.

In 1966, when the plantation was 56 years old, the trees were measured again. The merchantable portion of each tree was graded into log grades based on location and extent of visible defects. Standard log grades for hardwood lumber were used, but they were slightly modified when applied below the 10-in. minimum log diameter (3). Thus, to some extent, log grades assigned to the merchantable portions of each tree indicate the potential log grade of that part of each tree.

The stand had 106.5 trees per acre, ranging from 6 to 18 in. d.b.h. (Table 12, Fig. 10). The average diameter was 11.4 in. and the average tree height was 76 ft. Most trees had a clear bole length slightly exceeding two 16-ft. logs. The volume, 2,324 cu. ft. per acre, was distributed by log grades as follows:

Log grade	Volume (cu. ft.)	Percent of volume
1	1,430	62
2	523	22
3	341	15
4	30	1
<b>Total</b>	<b>2,324</b>	<b>100</b>

**TABLE 12. Stand and stock table for 56-year-old black walnut plantation, Michigan State University Campus — per acre basis-1966**

D.B.H. (in.)	No. of trees	Total height (ft.)	Volume (cu. ft.)	Basal area (sq. ft.)
6	2.2	42	.4	6
7	1.1	36	.3	2
8	5.6	61	1.9	42
9	10.0	68	4.3	106
10	13.3	71	7.2	200
11	20.0	77	14.0	381
12	22.2	80	16.7	532
13	10.0	81	9.2	261
14	10.0	82	10.5	326
15	4.4	82	5.3	147
16	4.4	90	6.2	196
17	2.2	93	3.5	85
18	1.1	73	1.9	40
<b>Totals</b>	<b>106.5</b>		<b>81.4</b>	<b>2,324</b>

Avg. d.b.h., 11.4 in.; Avg. total height, 76 ft.



Fig. 10. Fifty-six-year-old black walnut plantation, Michigan State University Campus.

This plantation is becoming a very high quality stand, with almost two-thirds of its volume already in grade 1 logs. Growth has been slow, however, averaging about 42 cu. ft. per acre per year (excluding the volumes removed in thinnings). The average annual diameter growth has been .20 in., which is also quite low.

If the stand growth continues at its present rate, it will take approximately 40 years for the average tree diameter to reach 20 in. d.b.h. The estimated volume at that time would be approximately 4,000 cu. ft. per acre. If the estimated volume 40 years hence were distributed by log grade in the same way as the present volume, then an estimate of future value could be obtained by applying estimated prices for each log grade.

## SUMMARY

The 10 black walnut plantations ranging in age from 19 to 56 years, and the 60-year-old natural stand for which data are presented in this report, show generally slow growth. No weed control practices were applied apart from cultivation for 2 years at most after planting. All plantings were made on abandoned agricultural land whose fertility was depleted, except for that at Michigan State University. Unfortunately, the campus planting is on poorly to imperfectly drained soil, which is not conducive to the development of the tap root of walnut. No fertilizer or other soil amendments were applied to any of these stands.

The 56-year-old campus plantation may become a high quality, high value stand, but at its present diameter growth rate (.20 in. per year), it will take 40 more years for the average tree to reach 20 in. in diameter.

These growth data show that planting black walnut in mixtures with other species, or bordering walnut plantations with coniferous plantings has little beneficial effect without additional cultural treatments. In each planting studied, considerable numbers of trees, shrubs, vines and herbaceous vegetation have developed, even in closed stands, hampering walnut growth.

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## Research Units of the Michigan Agricultural Experiment Station

- 1** Upper Peninsula Experiment Station, Chatham. Established 1907. Beef, dairy, soils and crops. In addition to the station proper, there is the Jim Wells Forest.
- 2** Dunbar Forest Experiment Station, Sault Ste. Marie. Established 1925, forest management.
- 3** Lake City Experiment Station, Lake City. Established 1928. Breeding, feeding and management of beef cattle; and fish pond production studies.
- 4** Graham Horticultural Experiment Station, Grand Rapids. Established 1919. Varieties, orchard soil management, spray methods.
- ★** Michigan Agricultural Experiment Station, Headquarters, 101 Agriculture Hall, MSU, East Lansing. Established 1888. Research work in all phases of Michigan agriculture and related fields.
- 6** Muck Experimental Farm, Laingsburg. Plots established 1941, crop production practices on organic soils.
- 7** South Haven Experiment Station, South Haven. Established 1890. Breeding peaches, blueberries, apricots. Small fruit management.
- 8** W. K. Kellogg Farm and Bird Sanctuary, Hickory Corners, and W. K. Kellogg Forest, Augusta. Established 1928. Forest management, wildlife studies, mink and dairy nutrition.
- 9** Fred Russ Forest, Cassopolis. Established 1942. Hardwood forest management.
- 10** Ferden Farm, Chesaning. Plots established 1928. Soil management, with special emphasis on sugar beets. (Land Leased)
- 11** Montcalm Experimental Farm, Entrican. Established 1966. Research on crops for processing, with special emphasis on potatoes. (Land Leased)
- 12** Sodus Horticultural Experiment Station, Sodus. Established 1954. Production of small fruit and vegetable crops. (Land Leased)
- 13** Trevor Nichols Experimental Farm, Fennville. Established 1967. Studies related to fruit crop production with emphasis on pesticides research.