UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service
Washington, DC

NOTICE TO FRUIT GROWERS AND NURSERYMEN RELATIVE TO THE NAMING AND RELEASE OF THE US-942 CITRUS ROOTSTOCK

The Agricultural Research Service, U.S. Department of Agriculture hereby releases to nurserymen and growers the US-942 citrus rootstock. This rootstock selection originated from a cross of Sunki mandarin (Citrus reticulata) × Flying Dragon Trifoliate Orange (Poncirus trifoliata) made by Dr. Herb Barrett (deceased) of the USDA, ARS, USHRL, Florida. Field testing of US-942 was planned and conducted by Drs. Don Hutchison, Heinz Wutscher, Greg McCollum, and Kim Bowman (all of USDA, ARS, USHRL, Florida) in collaboration with or with support from industry partners, including Florida Citrus Research Foundation, Florida Citrus Production Research Advisory Council, Bentley Brothers Citrus, and Mid-Florida Citrus Foundation. During field testing, this hybrid rootstock was identified by code numbers HRS-942 or US-942. The major positive attributes of this new rootstock are ease of seed propagation, resistance or tolerance to citrus tristeza virus, citrus blight, and Phytophthora root diseases, as well as a semi-dwarfing effect on scion tree size, induction of good fruit quality, and induction of good fruit productivity per tree and per canopy volume.

US-942 rootstock has been field tested at several locations and with several different scions. Tree survival in all trials was outstanding for US-942 rootstock. The longest field test involving this rootstock is a replicated cooperative trial in Polk County (Florida). In this trial with cooperator Bentley Brothers Citrus, 24 'Valencia' sweet orange trees on US-942 were compared with a similar number of trees on 20 other rootstocks planted in 1991. Fruit production of 'Valencia' on US-942 was measured through the first four harvest seasons and both fruit and soluble solids production was found to be outstanding on a per tree basis (Table 1). Fruit quality for trees on US-942 in this trial was excellent, with total soluble solids (TSS) for the first four harvest seasons the highest of any rootstock in the trial (Table 2). Fruit quality for trees on US-942 in this trial remained excellent for the next five harvest seasons (Table 3). US-942 rootstock was among the best rootstocks in fruit productivity and fruit quality in a 'Valencia' trial severely affected by Huanglongbing disease in St. Lucie County (Tables 4 and 5). It should be noted that none of the rootstocks in the trial continued to produce good fruit yields after the trees became affected by Huanglongbing.

In trials of US-942 with 'Hamlin' sweet orange in two different locations, fruit yield over 5 years and 8 years, respectively were outstanding in comparison with other common rootstocks (Tables 6 and 8). In these 'Hamlin' trials, fruit quality was intermediate, generally having similar TSS values to the common rootstocks Carrizo and Swingle (Tables 7 and 9).

In most trials, trees on US-942 were slightly smaller than standard size trees on Carrizo rootstock. Trees of 'Hamlin' in Lake County and 'Valencia' in Polk County on US-942 rootstock at 12 and 9 years old, respectively, were 3.1 m tall (Table 10). Because of its induction of large yields on slightly smaller trees, yield efficiency of trees on US-942 was outstanding in both the 'Hamlin' and 'Valencia' trial.

Two trials of US-942 in Lake County indicated good performance of this rootstock with mandarin scions. In a trial with 'Fallglo', trees on US-942 were similar in productivity to trees on Swingle and only exceeded in productivity by trees on Carrizo and US-812 (Table 11). In a trial with 'Sunburst', trees on US-942 were similar in productivity to trees on Cleopatra and Swingle, and only exceeded in productivity by trees on Carrizo and US-812 (Table 12). In both trials, soluble solids concentration of fruit on US-942 was similar to or better than trees on Carrizo and Swingle rootstocks. Fruit quality of 'Sunburst' on US-942 in a second trial was also good and similar to that from trees on Swingle and Carrizo rootstocks (Table 13).

US-942 produces apomictic seed by nucellar polyembryony and is thus very easy to propagate uniformly by seed. Nursery studies have indicated that US-942 produces vigorous and true to type seedlings at a frequency similar to or better than that of most other commercial rootstocks (Table 14). US-942 has not been tested for response to viroid diseases, but is expected to be sensitive to exocortis infection and only scion sources free of viroid diseases should be used for propagations with this rootstock.

Source plant material for US-942 has been tested and found free of CTV. Source plant material for US-942 will be distributed by the Florida Bureau of Citrus Budwood Registration, 3027 Lake Alfred Road (Highway 17), Winter Haven, Florida 33881. Limited quantities of US-942 seed will be distributed by the Citrus Nursery Division of the Florida Nursery, Growers and Landscape Association (FNGLA; phone 800-375-3642). Small quantities of US-942 plant material for professional research and additional information may be obtained from Kim D. Bowman, USDA, ARS, USHRL, 2001 South Rock Road, Ft. Pierce, Florida 34945 (kim.bowman@ars.usda.gov). Genetic material of this release will be deposited in the National Plant Germplasm System where it will be available for research purposes, including development and commercialization of new cultivars. Appropriate recognition should be made if this germplasm contributes to the development of a new breeding line or cultivar.

Signature:

Sally Schneider — 10-22-10

Deputy Administrator, Crop Production and Protection — Date
Agricultural Research Service, U.S. Department of Agriculture

Table 1. Fruit (kg) and Soluble Solids (kg) yield per tree of young 'Valencia' sweet orange on US-942 and selected rootstocks in Cooperative trial with Bentley Bros. in Polk County. Twenty-four trees on each rootstock were planted in 1991 on Candler fine sand.

Rootstock	*kg fruit 1995*	*kg fruit 1996*	*kg fruit 1997*	*kg fruit 1998*	*Cumulative kg fruit (1995-98)*	*Cumulative kg SS (1995-98)*
US-812	40 bc	64 a	89 b	113 a	306 a	17.7 a
US-942	**44 ab**	**64 a**	**83 bc**	**99 ab**	**291 a**	**17.5 a**
Vangasay lemon	54 a	51 b	119 a	92 ab	317 a	15.6 ab
Swingle	38 bc	39 bc	75 bc	87 b	240 b	13.7 bc
Carrizo	25 cd	29 c	75 bc	86 b	216 bc	11.9 cd
Sun Chu Sha	29 c	28 c	66 c	60 c	184 cd	10.8 de
Gou Tou	13 de	15 d	73 bc	64 c	165 d	8.5 e
Sour orange	7 e	3 e	20 d	22 d	52 e	2.9 f

Mean separations for significant ANOVA within columns were by Duncan's multiple range test at $P<0.05$

Table 2. Fruit quality of young 'Valencia' sweet orange on US-942 and selected rootstocks in cooperative trial with Bentley Bros in Polk County. Values are means of four harvests, 1995-98.

Rootstock	*TSS*	*Acid (% citric)*	*TSS/Acid Ratio*
US-812	10.5	0.78	13.5
US-942	**10.8**	**0.78**	**13.9**
Vangasay lemon	9.4	0.71	13.3
Swingle	10.5	0.77	13.6
Carrizo	10.2	0.74	13.8
Sun Chu Sha	10.6	0.77	14.0
Gou Tou	9.5	0.70	13.5
Sour orange	10.6	0.75	14.2

Values are means without statistical comparisons.

Table 3. Fruit quality of mature 'Valencia' sweet orange on US-942 and selected rootstocks in cooperative trial with Bentley Bros in Polk County. Values are means of five harvests, 1999-2003.

Rootstock	Acid (% citric)	TSS/Acid Ratio	TSS	Solbox	Juice Color (CN)
US-812	0.688	16.2	10.8abc	2.6ab	38.8a
US-942	**0.692**	**16.5**	**11.0ab**	**2.6ab**	**38.9a**
Vangasay lemon	0.677	15.6	10.1cd	2.3cd	39.0a
Swingle	0.689	15.8	10.5abcd	2.5abc	39.0a
Carrizo	0.647	16.2	10.1cd	2.3bcd	39.0a
Sun Chu Sha	0.682	15.9	10.3bcd	2.4abcd	39.1a
Gou Tou	0.639	15.7	9.8d	2.2d	38.8a
Sour orange	0.613	19.5	11.1a	2.6a	38.2b

Mean separations for significant ANOVA within columns were by Duncan's multiple range test at P<0.05

Table 4. Fruit yield (kg/tree) of 'Valencia' sweet orange on US-942 and selected rootstocks in trial at Ft. Pierce in St. Lucie County. Ten trees on each rootstock were planted in 1999.

Rootstock	2006	2007	2008	2009	Cumulative (2006-9)
US-802	0 c	42 ab	63 a	31	137 a
Rough lemon	0 c	53 a	63 a	19	135 a
US-942	**16 a**	**49 ab**	**42 a-c**	**19**	**127 a**
Carrizo	2 c	44 ab	51 ab	21	117 a
Sour Orange	0 c	35 a-c	44 a-c	28	107 a
US-812	9 a-c	34 a-c	31 bc	30	104 a
US-897	13 ab	38 a-c	32 bc	16	99 a
Sun Chu Sha	1 c	36 a-c	35 a-c	20	93 ab
Swingle	4 bc	27 bc	29 bc	25	85 ab
Flying Dragon	1 c	5 d	16 c	18	40 b

Mean separations for significant ANOVA within columns were by Duncan's multiple range test at P<0.05

Table 5. Fruit quality of 'Valencia' sweet orange on US-942 and selected rootstocks in trial at Ft. Pierce in St. Lucie County.

Rootstock	***TSS***	***Acid (% citric)***	***TSS/Acid Ratio***
US-802	11.8 cd	0.864 d-f	14.1 bc
Rough lemon	11.4 d	0.852 f	13.8 b-d
US-942	**12.8 ab**	**0.943 bc**	**14.1 bc**
Carrizo	12.7 ab	0.926 c	14.3 bc
Sour Orange	12.8 ab	0.910 c-e	14.5 b
US-812	13.2 a	1.047 a	13.1 d
US-897	12.3 bc	0.922 c	13.6 cd
Sun Chu Sha	12.8 ab	0.918 cd	14.2 bc
Swingle	12.9 a	0.981 b	13.6 cd
Flying Dragon	12.8 ab	0.870 ef	15.6 a

Mean separations for significant ANOVA within columns were by Duncan's multiple range test at $P<0.05$

Table 6. Fruit yield (kg/tree) of 'Hamlin' sweet orange on US-942 and selected rootstocks in cooperative trial with Mid-Florida Citrus Foundation in Lake County. Twelve trees on each rootstock were planted in 2002.

Rootstock	***2005+6***	***2007+8***	***2009***	***Cumulative 2005-9***
US-942	**65 a**	**172 a**	**140 a**	**378 a**
US-812	55 ab	161 ab	127 ab	343 ab
Carrizo	57 ab	142 bc	123 ab	323 bc
US-952	52 ab	112 c	113 a-c	278 cd
Swingle	45 bc	120 c	82 c	247 d
US-1277	35 c	72 d	83 c	190 e

Mean separations for significant ANOVA within columns were by Duncan's multiple range test at $P<0.05$

Table 7. Fruit quality of 'Hamlin' sweet orange on US-942 and selected rootstocks in cooperative trial with Mid-Florida Citrus Foundation in Lake County.

Rootstock	*TSS*	*Acid (% citric)*	*TSS/Acid Ratio*	*Juice color (CN)*
US-942	**8.6 d**	**0.678 c**	**12.8 bc**	**35.6**
US-812	8.8 cd	0.718 bc	12.3 c	35.4
Carrizo	8.9 c	0.681 c	13.2 ab	35.6
US-952	9.5 a	0.699 bc	13.8 a	35.6
Swingle	8.8 cd	0.795 a	11.5 d	35.4
US-1277	9.2 a	0.732 a	12.7 bc	35.6

Mean separations for significant ANOVA within columns were by Duncan's multiple range test at P<0.05

Table 8. Fruit yield (kg/tree) of 'Hamlin' sweet orange on US-942 and selected rootstocks in trial at the Whitmore Farm in Lake County. Four trees on each rootstock were planted in 1997. Soil is Astatula fine sand, pH 6.2.

Rootstock	*2001+2*	*2003+4*	*2005+6*	*2007+8*	*Cumulative (2001-8)*
US-942	**165 a**	**243 a**	**286 a**	**248 a-c**	**942 a**
US-801	137 a-c	222 ab	238 ab	276 a	873 ab
Carrizo	105 b-d	233 a	243 ab	266 ab	847 a-c
US-802	101 b-d	202 a-c	235 ab	276 a	814 a-c
US-812	140 a-c	143 b-d	212 ab	222 a-d	717 b-e
US-852	102 b-d	187 a-c	222 ab	176 c-e	688 b-e
Swingle	92 cd	140 b-d	187 b	205 a-d	624 c-e
US-897	124 a-d	135 cd	164 b	181 a-e	605 de
US-809	69 de	133 cd	169 b	151 de	521 e
Flying Dragon	38 e	95 d	87 c	105 e	325 f

Mean separations for significant ANOVA within columns were by Duncan's multiple range test at P<0.05

Table 9. Fruit quality of 'Hamlin' sweet orange on US-942 and selected rootstocks in trial at the Whitmore Farm in Lake County.

Rootstock	*TSS*	*Acid (% citric)*	*TSS/Acid Ratio*	*Juice color (CN)*
US-942	**10.3 b**	**0.817 a**	**12.9 d**	**34.6 bc**
US-801	10.2 b	0.761 bc	13.7 bc	34.9 ab
Carrizo	10.2 b	0.783 ab	13.5 bc	34.5 c
US-802	10.1 b	0.759 bc	13.7 bc	34.4 c
US-812	10.6 a	0.806 a	13.5 bc	34.4 c
US-852	10.1 b	0.755 bc	13.7 bc	35.0 a
Swingle	10.2 b	0.787 ab	13.2 cd	34.7 a-c
US-897	10.7 a	0.787 ab	13.9 b	34.7 a-c
US-809	10.3 b	0.753 bc	13.9 b	34.5 c
Flying Dragon	10.5 a	0.731 c	14.7 a	34.9 ab

Mean separations for significant ANOVA within columns were by Duncan's multiple range test at P<0.05

Table 10. Tree height (m), canopy volume (m3) and yield efficiency (kg fruit/m3/yr) in Hamlin trial in Lake County and Valencia trial in Polk County, after harvest seasons 3-8 and 3-6, respectively.

	Hamlin trial in Lake County			*Valencia trial in Polk County*		
Rootstock	*Tree height*	*Canopy volume*	*Yield efficiency*	*Tree height*	*Canopy volume*	*Yield efficiency*
Sour orange	nd	nd	nd	1.8 d	1.6 d	16.8 a
US-942	**3.1 b**	**9.5 a-c**	**13.5 a**	**3.1 c**	**7.5 c**	**13.9 a**
Flying Dragon	2.2 c	3.9 d	12.4 ab	nd	nd	nd
US-897	2.9 b	7.3 c	11.3 ab	nd	nd	nd
Swingle	3.1 b	8.6 bc	10.5 ab	3.2 c	8.4 c	10.6 b
US-812	3.1 b	9.3 a-c	10.7 ab	3.5 b	11.1 b	10.5 b
Gou Tou	nd	nd	nd	3.2 c	8.5 c	9.2 bc
Carrizo	3.4 a	10.7 ab	11.4 ab	3.5 b	11.2 b	8.3 bc
Sun Chu Sha	nd	nd	nd	3.6 b	11.3 b	6.8 c
Vangasay	nd	nd	nd	3.9 a	14.4 a	6.7 c
US-802	3.2 ab	11.8 a	10.1 b	nd	nd	nd

Mean separations for significant ANOVA within columns were by Duncan's multiple range test at P<0.05

Table 11. Fruit yield (kg/tree) and soluble solids (%) of 'Fallglo' in trial at the Whitmore Farm in Lake County. 5-13 trees on each rootstock were planted in 1992. Soil is Astatula fine sand, pH 6.2. TSS is average of values on 10/24/00 and 11/5/01.

		Kg fruit per tree		
Rootstock	***TSS***	***2000***	***2001***	***1995-2001***
US-812	11.3	109	140	628
Carrizo	10.8	92	142	522
Swingle	10.4	69	133	476
US-942	**10.9**	**29**	**94**	**453**
Cleopatra	10.3	69	102	410
US-827	10.7	71	97	393
Sun Chu Sha	10.0	49	87	290
US-937	11.2	38	62	224
US-953	11.0	26	25	166

Values are means without statistical comparisons.

Table 12. Fruit yield (kg/tree) and soluble solids (%) of 'Sunburst' in a trial planted in 1992 at the Whitmore Farm in Lake County. 5-13 trees on each rootstock. Soil is Astatula fine sand, pH 6.2. TSS is average of values on 12/4/00 and 12/3/01.

		Kg fruit per tree		
Rootstock	***TSS***	***2000***	***2001***	***1995-2001***
Carrizo	11.3	45	148	470
US-812	11.7	42	158	428
US-942	**11.8**	**46**	**119**	**381**
Cleopatra	11.4	48	102	375
Swingle	11.7	44	101	324
US-827	11.8	58	84	293
US-953	11.7	14	84	283
Sun Chu Sha	11.5	24	90	277
US-937	11.8	18	55	161

Values are means without statistical comparisons.

Table 13. Fruit quality of 'Sunburst' on US-942 in a trial planted in 1997 at the Whitmore Farm in Lake County. Values are means of harvest in 2000, 2001, 2002, 2003, and 2005.

Rootstock	*TSS*	*Acid (% citric)*	*TSS/Acid Ratio*	*Juice Color (CN)*
US-897	11.0	0.945	9.2	43.2 a
US-942	**10.7**	**0.896**	**9.4**	**42.9 ab**
US-812	10.9	0.896	9.4	42.8 b
Carrizo	10.7	0.892	9.3	42.7 b
Swingle	10.7	0.876	10.1	42.7 b
US-802	11.0	0.926	9.5	42.7 b
Flying Dragon	10.5	0.928	11.6	42.1 c

Mean separations for significant ANOVA within columns were by Duncan's multiple range test at P<0.05

Table 14. Nursery performance of US-942: Seedling vigor and trueness to type. 'Usable seedlings' is calculated as percent strong seedlings × percent true to type among strong.

Rootstock	*Strong seedlings (%)*	*True to type among strong (%)*	*Usable seedlings (%)*
US-942	**78 a**	**100 a**	**78**
US-897	76 a	100 a	76
US-802	76 a	90 bc	68
Cleopatra	66 bc	100 a	66
Swingle	65 bc	97 ab	63
Volkamer	58 c	97 ab	56
Kinkoji	63 bc	86 c	54
Smooth Flat Seville	67 b	37 d	25

Mean separations for significant ANOVA within columns were by Duncan's multiple range test at P<0.05