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Auburn 76 FMN

A Fusarium Wilt, Tobacco Mosaic Virus, Root-knot Nematode Resistant Tomato Variety

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Auburn 76 FMN, A Fusarium Wilt, Tobacco Mosaic Virus, and Root Knot Nematode Resistant Tomato Variety

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AUBURN 76 FMN, hereafter referred to as Auburn 76, is an indeterminate, true breeding, standard tomato variety. It possesses a unique combination of 3 genetic disease resistances not previously available in a single variety, viz. to Fusarium wilt (F) race 1, to tobacco mosaic virus (M) and to root knot nematodes (N). It also possesses resistance to ripe rot of the fruit for on ground field culture. Auburn 76 is high yielding, with a high percentage of marketable fruit of good quality.

ORIGIN

The pedigree of Auburn 76 reflects the breeder's motto: 'Cross the best with the best'. Southern Tomato Exchange Program (STEP) entries that appear in its pedigree were all fresh market types developed by plant scientists of the United States Department of Agriculture (USDA) and of State Agricultural Experiment Stations (AES). They all carried the dominant gene pair I/I conferring immunity to race 1 of *Fusarium* wilt from the currant tomato *Lycopersicon pimpinellifolium* Accession 160 (2, 5, 6). Roma (USDA) and Chico (Texas AES) are smaller fruited pear shaped processing tomatoes.

Auburn University (AU) developed breeding lines used were all true breeding resistant to the southern root knot nematode *Meloidogyne incognita* and its race *acrita,* the cotton root knot nematode. The dominant gene pair Mi/Mi governing nematode resistance derives from the Hawaii AES line No. 4521. The gene Mi was originally transferred from *L. peruvianum* P.I. 128657 to *L. esculentum* by means of the embryo culture technique through the combined efforts of Dr. Paul G. Smith (California AES), Dr. Victor M. Watts (Arkansas AES) and Dr. W. A. Frazier (Hawaii AES), in what has now become known as the famous Smith-Watts-Frazier triangle (4, 5).

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The Ohio mosaic resistant (OMR) releases OMR4 and OMR9 provided the best of several possible sources of genetic resistance to tobacco mosaic virus (TMV) presently known, viz. the dominant gene pair Tm_2^a/Tm_2^a, the superscript denoting the particular gene that Dr. L. J. Alexander transferred from *L. peruvianum* P.I. 128650 to *L. esculentum* (1, 3), also by means of the embryo culture technique.

The pedigree chart shows the sources of additional varieties and breeding lines that entered the lineage of Auburn 76.

DESCRIPTION

Plant Type

Plants of Auburn 76 are medium early in maturity. They are vigorous, indeterminate (sp^+ gene) with 3 to 4 nodes between flower clusters, yet compact because of short internodes. Auburn 76 is therefore suitable for stake culture for the production of high yields over an extended harvest season. Leaf cover is adequate to protect the fruit against sunscald but is not excessive for hand harvesting.

Fruits

Fruits of Auburn 76 are medium sized, crack resistant, smooth, deep oblate, with a small stylar scar and medium sized, moderately depressed stem scar. The fruit stem is jointed. The average marketable fruit weight ranged from 0.27 - 0.35 pound, depending on plant spacing, soil fertility, season, and location, tables 2, 3. The immature fruit color is pale green with a darker, medium green shoulder (ug gene). Smaller and younger fruit tend to be bluntly pointed (cover photo). The immature fruit shows superior shoulder ripening characteristics when stored in an air conditioned room at 75°F, or at ambient outdoor summer temperatures in the shade. Mature green fruit thus ripened developed superior external color in 3 - 7 days while more immature fruit turned evenly pink in 3 — 4 weeks, with some shrinkage but with few rotted. The fruit is medium firm at optimum maturity.

Fruit Quality

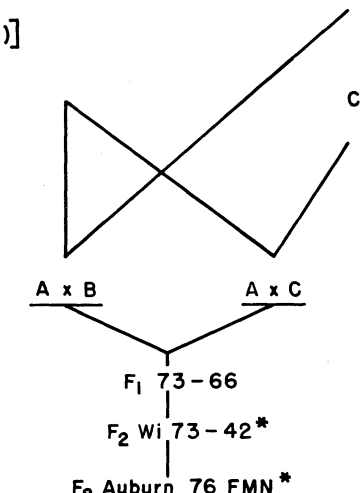
The internal color of Auburn 76 fruits varies from a pale red with some green gel to a uniform dark red flesh and gel color (cover photo). The fruit wall is medium thick, the flesh is juicy and the core is small. Fruit flavor is good with a proper balance between sugar and acid. The pH of fresh field grown fruit ranged from 4.0 to 4.3 in 1975 and from 4.3 to 4.4 in 1976. Corresponding soluble solids percentages ranged

PEDIGREE OF AUBURN 76 FMN

A = F_8 [(Floradel x Atkinson x Manalucie) x F_6 (AU 63-20 x Roma x AU 20 x Chico x STEP 372 x Marion x AU 20 x Atkinson = F_6 AU 67-21)] = F_8 AU 72-4*

B = F_1 [F_2 ((F_5 AU 70-81 x STEP 586 x OMR_9)) x F_7 of 'A'] = F_1 AU 72-137*

C = F_2 [F_2 [((F_6 AU 67-21 x AU 67-43 A x F_1 ((OMR_4 x F_5 (Roma x AU 20 x Chico x STEP 432 x AU 67-43 A))] x F_7 of F_6 67-21] = F AU 72-85*



N. B. F_3 AU 63-20(Mi/Mi) has a complex pedigree, similar to that of Atkinson, involving Pearson S, F_4(Ala No. 1 x 15B-1), Hawaii AES 4521(Mi/Mi), Kokomo, Rutgers, STEP 174 (USDA), and STEP 281 (S. C. AES).
AU 67-43 A (Mi/Mi), a processing type breeding line was F_6 (Campbell Soup Co., L. W. Schaible heatset lines No. 783 or 788 x Roma x Au 20 x Chico). Heat tolerance in the Schaible lines derives from the Philippine tomato variety Narcarlang.
AU 70-81 Mi/Mi) is F_5 (P. I. 273444 (Compact fruited determinate 'Birdsnest' type from Professor T. O. Graham, University of Guelph, Canada) x 67-43 A).
*Numbers with asterisks are superior selections.

TABLE 1. VINE RIPE TOMATO FRUIT QUALITY CRITERIA, AUBURN STAKED TRIAL, JULY—AUGUST, 1976

Variety	Means of 4 samples[1]			
	pH	Soluble solids	Total acidity	Vitamin C
		Pct.	*Pct.*	*mg/100g*
L. pimpinellifolium				
P.I. 127805 P_7	4.17 a[2]	6.50 a	0.68 a	60.2 a
Saturn	4.26 ab	5.45 b	0.61 b	34.7 bc
Small Fry	4.30 bc	4.20 ef	0.51 cd	36.1 b
Golden Jubilee	4.30 bc	5.07 bc	0.56 bc	29.2 cde
Floradel	4.32 bcd	5.10 bc	0.47 defg	26.4 ef
Atkinson	4.33 bcde	5.10 bc	0.48 def	33.2 bcd
Auburn 76 FMN	4.37 bcdef	5.17 bc	0.42 fgh	27.3 ef
Bonnie NR	4.37 cdef	4.20 ef	0.47 def	20.9 g
Homestead 24	4.40 cdefg	4.25 ef	0.52 cd	28.8 de
Walter	4.43 efg	4.62 de	0.45 defgh	23.1 fg
Better Boy VFN	4.44 fg	5.12 bc	0.44 efgh	30.9 bcde
Traveler	4.45 fg	4.77 cd	0.49 de	34.1 bcd
Chico Grande	4.47 fg	3.97 f	0.43 efgh	19.9 g
Tropic	4.49 g	4.62 de	0.42 fgh	26.6 ef

[1]Fruits were harvested at optimum maturity. A sample for analysis consisted of five quarter sections, one from each of five fruits. Four samples were taken of each variety over a 1-month period.
[2]Means with no letters in common differ significantly at odds 19:1 by Duncan's new multiple range test.

from 4.4 to 5.2 and from 5.1 and 5.2 respectively. Total acidity and ascorbic acid (Vitamin C) levels also conformed to acceptable standards, Table 1. High total acidity and high Vitamin C are considered to be desirable quality characteristics in tomatoes. A pH below 4.4 is considered essential in canning tomatoes and is preferred also in fresh market tomato varieties. A high soluble solids content as measured with a refractometer means a high sugar level. The combination high acid plus high sugar is prerequisite to good flavor in tomatoes as judged by most people.

Yields

In trials at Auburn and Clanton in 1975 and at Clanton in 1976, Auburn 76 yielded as well as or better than the four standard varieties Homestead 24, Tropic, Floradel, and Walter. However, the mean fruit weight was smaller than that of these four varieties, Table 2. The percent of marketable fruit in the more accurately graded trials at Auburn in 1975 and at Clanton in 1976 showed that Auburn 76 produced a significantly higher percentage of marketable fruit than the four commercial varieties. This difference is probably due to fewer rotted and catfaced fruits, tables 2, 3. In a staked, replicated trial at Fairhope in 1975, Auburn 76 yielded nearly 22 tons in 14 harvests, second only to the F_1 hybrid Monte Carlo and significantly above 10 commercial varieties, Table 3.

TABLE 2. COMPARATIVE PERFORMANCE OF AUBURN 76 FMN WITH THAT OF FOUR STANDARD COMMERCIAL TOMATO VARIETIES AT AUBURN AND CLANTON, ALABAMA 1975-1976

Entry	Marketable fruit			Average marketable fruit wt.			Marketable fruit			Rotted fruit			Catfaced fruit		
	A'75[1]	C'75	C'76	A'75	C'75	C'76	A'75	C'75	C'76	A'75	C'75	C'76	A'75	C'75	C'76
	T/A	*T/A*	*T/A*	*Lb.*	*Lb.*	*Lb.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Auburn 76 FMN	5.1a[2]	5.1ab	7.5a	.27a	.31b	.35b	60.4a	54.6a	64.8a	11.3a	6.6a	7.3a	9.2a	8.1a	22.2
Homestead 24	3.4b	6.8a	6.5ab	.28a	.34ab	.39a	48.5b	59.9a	61.7b	19.2a	9.5a	10.0a	12.2a	9.6a	20.9
Tropic	2.8b	5.6ab		.29a	.37a		45.1b	52.5a		18.2a	11.0a		26.3c	18.8b	
Floradel	2.7b	5.1b	7.4a	.25a	.32b	.39a	48.6b	54.1a	59.9bc	17.7a	9.6a	10.8a	16.1b	13.4b	24.1
Walter			5.0b			.38ab			54.3c			9.7a			29.6

[1]Abbreviations: A'75, C'75, C'76 refer to yield trials at Auburn (one harvest) and Clanton (3 harvests) in 1975, and to a single harvest trial at Clanton in 1976. A hailstorm on May 26, 1975, severely damaged the Auburn trial but the plants made a remarkable recovery.
[2]Duncan's multiple range test. Entries with no common letter differ significantly at odds 19:1.

TABLE 3. STAKED REPLICATED FRESH MARKET TOMATO TRIAL, FAIRHOPE, 1975[1]

Variety	Source	Marketable yield/acre[2]									Culls				Quality Criteria			
		5x6[3]	Mean fruit wt.	6x6	Mean fruit wt.	6x7	Mean fruit wt.	Total[4]	Mean fruit wt.	DT[5]	Total wt.	Cracks	Catface	Others[6]	pH	Total acidity	Vit. C	Harvest season[7]
		Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*		*Lb.*	*Lb.*		*Lb.*	*Pct.*	*Pct.*	*Pct.*	*Av.*			
Monte Carlo																		
VFN	Petoseed	26,976	.56	12,787	.35	7,114	.26	46,877	.42	a	10,747	30	31	39	4.27	.304	27.15	E
Auburn 76	Alabama AES	13,305	.48	16,274	.34	14,333	.24	43,912	.33	ab	5,889	9	4	87	4.25	.304	21.88	E
Floradel	Asgrow	21,939	.54	11,765	.36	8,782	.26	42,486	.40	abc	6,524	34	21	55	4.22	.295	19.93	M
Terrific VFN	Petoseed	19,705	.54	14,572	.37	7,625	.24	41,902	.39	abc	14,343	24	40	36	4.25	.322	26.67	E
Tropic	Asgrow	23,134	.56	12,089	.38	4,715	.27	39,938	.44	bc	6,754	50	16	34	4.31	.282	18.90	L
Better Boy																		
VFN	Petoseed	21,763	.57	11,108	.39	4,823	.27	37,694	.46	bcd	9,955	24	46	30	4.18	.406	23.33	E
Bonnie N	Bonnie Farms	14,127	.49	12,690	.35	8,827	.24	35,644	.35	cd	6,788	20	12	68	4.18	.285	25.85	E
Creole	LSU	14,870	.54	10,212	.36	9,787	.26	34,869	.37	cde	7,834	21	14	65	4.33	.260	25.00	M
Walter	Asgrow	10,026	.47	10.988	.36	7,790	.25	28,804	.34	def	6,377	31	9	60	4.27	.295	24.68	E
Homestead Elite	Ferry Morse	12,730	.48	8,479	.35	6,708	.24	27,917	.36	ef	4,390	13	3	84	4.21	.360	26.13	E
Homestead 500	Petoseed	10,974	.45	8,276	.33	6,933	.24	26,183	.33	f	4,746	8	2	90	4.24	.323	28.35	M
Florida MH-1	Florida AES	11,008	.47	8,043	.35	6,510	.24	25,561	.35	f	4,042	16	9	75	4.28	.286	24.15	M
Traveler	Petoseed	7,640	.41	7,111	.33	8,799	.24	23,550	.31	f	3,041	5	2	93	4.31	.286	22.30	L
Homestead 24	Niagara	8,542	.44	7,045	.34	7,017	.23	22,504	.32	f	3,513	15	2	83	4.25	.385	26.83	E
Homestead 61	Petoseed	7,949	.44	7,595	.34	6,213	.24	21,757	.33	f	6,656	10	2	88	4.25	.335	25.53	M
Sunburst	ClemsonU.	4,431	.39	5,624	.34	10,749	.24	20,804	.29	f	5,813	2	2	96	4.29	.307	27.45	L

[1]Soil test p — 110 (high); k — 90 (medium); pH — 5.7. 1 ton limestone applied per acre.
[2]Size yields reported here are in accordance with the size standards established by the USDA for the Los Angeles type lug arrangements.
5x6 arrangement: medium diameter 2-11/16 inches; maximum diameter 3-3/16 inches.
6x6 arrangement: minimum diameter 2-8/16 inches; maximum diameter 2-14/16 inches.
6x7 arrangement: minimum diameter 2-4/16 inches; maximum diameter 2-10/16 inches.
[3]Some fruits in this size arrangement were larger than standard sizes.
[4]While fruits were graded as carefully as possible under field conditions, no rigid effort was made to grade for a strict U.S. No. 1 grade. Fruits were separated for cull conditions as reported here.
[5]Duncan's multiple range test. Entries with no common letter differ significantly at odds 19:1.
[6]Others were mostly tomatoes too small to be marketed in the above sizes. Some were from rots, insect damage, mechanical damage and misshapen fruits.
[7]E — early; M — mid-season, L — late.

Disease Resistances

The TMV resistance of Auburn 76, conferred by the gene pair Tm_2^a/Tm_2^a, is practical immunity against all strains of this virus tested in the USA (3). TMV resistance is important to home gardeners and to commercial growers as early infested plants suffer 25 percent or more yield loss.

Root knot nematode resistance continues to be important in both greenhouse and field production of tomatoes because soil sterilization only controls but does not eradicate this pest. Crop rotation plus the use of a resistant variety, plus soil sterilization offer the best chance for root knot control. All three of these control measures should be used to reduce the nematode population to a minimum level and hopefully to eradicate this pest. It should be emphasized that the root knot resistance of Auburn 76 is not immunity, and that successive cropping with this variety on the same land without control measures would result in the buildup of a new race of the root knot nematode that would attack the resistant variety.

Uses

Based on its plant and fruit characteristics plus its disease resistances, Auburn 76 should prove useful to home gardeners and to commercial growers of green wrap or vine ripe tomatoes. However, commercial production should be on a trial basis because no commercial trials have as yet been made. Auburn 76 should also serve as a superior parent in breeding programs for multiple disease resistances.

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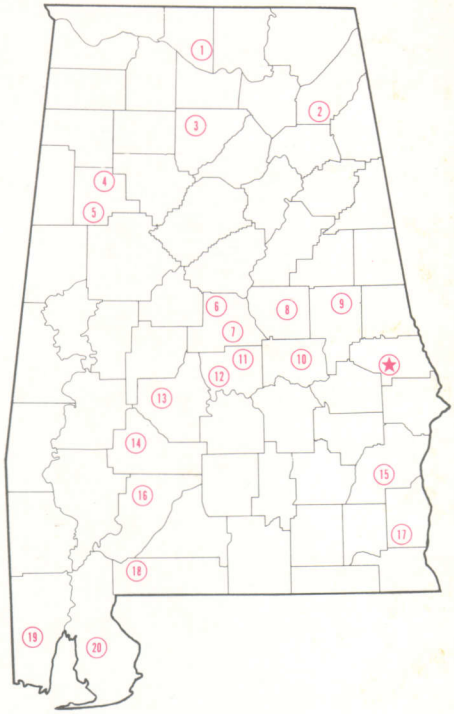

Research Unit Identification

★ 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.
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15. Forestry Unit, Barbour County.
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