Influence of Rootstocks on Yield and Quality of "Redblush" Grapefruit.

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Abstract

The influence of 12 different rootstocks on yield and quality of "Redblush" grapefruit was studied for several years. Rootstocks consisted of: macrophylla, volkameriana, rough lemon, Palestine sweet lime, sour orange, Carrizo citrange, taiwanica, Savage citrange, Citrumelo, Ichang pummelo, Troyer citrange and Cleopatra mandarin. Trees on volkameriana, Palestine sweet lime, rough lemon, and sour orange had higher yield than other rootstocks, while trees on Savage citrange had lowest yield. However, soluble solids and acid/sugar ratio were relatively low in the fruits on volkameriana but high in fruit on Savage citrange rootstocks.

Introduction

Yield and quality are the most important factors determining success of grapefruit production. These 2 factors, however, do not always change in the same direction. Among a host of genetic and environmental factors, rootstock is considered one of the most important factors in determining yield and quality of grapefruit. Our goal in this long-term experiment was to study the effect of 12 rootstocks on yield and quality of grapefruit on Yuma Mesa silty sand soil.

Materials and Methods

"Redblush" grapefruit (CES No. 3 Nucellar) trees on 12 rootstocks: macrophylla, volkameriana, rough lemon, Palestine sweet lime, sour orange, Carrizo citrange, taiwanica, Savage, Citrumelo, Ichang pummelo, Troyer citrange and Cleopatra mandarin were planted on Yuma Mesa silted sand in 1966. The experimental design was a completely randomized block, with 2 trees per replication and 4 replications per rootstock. Trees were irrigated at the approximate rate of 12 acre feet per year. The orchard was disked between irrigations to control weeds. Fertilizer and spray programs were operated the same as those of commercial orchards.

Fruit were harvested 2-3 times every year and total yield per tree was recorded. At the last harvest (late February) of each year, eight fruit were harvested from each replication and were used for quality measurement. Fruit were weighed and juiced. Average percent juice and specific juice weight were determined. Soluble solids were measured by a refractometer and total acid was titrated by an automated Fisher Scientific Acid Titralizer, using 0.33 N NaOH to a neutralization point of Ph = 7.0.

Results and Discussion

Long term effects of rootstocks on yield is shown in Table 1. Trees on volkameriana, Palestine sweet lime, sour orange, and rough lemon had higher yield than trees on other rootstocks, while trees on Savage citrange showed lowest yield among our tested rootstocks. Yield on most of these rootstocks was proportional to their trunk cross-sectional, with Savage citrange having the smallest cross-sectional area.

Fruit quality in some of these rootstocks was inversely proportional to their yield efficiency. Trees on volkameriana and Palestine sweet lime and rough lemon had smaller fruit (Table 2) with lower soluble solids

compared to trees on other rootstocks (Table 3). Trees on Savage citrange had large fruits with maximum levels of soluble solids and sugar/acid ratio but low peel thickness (Tables 2 and 3).

Selecting a single "acceptable" or "desirable" rootstock for all types of soil and climate is difficult because every location has its own local problems. Susceptibility to disease is an important factor in choosing a rootstock. Also, a high yielding rootstock may not produce high quality scion fruit. An example of that was observed in volkameriana rootstock, which showed maximum yield but minimum sugar. The opposite situation was observed in trees on Savage rootstock, which had low yield but high quality fruit.

Selection of a rootstock is a compromise among several factors, particularly their resistance to diseases and their relative yield efficiency and fruit quality. Based on the demand of the grapefruit market, quality and fruit size are becoming more important than yield in some areas. Considering all factors, sour orange and citrus taiwanica seem to be desirable rootstocks for our area. Sour orange is susceptible to tristeza, but taiwanica is tristeza-resistant. Tristeza is not a problem in Arizona at the present time; however, the use of taiwanica would help to prevent any future infestation. Savage produces smaller trees which could be more desirable for home gardeners.

Development of rootstock is a difficult process, because success depends on the interaction of plant's genotype with diseases, soil type, climate, cultural practices and pests. Rootstock development requires time and the repetitive task of taking yield and quality measurements. In our long-term study, we can draw firm conclusions on the effects of these rootstocks on yield and quality of "Redblush" grapefruit in the sandy soil of Yuma Mesa. However, the physiological principle of these rootstocks should receive additional study in the future.

Table 1. Effect of Rootstock on yield (lbs.) of "Redblush" grapefruit grown at Yuma Agricultural Center; Silty Sand Soil[z]

	Bloom Years														
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Total	Avg.
Macro	412	223	309	394	497	399	446	465	414	568	277	477	442	5323	409.46
Volk	332	139	319	435	597	495	497	473	560	623	577	467	410	5924	455.69
R.L.	243	167	347	320	542	474	529	476	552	579	417	449	447	5542	426.31
Pal.	212	240	340	408	535	487	426	517	542	571	526	433	375	5612	431.69
S.O.	205	107	270	348	524	513	649	408	591	644	442	475	364	5540	426.15
Carr	191	150	290	359	548	479	636	321	600	579	406	445	309	5313	408.69
Tai	170	70	224	295	420	529	555	346	586	666	469	462	466	5258	404.46
Savage	169	65	159	232	334	384	319	229	439	408	246	261	182	3427	263.61
Citr.	153	94	178	260	413	426	490	305	486	647	392	382	331	4557	350.54
Ich	138	117	232	270	410	334	422	262	487	449	427	364	297	4209	323.77
Troyer	120	148	174	311	436	471	541	326	555	543	404	408	307	4744	364.92
Cleo	104	83	159	225	339	463	530	362	470	520	473	398	397	4523	347.92

[z]Each value in the table is an average of 4 replications with 8 fruit per replication.

Table 2. Influence of rootstocks on Fruit Weight, Juice Content and Peel Thickness in "Redblush" grapefruit.[z]

	Fruit Avg. Weight (g)			Total Juice per Fruit (ml)			% Juice by Weight			Peel Thickness (mm)		
	1975	1985	Avg.	1975	1985	Avg.	1975	1985	Avg.	1975	1985	Avg.
Macro	398	419	409	194	182	188	48.8	44.7	46.8	8.35	8.83	8.59
Volk	384	408	396	179	180	180	46.6	45.2	45.9	8.50	8.37	8.44
R.L.	384	418	401	174	184	179	45.3	45.4	45.4	8.40	8.36	8.38
Pal.	384	399	392	188	178	183	48.8	45.9	47.4	8.70	7.83	8.27
S.O.	386	430	408	171	186	179	44.2	44.7	44.5	8.15	8.57	8.36
Carr.	375	466	421	177	210	194	47.1	46.5	46.8	7.95	7.58	7.77
Tai	389	455	422	181	187	184	46.4	42.2	44.3	8.20	9.05	8.63
Savage	397	480	439	187	216	202	47.1	46.6	46.9	8.00	7.96	7.98
Cit.	397	498	448	189	210	200	47.6	43.5	45.6	7.90	8.95	8.43
Ich.	383	447	415	178	186	182	46.3	43.3	44.8	8.90	8.66	8.78
Troyer	384	474	429	178	214	196	46.2	46.6	46.4	8.90	7.76	8.33
Cleo	390	441	416	185	203	194	47.4	47.4	47.4	7.90	7.98	7.94

[z]Each value in the table is an average of 4 replications with 8 fruit per replication.

Table. 3. Influence of rootstocks on quality of "Redblush" grapefruit grown at Yuma Mesa Agricultural Center.[z]

	Soluble Solids (°Brix) Bloom Years					Sugar/Acid Ratio Bloom Years			
Rootstock	1972	1974	1977	1985	Avg.	1974	1977	1985	Avg.
Macro	8.0	8.4	9.0	9.3	8.68	6.5	8.0	8.11	7.54
Volk	7.8	8.6	8.9	9.1	8.60	6.0	7.5	7.66	7.05
R.L.	8.0	8.7	9.0	9.2	8.73	5.9	7.5	7.71	7.03
Pal.	8.4	8.7	9.0	9.7	8.95	6.0	7.3	7.85	7.05
S.O.	9.2	10.1	10.4	11.2	10.23	6.2	7.6	8.09	7.30
Carr	8.8	9.5	9.8	10.7	9.70	6.4	7.5	8.73	7.54
Tai	8.2	9.0	9.4	10.0	9.15	6.0	7.3	7.77	7.02
Savage	9.8	10.1	10.6	11.6	10.53	6.4	8.1	8.34	7.61
Cit.	9.0	9.5	10.2	11.3	10.0	6.0	7.0	7.72	6.91
Ich	9.0	9.4	10.2	11.3	9.93	6.1	7.9	7.75	7.25
Troyer	9.4	9.6	10.0	10.6	9.90	6.4	7.5	8.41	7.44
Cleo	8.8	9.4	10.0	10.3	9.63	6.2	7.9	7.95	7.35

[z]Each value in the table is an average of 4 replications with 8 fruit per replication.