grape juice. Following the early success of Canada Muscat a larger planting of this cultivar was made from which very promising unfermented juice and wine have been produced. Details of fruit composition are shown in Table 2.

Of the two seedless varieties, Himrod is the more vigorous, but its fruit abscises as soon as it is ripe. Romulus appears to be more fruitful and the attractive bunches mature and hold well.

Table 2. Composition of Canada Muscat grapes grown at Merbein.

Date of harvest	Total soluble solids °Brix	pH	Titratable acidity gl^{-1} as tartaric
Feb. 6, 1976	18.0	3.21	8.5
Feb. 7, 1977	16.2	3.52	5.7
Feb. 3, 1978	19.5	3.30	5.1

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Black Walnut Variety Trials—1950-1977

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In the spring of 1950 a grove of 59 black walnut trees, grafted on seedling stock, was established on The Pennsylvania State University Pomology Farm. In 1959 two trees of Cornell black walnuts were added to the grove. The tree numbers for each variety are given in Table 1.

The various varieties were obtained from many sources; however, most came from Tennessee Valley Authority nurseries. The exact source of each variety is not known as no record now exists. Through 1961 and 1956 the grove was supervised by the second and third authors, respectively.

The numbers of trees and first-fruiting are presented for each variety in Table 1. The Burton and Cornell trees never fruited. The Burton tree lived through the 18th leaf but was never a vigorous tree. The Cornell trees likewise were weak and developed a "witches broom" growth effect several years before their death. Growth of the other varieties was uneventful.

During the 18-year period, from 1955 to 1977, two crops were lost completely to spring frosts. Although no systematic yield records were maintained, Wiard probably has produced

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more nuts than any other variety in the trial.

Initially all trees were trained to a 6 to 8 foot trunk to facilitate subsequent mowing operations. No additional pruning has been done, except to remove broken limbs.

Standard pesticide sprays, as recommended by Pennsylvania Extension Specialists, were applied periodically each year from 1950 through 1975. Annual fertilization was broadcast at the rate of one pound of 10-10-10 per inch of trunk diameter (measured at a height of 18 inches above ground). The grove floor was mowed at least three times each summer during the period of 1950-1975.

The planting is located on Hagerstown clay loam soil on a 3 to 5 percent slope. Internal soil drainage is rapid and surface runoff is not excessive.

The nuts produced per tree were examined in 1955 and 1972. In 1955, 1975, and 1977 trunk measurements were taken. The data are in Tables 4 and 5.

The procedures used to hull, cure and crack the nuts in 1955 were not recorded. The nut weights, cracking and kernel qualities for the 1955 examinations are presented in Table 2. In most cases, only a very limited quantity of nuts were tested.

In 1972, the total nut crop from each tree was harvested on October 15. The nuts were shaken from each tree and gathered immediately. The tree-to-tree yield varied widely, but no total per tree yields were recorded. The total crop per tree in the grove varied from approximately one-half bushel to 3.5 bushels of hulled nuts. The nuts were cleaned in a revolving potato peeler under a high pressure water spray. The nuts were spread in wire-bottom trays in a barn loft and allowed to air dry for 2 weeks. Thirty nut samples from each tree were selected at random and placed in coffee cans fitted with plastic lids. The 30-nut sample was selected from nuts that did not float. The cans were then placed in 8°C. storage.

Table 1. Black Walnut Variety Trial, including number of trees planted and year of first fruiting. University Park, PA.

Variety	Number of trees	Year of first fruiting
Burton	1	Never fruited[1]
Cornell	2	Never fruited[1]
Errickson	2	1974
Grundy	1	1955
Hare	2	1955
Hunter	3	1955
Kettler	4	1959
Metcalf	3	1957
Moreland	3	1955
Ohio	2	1958
Pace	3	1955[2]
Patuxent	3	1955
Schreiber	1	1957
Snyder	5	1955
Stabler	2	1956
Ten Eyck	6	1955
Thomas	10	1955
Wiard	4	1955
Zeke	2	1955
Zeta	2	1955

[1]Trees died 1967.
[2]One tree damaged by storm in 1969.

During March 1973 the cans of nuts were filled with water for 24 hours, drained, relidded and allowed to stand overnight. The nuts were cracked with a mechanical cracking device using just sufficient force to crack the shell. The shells were opened and the kernels extracted. This cracking process permits the kernel to absorb enough water to resist shattering when the shell is cracked. After extraction, the kernels were air dried at room temperature for 4 days and separated into halves, quarters, and pieces.

Fourteen of the varieties fruited in 1972; the most abundant production in the life of the planting. These trees

Table 2. Black Walnut Variety Evaluation—1955[1].

Variety and Number of Trees	Whole Nut Wt. (gm/nut)	Total Kernel Wt. (gm/nut)	Kernel to Nut Ratio (%)	Whole Quarters (%)	Empty Nuts (%)	Comments
Grundy (1)	18.80	5.08	27	83	0	Hard to crack, high kernel yield but much kernel shriveling.
Hare (1)	14.82	4.44	30	90	0	Cracks easy, plump kernels, pellicle dark, hulls cleanly.
Hunter (3)	15.88	4.28	27	73	0	Kernels severely shriveled.
Metcalf (3)	17.12	2.57	15	79	0	Kernels severely shriveled.
Pace (3)	13.23	2.50	19	75	20	Shell relatively thin. Shell clings tightly to kernel.
Patuxent (3)	20.07	3.35	17	75	10	Shell thick, hard to crack.
Snyder (5)	18.59	4.44	24	85	10	Excellent cracking quality.
Ten Eyck (6)	12.95	3.76	29	40	0	Poor cracking quality, hull clings tightly.
Thomas (10)	19.01	4.93	26	78	0	Cracked easy, plump kernels.
Wiard (4)	11.89	2.94	25	83	0	Shell thin, easy to crack, hulls cleanly. Pellicle light tan.
Zeta (2)	16.13	3.54	22	58	0	Poor cracking quality.

[1]Ten nuts/tree sampled, except only 6 nuts produced by the Grundy and 6 nuts on one of the Metcalf trees. Nuts hulled in October, 1955; cracked in December 1955.

have continued to fruit regularly since that time. None exhibit any degree of triennialism; however, all except Wiard do appear to be moderately biennial in their bearing habit. No marked differences in nut maturity have been observed.

The nut and kernel weight characteristics of the 1972 nuts were analyzed satistically to determine sample means and standard deviations. Metcalf and Schreiber produced whole nuts which were markedly heavier than Moreland and Pace (Table 3). Total kernel weight per nut in Wiard and Ten Eyck nuts was greater than with those produced by the Zeta and Pace trees. The total kernel weights of the other varieties was not statistically different.

Cracking characteristics of Wiard and Kettler were superior to that of Zeta, Zeke and Moreland as demonstrated by the combined weights of halves and quarter kernels as compared to the amount of kernel "pieces" per nut (Table 3).

Taste and physical appearance of the half- and quarter-kernels, from the 1972 crop, were described by two members of a trained taste panel. The results of their characterization are presented in Table 4. The kernels from Snyder received high marks in every category—suggesting that it would find favor as a fresh market sales item. Zeke kernels had the lightest colored pellicles of any variety sampled while Schreiber and Metcalf kernels had very dark pellicles. Nut growers prefer the lighter colored pellicles; however, this was not the reaction of the taste panel members.

Hunter, Pace, Thomas and Zeta kernels were described as unattractive because of the shrivelled appearance of the pellicle (Table 4).

Averages of trunk size and rate of growth measurements for all trees of each variety—1955 to 1977—are in-

Table 3. Black Walnut Variety Evaluation—1972.

Variety and Number of Trees	Average Nut Weight (grams)	Total Kernel Weight/Nut (grams)	Kernel Halves per nut		Kernel Quarters per nut		Kernel Pieces per nut	
			grams	% total kernel wt.	grams	% total kernel wt.	grams	% total kernel wt.
Metcalf (3)	21.3a[1]	3.39	1.33[1]	39	1.98[1]	58	0.08[1]	3
Schreiber (1)	20.3a	3.45	1.55	45	1.65	48	0.25	7
Wiard (4)	10.6a	4.59a	2.13a	46	2.22	48	0.24	6
Hare (2)	19.0a	3.66	1.66	45	1.47	40	0.53	15
Patuxent (3)	18.8a	2.75	0.95	35	1.49	54	0.31	11
Snyder (5)	17.3	3.83	1.35	35	2.21	58	0.27	7
Ten Eyck (6)	16.9	4.17a	0.94	22	2.70a	65	0.53	13
Zeta (2)	16.7	2.21c	0.19c	9	1.31	59	0.71	32
Hunter (3)	15.7	3.03	0.80	26	2.01	66	0.22	8
Kettler (4)	14.9c	3.81	2.23a	58	1.45	38	0.13	4
Thomas (10)	14.9c	2.55	1.51	59	0.82c	32	0.22	9
Zeke (2)	14.4c	3.00	0.28c	9	1.63	54	1.09a	37
Moreland (3)	13.3c	3.21	0.51	16	2.19	68	0.51	16
Pace (3)	9.8c	1.91c	1.72	90	0.18	9	0.01c	1
Mean	16.6	3.26	1.23	38	1.67	50	0.36	12
+1 Std. Dev.	17.6	4.00	1.87	—	2.31	—	0.66	—
−1 Std. Dev.	15.6	2.50	0.59	—	1.03	—	0.06	—

[1]Numbers in column, followed by "a" are greater than the mean plus one standard deviation; those marked "c" are less than the mean plus or minus one standard deviation; those not marked are in the range of the mean + or one standard deviation.

cluded in Table 5. (No record exists to explain why some of the trees were not measured in 1955.) During the early years, Patuxent and Zeta demonstrated rapid growth rate, especially when compared with Hare, Metcalf, and Pace.

Following a 20-year growth period it was found that Patuxent, Snyder and Wiard had achieved the greatest trunk diameter. They were significantly greater in trunk diameter than Errickson and Moreland (Table 5). The two latter varieties represent the slowest growth rates of any of the varieties tested.

Wiard, Patuxent and Snyder continue to grow at a faster rate than the other varieties as indicated by the trunk growth data for 1977 presented in Table 5. Errickson, Kettler and Zeke have been the slowest growing of all varieties tested during the 28-year record period.

Zeke trees consistently have produced highly desirable kernels (Tables 4 and 5), but tree growth and yield have been poor. At the other end of the spectrum of tree and kernel quality, Wiard and Snyder have demonstrated comparatively rapid tree growth (indicative of possibly high quality timber) and have consistently produced nuts with highly desirable kernel qualities (Tables 2, 3, 4, and 5).

Over the 28-year period covered in this trial, Wiard and Snyder trees are rated superior in all tree and kernel qualities compared with the other 18 varieties tested. Based on casual visual observations over the years, the Wiard has proven to be the variety best adapted to central Pennsylvania conditions of any of the varieties studied. The tree has a very erect, "self-pruning" type of growth that has resulted in a combination of nut and timber production that should be valuable characteristics for those who wish to plant black walnut trees.

Table 4. Black Walnut Kernel Characterization—1972 Crop.

Variety	Flavor	Texture	Pellicle Color	Kernel Condition
Hare	Astringent	Good	Medium	Plump
Hunter	Fair	Good	Medium	Shriveled
Kettler	Mild	Tough	——	Plump
Metcalf	Excellent	Very oily	Dark	Plump
Moreland	Fair	Oily	——	Plump
Pace	Fair	Tough, Dry	Light	Shriveled
Patuxent	Good	Good, Dry	Light	Not plump
Schreiber	Fair	Oily	Dark	Plump
Snyder	Excellent	Excellent	Medium	Plump
Ten Eyck	Good	Good	Medium	Not plump
Thomas	Fair	Tough	Medium	Shriveled
Wiard	Good	Rather tough	Medium	Plump
Zeke	Good	Excellent	Light	Not plump
Zeta	Poor	Tough, Dry	——	Shriveled

Table 5. Trunk circumference measurements. Black Walnut Variety Trial, University Park, PA.

Variety	Trunk Circumference (Inches)[1] 1955	1975	1977	Trunk Increase (Inches) 1955-1975	1975-1977
Burton	(NM)[2]	——	——	——	——
Cornell	(NM)	——	——	——	——
Errickson	(NM)	27.38c	27.69c[3]	——	0.31
Grundy	10.75	29.75	31.00	19.00	0.25
Hare	8.25c[3]	31.50	33.13	27.25	1.63
Hunter	10.75	29.42	29.67	18.67	0.25
Kettler	(NM)	28.00	28.13c	——	0.13
Metcalf	8.67	32.17	33.33	23.50	1.16
Moreland	(NM)	27.42c	29.04	——	1.62
Ohio	(NM)	29.44	31.13	——	1.19
Pace	8.17c	30.25	31.29	22.08	1.04
Patuxent	11.92a	37.50a	38.66a	25.58	1.16
Schreiber	(NM)	30.88	31.75	——	0.87
Snyder	10.00	38.63a	40.15a	28.63	1.52
Stabler	(NM)	30.00	31.37	——	1.37
Ten Eyck	10.67	34.54	35.08	23.87	0.54
Thomas	11.78	30.67	31.28	18.89	0.61
Wiard	10.75	37.72a	38.53a	26.97	0.81
Zeke	(NM)	24.88c	25.00c	——	0.12
Zeta	12.75a	34.07	34.38	21.32	0.31
Mean	10.36	31.37	32.25		
+ 1 Std. Dev.	11.80	35.17	36.23		
— 1 Std. Dev.	8.92	27.57	28.27		

[1]Measured at 18 inches above ground line.
[2]NM = no measurement recorded.
[3]Circumference marked "a" are greater than the mean plus one standard deviation. Those marked "c" are less than the mean minus one standard deviation. Those not marked are included in the range of the mean ± one standard deviation.