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PERFORMANCE of SELECTED APPLE ROOTSTOCK in the PIEDMONT AREA of CENTRAL ALABAMA, 1965 - 1975

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INTRODUCTION

SELECTING A ROOTSTOCK for trees is one of the most important decisions made before establishing an apple orchard. In fact, the root system is just as important in the production of quality trees and fruit as is the scion variety which it supports. Thus, a wrong choice will penalize the grower for as long as the orchard is maintained.

Some of the important characteristics that should be considered when selecting a rootstock are: (1) type of rooting system that it develops, anchorage, and performance in a given soil type and moisture condition; (2) effect on ultimate tree size and form; (3) ability of the rootstock to induce the scion variety to begin fruiting at an early age and bear larger yields each successive year; (4) influence on fruit size, color, and quality; (5) degree of resistance to certain insects and diseases; (6) adaptability and hardiness of the rootstock to climatic conditions and its effect on the hardiness of the scion variety; and (7) compatibility with the scion variety.

Apple production has shifted from large, standard size trees on seedling rootstocks to smaller trees on size controlling (dwarfing) rootstocks. Newer plantings may be on semi-dwarf rootstocks and be free standing or be on the dwarfing rootstocks that

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require support by trellising or staking. Mature trees that do not exceed 8 to 10 feet in height provide for efficient use of labor, by allowing harvesting and pruning to be done from the ground, and make spraying efficient. Size controlling rootstocks induce earlier fruiting and higher per acre yields, which lower per unit production costs, and improve overall fruit quality.

The size controlling Malling Merton (MM) rootstock series are crosses of 'Northern Spy' with certain 'East Malling' (EM) clones. Desired characteristics of both parents are incorporated into the MM series: size control, resistance to woolly apple aphids, improved anchorage, scion compatibility, and precocity.

DESCRIPTION OF EXPERIMENT

An experimental planting was established in 1965 and 1966 on Hiwassee series soil at the Piedmont Substation, Camp Hill, to compare performance of the more promising rootstocks of the Malling Merton (MM) series with seedling rootstocks. Purpose of this evaluation planting was to determine the apple rootstock best suited for the Piedmont Area of Alabama. To achieve this end, rootstocks were evaluated for their influence on tree size, yield, fruit size, and maturity, and susceptibility of the rootstocks to root diseases and woolly apple aphid infestations.

Rootstocks included in the study were MM 104, MM 106, MM 111, and seedling. Each rootstock was replicated 10 times with five trees per replication in a randomized complete block design. 'Miller Sturdeespur Delicious' was replicated eight times and 'Sundale Sturdeespur Delicious' was replicated two times for pollination. The Sundale Sturdeespur Delicious was top worked to 'Mollies Delicious' in 1968 and 1969. The planting was bordered on one side by a pollinator row of Mollies Delicious. Pollen was also furnished each season (1969-75) during bloom with beehive inserts.

Trees on MM 104 and seedling rootstocks were planted in the spring of 1965 and the trees on MM 106 and MM 111 were planted in spring 1966. One-year-old apple whips of ½- to ⅝-inch caliper were used. Trees were spaced 12 feet apart in rows, and the rows were 16 feet apart. This spacing is the equivalent of 227 trees per acre. The trees were trained to a modified central leader system. In the winter of 1972, and each pruning season thereafter, trees were reduced to a height of 9.5 to 10.0 feet with a Fossum tree pruner. Detailed hand pruning was carried out after mechanical pruning. Vegetation on the orchard floor was controlled by using recommended herbicides in the row and mowing between rows. Soil pH and fertility levels were maintained according to soil test and foliar analysis recommendations. The Auburn University apple spray schedule was followed for insect and disease control.

Trunk diameter, tree height, and tree width measurements were obtained in the fall of 1969, 1971, 1972, and 1975 and on July 14, 1976. Trunk diameter measurements were made 1 foot above the soil line. Measurements were made to obtain maximum tree height and tree width.

Rootstock influence on leaf area was obtained by measuring 15 average size leaves from the fruiting spurs and the center of the terminal growth of one Red Delicious tree from each of the three replications. The area of each leaf was determined by length × width measurements.

Yield data were recorded in pounds per tree for Red Delicious trees from 1969 through 1975, except in 1973. Effect of rootstock on maturity and red color development was investigated in 1971 and 1975. Twenty fruits from each of the eight replications were harvested each sample date. In 1971 the fruits were sampled August 6, 13, 20, and 27 and September 3 and 9. In 1975, the fruits were sampled August 5, 8, 11, 15, 18, 22, 25, and 29. Maturity indices investigated were fruit firmness, percent soluble solids, fruit size, ground color, flesh color, percent seed color, and percent red color development.

From 1967 through 1973, dying and dead experimental trees were evaluated for root rot causal agents. Infected tree roots and stumps were evaluated in the laboratory for *Xylaria mali* Fromme black root rot infection. Isolates of *X. mali* were evaluated for pathogenicity to apple seedlings in the greenhouse. Identification of Armillaria or oak root rot *Armillaria mellea* (Vahl) Quel., white root rot *Corticium galactinum* (Fr.) Burt, and crown gall *Agrobacterium tumefaciens* (E. F. Sm. and Towns.) Conn was made according to symptoms and cultural characteristics of the pathogen.

During July 1971, roots of all living experimental trees were sampled at five locations from the drip line to the trunk at a 6-inch depth and 12-inch width to determine woolly apple aphid infestations. Rootstock susceptibility to woolly apple aphid was evaluated on a 1 to 5 scale: 1 = no infestation or galling; 2 =

light infestation or galling (on feeder roots); 3 = medium infestation and galling; 4 = heavy infestation and galling (on roots of a portion of the tree); 5 = heavy infestation and galling on all roots.

RESULTS AND DISCUSSION

Tree Size and Leaf Area

Trunk diameter of trees on MM 111 rootstock was smaller than on MM 104, MM 106, and seedling rootstocks throughout the experiment, Table 1. Trees on seedling rootstock measured larger in trunk diameter than trees on the other rootstocks, with the exception of trees on MM 104 in 1969, 1971, and 1976. Trunk diameter of trees on MM 106 was greater than on MM 111 root-

TABLE 1. INFLUENCE OF ROOTSTOCK[1] ON TREE SIZE OF MILLER STURDEESPUR DELICIOUS APPLE TREES, PIEDMONT SUBSTATION, 1969, 1971, 1972, 1975, AND 1976

Rootstock	Trunk diameter	Tree height	Tree width
	In.	*Ft.*	*Ft.*
1969			
MM 104	2.11a[2]	8.55a	5.15a
MM 106	1.82b	8.60a	4.98a
MM 111	1.56c	7.87ab	4.41b
Seedling	2.03ab	7.34b	5.07a
1971			
MM 104	3.02ab	10.69ab	8.13a
MM 106	2.74b	11.46a	8.70a
MM 111	2.25c	9.94b	7.72b
Seedling	3.15a	11.54a	8.53a
1972			
MM 104	3.43b	9.95bc	7.00ab
MM 106	3.28b	10.90ab	7.65a
MM 111	2.65c	9.41c	6.22b
Seedling	3.93a	11.46a	7.76a
1975			
MM 104	4.10b		8.43b
MM 106	3.81b		9.00a
MM 111	3.08c		7.38c
Seedling	4.58a		9.29a
1976 (July 14)			
MM 104	4.72ab	11.22b	11.17a
MM 106	4.60b	12.40a	11.10a
MM 111	3.72c	10.20c	8.83b
Seedling	5.14a	12.63a	11.66a

[1] Trees on MM 104 and seedling rootstocks were planted in spring 1965 and trees on MM 106 and MM 111 were planted the following spring.

[2] Values in a column followed by the same letter are not significantly different (Duncan's Multiple Range Test, 5 percent level).

stock and smaller than trees on seedling rootstock. Trunk diameter of trees on MM 106 rootstock was smaller than trees on MM 104, but the difference was significant only in 1969.

Trees were hand pruned to a modified central leader system from planting through 1971 and allowed to attain their natural height and width. In the fall of 1971, trees on MM 111 rootstock were the smallest in height and width, except they did not differ in height from trees on MM 104 rootstock. The orchard was mechanically pruned to a height of 9½ to 10 feet in late winter of 1972 and each season thereafter.

In the fall of 1972, after mechanical pruning in the spring, trees on seedling and MM 106 rootstocks were the tallest and trees on MM 111 were the shortest. Trees on MM 104 did not differ in height from trees on MM 106 or MM 111 rootstocks. On July 14, 1976, trees on seedling and MM 106 rootstocks were the tallest and those on MM 111 the shortest.

Width of trees was less on MM 111 rootstock than on the other rootstocks throughout the 11 years of orchard life. The one exception was in 1972 when there was no difference in width between trees on MM 111 and MM 104 rootstock. In the fall of 1975, the width of trees on seedling and MM 106 rootstocks was greater than the width of trees on MM 104 rootstock. When measured in July of 1976 with a crop of fruit, however, width of the trees on MM 104, MM 106, and seedling rootstocks did not differ.

Throughout the 11 years of orchard life there has been a great, observable difference in tree vigor. Trees on MM 111 rootstock have not been as vigorous as trees on the other rootstocks and do not appear adapted to Piedmont growing conditions. Few lateral branches developed from the major scaffold branches and little terminal growth has been made. When pruning with a mechanical pruner, about 3 to 6 feet of excessive vegetative growth has been removed each season from the top of trees on MM 104, MM 106, and seedling rootstocks; however, no terminal growth has been removed from the top of trees on the MM 111 rootstock. In addition to observable differences in shoot growth, leaves of trees appeared sparse and smaller on MM 111 rootstock than on the other rootstocks in each growing season. In 1975, leaves on the fruiting spurs and terminal growth of trees on MM 111 rootstock were found to be smaller than leaves on trees on MM 104, MM 106, and seedling rootstocks, Table 2. Leaves

Typical appearance of trees on the four rootstocks tested are illustrated. Left to right are MM 104, MM 106, MM 111, and seedling.

on the terminal growth of trees were larger in the case of trees on MM 106 rootstock than for trees on MM 104 rootstock. The leaves from the terminal growth of trees on seedling rootstock did not differ in size from those of trees on MM 104 and MM 106 rootstocks.

Typical trees on the MM 111, MM 104, MM 106, and seedling rootstocks are shown in the color photographs on pages 8 and 9. The small, sparse foliage and lack of vegetative growth of trees on MM 111 rootstock contrast with the vigor of trees on MM 104, MM 106, and seedling rootstocks. Trees on seedling rootstock were excessively vigorous.

TABLE 2. INFLUENCE OF ROOTSTOCK ON LEAF AREA OF FRUITING SPURS AND TERMINAL GROWTH OF MILLER STURDEESPUR DELICIOUS APPLE TREES, PIEDMONT SUBSTATION, 1975

Rootstock	Leaf area	
	Fruiting spurs	Terminal growth
	Sq. cm	*Sq. cm*
MM 104	25.71a[1]	50.07b
MM 106	26.34a	54.16a
MM 111	17.56b	37.19c
Seedling	28.21a	50.58ab

[1] Values in a column followed by the same letter are not significantly different (Duncan's Multiple Range Test, 5 percent level).

Yield

Fruit set prior to 1969 was light and scattered. Inadequate pollination probably contributed to poor fruit set since the 'Golden Delicious' pollinators did not bloom with the Red Delicious variety. In 1968 and 1969, the pollinators were top worked to Mollies Delicious, which has bloomed with the Red Delicious variety each year. Golden Delicious pollen was furnished by use of beehive inserts each year starting in the spring of 1969.

Collection of yield data was begun in 1969, Table 3. Trees on MM 106 have consistently produced the highest yields and trees on seedling and MM 111 rootstock the lowest yields. Production of trees on MM 104 and MM 106 rootstocks has not varied

TABLE 3. INFLUENCE OF ROOTSTOCK[1] ON YIELD OF MILLER STURDEESPUR DELICIOUS APPLE TREES, PIEDMONT SUBSTATION

Rootstock	Yield of fruit per tree						
	1969	1970	1971	1972	1973	1974	1975
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
MM 104	11.78a[2]	37.42a	11.11ab	75.04a	----	38.86a	58.31b
MM 106	11.06a	30.20a	13.05a	78.44a	----	40.01a	116.49a
MM 111	6.99b	18.07b	5.13b	44.71b	----	29.70a	61.00b
Seedling	3.34c	19.20b	4.88b	64.66a	----	34.01a	75.51b

[1] Trees on MM 104 and seedling rootstocks were planted in spring 1965 and trees on MM 106 and MM 111 were planted the following spring.

[2] Values in a column followed by the same letter are not significantly different (Duncan's Multiple Range Test, 5 percent level).

greatly, except in 1975 when trees on MM 106 produced twice as much fruit as trees on MM 104. Even though the per tree yield of trees on MM 104 and MM 106 did not vary greatly, the per acre yield on MM 106 would be much greater due to the higher loss of trees on MM 104 rootstock.

Yield data were not collected in 1973 because the orchard was used for a growth regulator study; however, all trees set a good crop.

Rootstock did not influence bloom date of the scion variety. All Red Delicious trees bloomed together each season.

Fruit Maturity

The influence of rootstock on maturity and red color development of Miller Sturdeespur Delicious apples was investigated in 1971 and 1975. Fruit reached a minimum level of maturity for

TABLE 4. EFFECT OF ROOTSTOCK ON MATURITY OF MILLER STURDEESPUR DELICIOUS APPLES, PIEDMONT SUBSTATION, 1971

Sample date	Firmness	Soluble solids	Red color	Ground color	Fruit size	Flesh color	Seed color
		Pct.	Pct.		In.		Pct.
MM 104 rootstock							
8-6-71	23.1	9.0	34.5	G[1]	2.64	G	17.3
8-13-71	23.0	10.0	70.5	G/YT	2.71	W/YT	80.0
8-20-71	20.4	10.6	80.0	G/YT	2.85	W/YT	84.5
8-27-71	22.4	11.8	94.5	G/YT	2.76	W/YT	89.0
9-3-71	20.8	12.6	96.1	Y	2.96	Y	100.0
9-8-71	16.9	13.8	94.0	Y	2.76	Y	97.0
MM 106 rootstock							
8-6-71	22.7	8.6	36.8	G	2.64	G	12.5
8-13-71	21.1	9.6	67.0	G/YT	2.78	W	68.0
8-20-71	21.8	10.6	85.0	G/YT	2.80	W/YT	88.5
8-27-71	20.7	11.0	94.0	G/YT	3.00	W/YT	96.5
9-3-71	19.3	13.4	97.5	Y	3.04	Y	99.0
9-8-71	15.1	14.6	93.5	Y	2.94	Y	99.0
MM 111 rootstock							
8-6-71	23.5	9.0	36.8	G	2.54	G	22.3
8-13-71	23.1	10.2	70.5	G/YT	2.66	W	50.5
8-20-71	23.3	11.0	88.5	G/YT	2.69	W/YT	84.0
8-27-71	22.8	11.8	90.3	G/YT	2.83	W/YT	97.0
9-3-71	22.6	12.4	95.6	Y	2.84	W/YT	99.0
9-8-71	17.6	13.8	88.0	Y	2.69	W/YT	97.0
Seedling rootstock							
8-6-71	18.7	8.0	66.0	G	2.69	G	31.5
8-13-71	21.2	9.6	67.5	G/YT	2.66	W/GT	65.0
8-20-71	20.3	10.6	89.0	G/YT	2.82	W/YT	84.0
8-27-71	23.7	11.2	92.5	Y	2.81	W/YT	99.5
9-3-71	22.6	11.2	84.5	Y	2.81	W/YT	100.0
9-8-71	16.9	13.8	91.0	Y	2.84	W/YT	98.0

[1] G = green; W = white; Y = yellow; T = tint. Each value is the average of 20 fruit.

harvest by August 20 in 1971 and August 15 in 1975, tables 4 and 5. Rootstock did not have an appreciable influence on fruit maturity, size, or red color development. However, fruit from trees on MM 111 rootstock tended to be a little smaller and firmer and have slightly higher percent soluble solids than fruit from trees on the other rootstocks. The higher fruit firmness was due to the smaller fruit size. Fruit from trees on the MM 111 rootstock had more of the surface area with red color development, but the color was not as deep a red as fruit from trees on

TABLE 5. INFLUENCE OF ROOTSTOCK ON MATURITY OF MILLER STURDY DELICIOUS APPLES, PIEDMONT SUBSTATION, 1975

Sample date	Soluble solids	Firmness	Red color		Fruit size	Ground color	Flesh color	Seed color
			Blush	Total				
		Pct.	Pct.	Pct.	In.			Pct.
MM 104 rootstock								
8-5-75	18.2	10.3	34.5	80.6	2.72	GYT[1]	WGT	69.4
8-8-75	17.4	9.0	41.7	81.8	2.77	GYT	WGT	53.7
8-11-75	17.8	9.1	36.3	83.0	2.73	GYT	WGT	50.3
8-15-75	17.9	10.5	50.2	87.5	2.78	GYT	WGT	87.3
8-18-75	17.7	10.9	48.1	86.7	2.88	GYT	WYT	98.6
8-22-75	17.1	11.6	60.5	91.2	2.90	YGT	WYT	96.3
8-25-75	17.1	11.6	48.0	91.3	2.82	YGT	WYT	99.4
8-29-75	15.6	12.1	44.0	84.2	2.90	YGT	Y	100.0
MM 106 rootstock								
8-5-75	17.5	10.0	31.1	73.7	2.80	GYT	WGT	68.3
8-8-75	17.6	9.2	35.9	82.9	2.91	GYT	WGT	44.9
8-11-75	17.2	9.0	32.3	81.3	2.90	GYT	WGT	55.7
8-15-75	17.9	10.3	47.9	89.6	2.91	GYT	WGT	95.9
8-18-75	17.2	10.8	50.7	89.2	2.90	GYT	WYT	93.8
8-22-75	17.5	11.2	59.0	89.6	2.98	YGT	WYT	89.7
8-25-75	16.3	11.8	55.0	89.6	2.97	YGT	Y	98.0
8-29-75	15.4	11.6	43.0	84.5	3.19	YGT	Y	100.0
MM 111 rootstock								
8-5-75	18.1	9.9	31.3	78.4	2.64	GYT	WGT	56.9
8-8-75	19.0	9.4	38.0	81.1	2.69	GYT	WGT	50.4
8-11-75	18.7	8.9	35.3	85.2	2.63	GYT	WGT	43.0
8-15-75	18.2	10.9	51.0	87.0	2.76	GYT	WGT	95.4
8-18-75	17.8	11.4	64.7	91.4	2.80	GYT	WYT	97.1
8-22-75	17.8	12.1	58.3	90.4	2.73	YGT	WYT	92.4
8-25-75	17.6	12.0	52.4	90.0	2.72	YGT	WYT	98.3
8-29-75	16.2	12.4	57.7	91.4	2.80	YGT	Y	100.0
Seedling rootstock								
8-5-75	18.1	9.5	23.6	68.3	2.78	GYT	WGT	66.9
8-8-75	18.3	8.8	30.1	70.3	2.76	GYT	WGT	50.9
8-11-75	16.8	9.0	33.8	81.3	2.88	GYT	WGT	54.4
8-15-75	17.8	10.5	44.5	86.7	2.80	GYT	WGT	92.0
8-18-75	17.4	10.7	48.7	85.9	2.88	GYT	WYT	99.4
8-22-75	17.1	11.1	51.6	88.0	2.93	YGT	WYT	91.8
8-25-75	16.2	11.2	43.9	83.7	2.92	YGT	WYT	95.7
8-29-75	15.5	11.9	42.0	80.3	2.79	YGT	Y	100.0

[1] G = green; W = white; Y = yellow; T = tint. Each value is the average of 20 fruit.

the other rootstocks. The fruit exhibited a brown sunburned appearance and was not as attractive.

Tree Mortality

During the first 11 years of the orchard life (1965-75), a higher percentage of trees died from *X. mali*, *A. mella*, *C. galactinum*, and *A. tumefaciens* on MM 104 than on MM 106, MM 111, and seedling rootstocks, Table 6. During this 11-year period, 62 percent of trees on MM 104 rootstock died, as compared with 18, 28, and 28 percent on MM 106, MM 111, and seedling rootstocks, respectively.

Incidence of black root rot was high in the test orchard and was the major causal organism of tree loss on all rootstock, Table 7. MM 104 rootstock was found to be more susceptible to black root rot than MM 106, MM 111, and seedling rootstocks. Of trees on MM 104 rootstock, 56 percent were lost from black root rot during the 11 growing seasons, 1965-75. Losses on seedling rootstock were 12 percent during the same period. Most tree loss occurred after fruiting began; however, 18 percent of the trees on MM 104 rootstock died during the first 4 years.

Apple trees infected with black root rot exhibited sparse, small, off-colored foliage and small, highly-colored fruit. The infected trees died during the season when symptoms appeared or the following year. Trees that had died from black root rot possessed brittle, punky, rotted roots with a black encrustation of *X. mali* mycelium covering the stump. Trees in such condition snapped off at or slightly below the soil surface. *X. mali* was isolated only from roots and stumps possessing characteristic symptoms of black root rot. Several *X. mali* stromata were found on tree stumps. Pathogenicity of all isolates tested were confirmed on apple seedlings.

TABLE 6. TREE MORTALITY CAUSED BY ROOT ROTS, BY ROOTSTOCK AND YEAR, PIEDMONT SUBSTATION, 1965-75

Rootstock	Tree loss								
	1965-67	1968	1969	1970	1971	1972	1973	1974-75	Total
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
MM 104	4	22	4	8	2	8	6	8	62a[1]
MM 106	0	2	0	0	2	2	2	10	18b
MM 111	0	0	0	6	6	2	10	2	28b
Seedling	0	0	2	4	2	6	0	14	28b

[1] Values in a column followed by the same letter are not significantly different (Duncan's Multiple Range Test, 5 percent level).

TABLE 7. TREE MORTALITY FROM CERTAIN CAUSAL ORGANISMS[1], PIEDMONT SUBSTATION, 1965-75

Rootstock	Tree loss			
	Black root rot	Oak root rot	White root rot	Crown gall
	Pct.	*Pct.*	*Pct.*	*Pct.*
MM 104	56a[2]	2	2	2
MM 106	12b	6	0	0
MM 111	28b	0	0	0
Seedling	20b	0	8	0

[1] Causal organism: Black root rot (*Xylaria mali*), oak root rot (*Armillaria mellea*), white root rot (*Corticium galactinum*), and crown gall (*Agrobacterium tumefaciens*).
[3] Values in a column followed by the same letter are not significantly different (Duncan's Multiple Range Test, 5 percent level).

Incidence of white root rot, oak root rot, and crown gall was slight in the test orchard. During the 11-year period, 2 percent of the trees on MM 104 and 6 percent of the trees on MM 106 rootstock were lost because of oak root rot, and 2 percent of trees on MM 104 and 8 percent on seedling were killed by white root rot. Only 2 percent of the trees on MM 104 rootstock died from crown gall. No trees were lost due to collar rot (*Phytophthora cactorum*) in this planting, even though MM 106 is reported to be susceptible to it.

Woolly Apple Aphid Infestation

Seedling rootstocks were significantly more susceptible to woolly apple aphid infestations than MM rootstocks, Table 8.

TABLE 8. SUSCEPTIBILITY OF APPLE ROOTSTOCKS TO THE WOOLLY APPLE APHID, PIEDMONT SUBSTATION[1]

Rootstock	Trees per rating group[2]					Rating	Infested
	1	2	3	4	5		
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Av.*	*Pct.*
MM 104	96.8	0	0	0	3.2	1.1a[3]	3.2a
MM 106	95.7	4.3	0	0	0	1.0a	4.3a
MM 111	81.0	16.7	2.4	0	0	1.2a	19.1a
Seedling	44.4	4.4	20.0	0	31.1	2.7b	55.5b

[1] Trees were 7 years old when surveyed.
[2] Rating scale: 1, no infestation or galling; 2, light infestation or galling (only on small feeder roots); 3, medium infestation and galling; 4, heavy infestation and galling (located on roots only around a portion of the tree); 5, heavy infestation and galling (located on all roots around the tree).
[3] Values in a column followed by the same letter are not significantly different (Duncan's Multiple Range Test, 5 percent level).

Most seedling rootstocks were moderately to heavily infested with aphid colonies. Galling was found on lateral roots as well as on small feeder roots. MM rootstocks were lightly infested or galled primarily on the small feeder roots. The MM rootstocks did not differ statistically from each other in resistance to woolly apple aphids. However, MM 111 showed a considerably higher degree of susceptibility (19.1 percent) than MM 104 (3.2 percent) or MM 106 (4.3 percent). Further investigations appear warranted to verify MM rootstock susceptibility to woolly apple aphid.

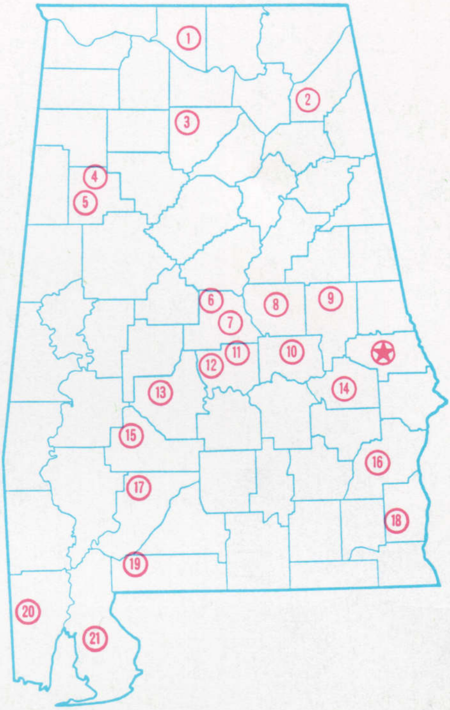
CONCLUSIONS

Results of this investigation indicate that MM 106 is the best of the four apple rootstocks tested for the Piedmont Area of central Alabama. Trees on MM 106 had earlier and higher yields, and there was less tree loss than with other rootstocks tested. Rootstock had no influence on bloom date and little effect on fruit maturity. MM 104 rootstock was found to be unsuitable because of its high degree of susceptibility to black root rot. Seedling and MM 111 were unsuitable due to lower yields and susceptibility to woolly apple aphid infestations. Trees on MM 111 rootstocks had sparser and smaller leaves and weaker growth than trees on the other rootstocks tested. This rootstock does not appear adaptable to growing conditions in the Piedmont Area. It was not possible to maintain trees on MM 104, MM 106, and seedling rootstocks short enough to permit pruning and harvesting without the aid of ladders.

Additional investigations are needed to find an apple rootstock that will induce earlier and heavier fruiting, possess more disease and insect resistance, and restrict vegetative growth more. Ideal tree height should not exceed 8 to 10 feet for most efficient production. Economy of production and tree size control not only depend on the rootstock used but on scion variety, tree training and pruning, soil type, and cultural management.

Alabama's Agricultural Experiment Station System
AUBURN UNIVERSITY

With an agricultural research unit in every major soil area, Auburn University serves the needs of field crop, livestock, forestry, and horticultural producers in each region in Alabama. Every citizen of the State has a stake in this research program, since any advantage from new and more economical ways of producing and handling farm products directly benefits the consuming public.



Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Thorsby Foundation Seed Stocks Farm, Thorsby.
7. Chilton Area Horticulture Substation, Clanton.
8. Forestry Unit, Coosa County.
9. Piedmont Substation, Camp Hill.
10. Plant Breeding Unit, Tallassee.
11. Forestry Unit, Autauga County.
12. Prattville Experiment Field, Prattville.
13. Black Belt Substation, Marion Junction.
14. Tuskegee Experiment Field, Tuskegee.
15. Lower Coastal Plain Substation, Camden.
16. Forestry Unit, Barbour County.
17. Monroeville Experiment Field, Monroeville.
18. Wiregrass Substation, Headland.
19. Brewton Experiment Field, Brewton.
20. Ornamental Horticulture Field Station, Spring Hill.
21. Gulf Coast Substation, Fairhope.