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Fresh Market Tomato Cultivar Evaluation for Northern Indiana, 2005

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The Indiana Agricultural Statistics Service reported that tomatoes for fresh market sales were harvested from 1,700 acres in Indiana in 2004 and had a total value of $21 million. Tomato fields are located throughout the state. Traditional wholesale buyers look for a large, firm, round tomato that will be red when ripe. Tomato growers are interested in identifying cultivars that show resistance to common foliar diseases like early blight and bacterial spot. Eleven semi-determinate large-fruited red tomato varieties were evaluated in a replicated trial at the Pinney-Purdue Agricultural Center in Wanatah, Indiana. Four indeterminate varieties reported to be resistant to early and late blight were also included in the plot. Two of these produced large round tomatoes, one produced small round cluster tomatoes, and the fourth produced grape tomatoes.

Materials and Methods. The trial was conducted on a Tracy Sandy Loam. Fertilization, insect and weed management followed recommended practices for the area. The trial was arranged in a randomized complete block design with 3 replications. A single plot consisted of 8 plants spaced 2 ft. apart. Rows were centered 6 ft. apart on top of 30-in. beds covered with black plastic mulch. The replicated trial was bordered on each end by a single row of tomatoes. Tomatoes were seeded on April 17 into 72-cell square TLC plug trays. Seedlings were transplanted to the field on May 24 using a waterwheel transplanter. A 9-45-15 starter fertilizer mixed at a concentration of 12 oz./50 gal. water was applied at transplanting. Irrigation was applied as needed through drip irrigation beneath the plastic. Plants were supported using a stake and weave system. A typical disease management program was followed, with applications of Quadris on 7/2, 7/25 and 8/17; Bravo Weatherstik on 7/2, 7/15, 8/1, and 8/8; and Kocide 4.5 LF on 8/1, 8/8, 8/17 and 8/26. Fungicides were applied using an air-blast sprayer.

The grape and cluster varieties were not harvested regularly because they were included in the trial primarily to observe their disease resistance. Two replications of each were harvested on Aug. 22, and average fruit size determined. Other varieties were harvested on Aug. 10, 17, 24, 30-31, Sept. 6-7, and Sept. 23. Fruit at or beyond the pink stage was harvested except for the final harvest when all turning fruit were harvested. On the first three harvest dates, tomatoes were graded into USDA No. 1, No. 2, and culls. USDA No. 1 fruit were sorted into USDA size classes: maximum large, extra large, large, and medium+small. We recorded the weight and number of fruit in each category, the number of culls due to catfacing, cracking, blossom end rot, and other reasons. Bacterial spot infection was present in some varieties, but fruit was not culled due to bacterial spot alone because we wanted to evaluate other quality factors. On the fourth and fifth harvest dates, tomatoes were graded into marketable and cull fruit and a subsample of 25 marketable fruit per plot were further graded as described above. The subsample was used to estimate the total number and weight of fruit in each grade and size category harvested that day from that plot. On Sept. 23 tomatoes were graded into marketable and cull and weight in each category determined. Fruit characteristics, including shape, firmness, skin smoothness, and overall attractiveness were evaluated at the third harvest. Plant height (two replications), overall vigor, and overall disease were evaluated on Sept. 17-18. Also at that time, the percent of leaf area covered by disease lesions was estimated for two leaves from the lower canopy on each side of the row, for a total of 4 leaves per plot. Diseases present included bacterial spot, early blight, and bacterial speck; bacterial spot was probably the most prevalent. Yield data from replicated plots were subjected to analysis of variance followed by mean separation using Fisher's protected

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LSD. Disease data for leaves were analyzed similarly following transformation to stabilize variance. Means of plant height and vine ratings are presented.

Results and Discussion.
The growing season was unusually warm and dry. Transplants established well. By June 21, over 85% of Debut, Mt. Crest, Sebring, NC 0463 and NC 03134 plants had bloomed. By that date only 4% of NC 0571 plants had bloomed.

Yield and fruit size are reported in Table 1. Total yield of marketable and cull fruit ranged from 32 lb. per plant for Florida 91, which did not differ from 8 other varieties, down to 26 lb. per plant for Debut, which did not differ from 3 other varieties. Yield of No. 1 fruit through Sept. 7 was highest for Florida 7514, at 18.8 lb. per plant, but was not significantly higher than Indy, Mt. Spring, Mt. Crest, Florida 91, or Sebring. NC 0571 had the lowest yield of No. 1 fruit through Sept. 7, at 11.6 lb. per plant, but it was not significantly lower than NC 0576, NC 03220, or Debut. Aside from Debut, these varieties with lower No. 1 yields had over 40% of the total yield harvested on the last harvest. Their lower yield through Sept. 7 probably reflects the fact that many of the tomatoes to be produced by the plant were still developing. Debut demonstrated almost the opposite: 10% of its total yield was harvested on Aug. 10, and over 75% of its total yield was harvested by Aug. 24.

Fruit size differed among the varieties. Florida 91, Amelia, Crista and Soraya had the largest No. 1 fruit, averaging between 0.62 and 0.64 lb. Maximum large fruit of these varieties averaged from 0.76 to 0.79 lb. Mt. Spring, Indy, and Sebring also had maximum large fruit in this size range. NC 0571 and NC 0576 produced the smallest No. 1 fruit at 0.45 to 0.46 lb. each. Fruit size differences also showed up in the yield of fruit in different size classes. Florida 91 and Mt. Spring produced the highest yields of maximum large tomatoes. Varieties with average fruit size less than 0.62 lb. tended to produce greater yield of extra large fruit than of maximum large fruit.

Fruit quality was variable. Statistical analysis showed that NC 0571 and Debut produced a greater percentage of No. 2 fruit than other varieties, over 19% in each case (Table 1). Both were observed to have enough rain-checking that some otherwise No. 1 fruit were classified as No. 2's, although no quantitative data were taken. Other varieties noted to have rain-checking or microcracks were Amelia, Crista, Indy and Soraya. The percentage of cull fruit through Sept. 7 was highest for Debut at 26%. Amelia, Soraya, Sebring and NC 0571 had intermediate levels of cull fruit ranging from 17% to 19%. The other 8 varieties had from 11% to 16% cull fruit. Blotchy ripening was noted on Debut, Mt. Crest, Soraya, and Sebring. Qualitative fruit characteristics are reported in Table 2. Varieties with 'very firm' or 'very firm to firm' fruit included Mt. Crest, Mt. Spring, Soraya and Sebring. Varieties with 'soft' or 'soft to medium' fruit included NC 0571, NC 0576, NC 03220 and Florida 7514. Mt. Spring and Florida 91 received the highest ratings for overall fruit appearance, followed by NC 03220 and Amelia. Debut and NC 0571 received the lowest ratings. NC 0571 and NC 0576 were both an attractive red color.

Table 2 also reports plant height and vine characteristics. Vines of most varieties were 3.5 to 4.0 ft. tall. Indy, Florida 7514 and Debut were a little shorter. Indeterminate varieties were between 5 and 6 ft. tall. Varieties with the most vigorous vines in mid-Sept. were NC 03134, NC 03220, NC 0463, NC 0576, Crista, and Florida 91. Those with the least vigorous vines were Debut and Soraya. Vines that appeared to have the least disease based on a rating of the whole plot included

NC 03134, NC 0463, Florida 7514 and Amelia. Based on the percentage of individual leaf area covered by disease, NC 0463 and NC 03134 had significantly less disease than all other varieties except Florida 7514. Indy and Debut had significantly more leaf area covered with disease than all other varieties except for Mt. Spring. Diseases present included bacterial spot, early blight, and bacterial speck; bacterial spot was probably the most prevalent.

Many of these varieties were also in last year's trial at this location. Debut performed similarly to last year: it was the earliest, but fruit size was smaller than many markets demand and it had the poorest fruit quality and the most disease. Florida 7514 produced the best yields last year; this year it again produced high yield of No. 1 fruit, but again fruit was somewhat small for many markets and not very firm. This year, as last year, Soraya and Sebring produced similar yields of firm fruit. They came on a little after Mt. Spring. This year the tomatoes were a little larger than average, similar in size to Mt. Spring, and more likely to be rough, whereas last year tomatoes were about average size and described as smooth. This year, Soraya produced larger fruit than Sebring, but last year it was the reverse. Amelia (HMX 0800) produced firm, attractive, smooth-skinned fruit on vigorous vines last year, and performed similarly this year. This year, Amelia tomatoes were a little larger than Mt. Spring; last year they were about the same size as Mt. Spring. The maturity of Amelia was similar to or a little earlier than Mt. Spring. This year, Mt. Crest again produced very firm fruit about 15% smaller than Mt. Spring and about the same time as Mt. Spring. This year, Florida 91 again produced larger than average fruit on vigorous vines. Maturity was later than Mt. Spring.

Five varieties were new to the trial this year. Crista produced moderate yield of medium-firm large tomatoes on vigorous vines, coming in a little later than Mt. Spring. Indy produced high yield of nearly round, medium-sized and medium-firm tomatoes on medium-sized vines. Disease incidence was high for Indy. It was the second earliest variety after Debut. The NC varieties were also new this year. They produced soft tomatoes, smaller than the typical Midwestern beefsteak. The indeterminate varieties NC 0571 and NC 0576 had good red fruit color.

The cluster and grape varieties were also new to the trial this year. NC 0463 tomatoes averaged 37.6 g, 3.8 cm long and 3.9 cm wide. A sample of 40 clusters had an average of 7.5 fruit each, of which 2 had not reached maturity by the time of harvest on Sept. 16. The range of fruit number per cluster was 3 to 14. Fruit split easily when ripe. NC 03134 grape tomatoes averaged 8.5 g, 3.3 cm long, and 2.2 cm wide. Vines of both varieties were vigorous and nearly disease-free.

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Table 1. Yield and fruit size of 13 tomato cultivars, Pinney Purdue Ag Center, Wanatah, Indiana, 2005.

		No. 1 Fruit Harvested Aug. 10 - Sept. 7								All Fruit Harv. Aug. 10 - Sept. 7				All Fruit Harvested Aug. 10 - Sept. 23						
		Yield per Plant*		Average Wt. per Fruit	Max. Large		Ex. Large	Large	Med. and Small	Yield per Plant	% No. 1	% No. 2	% Culls	Yield per Plant	Percent by weight harvested:					
Cultivar	Co.**	Number	Weight (lb.)	(lb.)	lb./plant	ave. wt. (lb.)	-------lb./plant--------			Weight (lb.)	------(% by wt.)-----			Weight (lb.)	8/10	8/17	8/24	8/31	9/7	9/23
Amelia	RI	25	15.5	0.63	7.9	0.79	7.0	0.5	0.04	21.0	74	10	17	30.3	1	25	28	10	5	31
Crista F1 (HMX 4	ST	26	15.9	0.62	7.3	0.77	8.0	0.5	0.04	21.0	76	9	16	28.9	0	19	35	14	5	27
Debut	ST	25	13.4	0.54	5.0	0.75	7.1	1.2	0.02	24.2	55	19	26	26.0	10	39	29	11	3	7
Florida 7514	RU	37	18.8	0.51	6.0	0.71	10.3	2.2	0.15	23.6	79	9	12	31.1	0	11	30	24	11	24
Florida 91	RU	27	17.5	0.64	10.8	0.78	6.4	0.4	0.01	23.1	76	11	13	32.0	0	6	28	32	6	28
Indy	SY	34	18.4	0.54	5.8	0.76	10.9	1.7	0.06	24.9	74	12	14	30.7	2	32	30	12	5	19
Mt. Crest	NU	35	17.7	0.51	5.1	0.74	10.8	1.8	0.11	23.2	76	9	15	29.3	1	14	39	19	6	20
Mt. Spring	RU	30	18.1	0.60	8.6	0.77	8.8	0.7	0.04	24.5	74	11	15	28.9	2	14	36	28	5	15
NC 03220	NC	25	12.5	0.49	3.1	0.71	7.7	1.6	0.11	15.5	80	8	11	30.3	0	6	19	16	10	49
NC 0571	NC	26	11.6	0.45	2.4	0.66	6.4	2.8	0.13	18.3	64	20	17	30.7	3	17	13	19	7	41
NC 0576	NC	28	12.8	0.46	1.9	0.70	8.5	2.2	0.26	16.8	76	13	11	31.1	2	15	12	14	11	46
Sebring	SY	28	16.6	0.60	6.6	0.77	9.4	0.6	0.02	23.8	70	14	17	29.8	0	5	30	31	14	20
Soraya	SY	24	15.1	0.62	7.2	0.76	7.4	0.4	0.00	23.7	64	17	19	28.3	1	5	32	34	12	16
Grand Mean		28	15.7	0.56	6.0	0.74	8.4	1.3	0.08	21.8	72	12	16	29.8	12	16	28	20	8	26
LSD .05#		4	2.6	0.03	2.5	0.04	1.7	0.6	–	2.4	7	4	5	3.0						

*Plant population was 3630 plants per acre.

**NC=North Carolina State, NU=Nunhems, RI=Rispens, RU=Rupp, ST=Stokes, SY=Syngenta.

#Fisher's protected least significant difference, p=.05. NS=cultivar effect not significant at p=.05. – AOV not performed.

Table 2. Plant and fruit characteristics and foliar disease severity for 15 tomato cultivars, Pinney Purdue Ag Center, Wanatah, Indiana, 2005*.

Cultivar	Co.**	Plant Height (ft.)	Vine Vigor	Vine Disease	Leaf Disease * * *	Fruit Shape	Fruit Firmness	Skin Smoothness	Overall Fruit Appearance
Amelia	RI	3.5	7.0	6.7	6.9 c d	2-3	F-M	M-S	5.7
Debut	ST	2.5	4.0	3.0	50.0 a	2-3	M-F	R-M	2.3
NC 03220	NC	3.8	8.3	6.0	15.9 b c	2	S-M	S	6.0
Crista F1 (HMX 4	ST	3.5	7.7	6.0	9.2 b c d	2-3	M	M-R	5.3
Mt. Crest	NU	3.5	6.0	5.0	16.5 b c	2	V	M-S	5.0
Florida 7514	RU	3.0	6.3	7.0	5.3 d e	2	S-M	M	5.0
Mt. Spring	RU	3.5	6.3	5.0	20.4 a b	2	V-F	S	7.0
Florida 91	RU	3.8	7.7	5.3	10.0 b c d	2	F-M	M-S	7.0
Indy	SY	3.3	5.7	4.0	45.8 a	2-3	M	M	5.0
Soraya	SY	3.5	5.3	4.7	9.8 b c d	2-3	V-F	R	4.3
Sebring	SY	3.5	6.0	4.3	13.9 b c d	2-3	V	R-M	4.3
NC 0571	NC	5.2	7.3	6.0	9.6 b c d	2-3	S	R	3.0
NC 0576	NC	5.8	7.7	6.0	13.8 b c d	2	S	R-M	4.7
NC 0463	NC	5.8	8.3	8.7	4.0 e f	3	–	–	–
NC 03134	NC	5.3	9.0	9.0	1.1 f	5	–	–	–
Grand Mean		4.0	6.8	5.8	15.5	–	–	–	5.0

*Vine vigor and vine disease rated on a 1 to 9 scale: 1=very non-vigorous or very diseased; 9=very vigorous or no disease. Leaf Disease is estimate of leaf area covered by lesions.

Fruit shape: 2=slightly flattened, 3=round, 5=elongated. Fruit firmness: S=soft, M-medium, F=firm, V=very firm; skin smoothness: S=smooth, M=medium, R=rough. Overall fruit appearance: 1 to 9 scale, 1=very unattractive, 9=very attractive.
**NC=North Carolina State, NU=Nunhems, RI=Rispens, RU=Rupp, ST=Stokes, SY=Syngenta.
***Means followed by different letters are significantly different at P<.05 based on analysis of transformed data.