ROOTSTOCK RESEARCH ON CITRUS AT HORTICULTURAL RESEARCH STATION SAHIWAL

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Introduction

Rootstocks undoubtedly constitute to be the most potent factor for the success or failure of fruit plants in a certain agro-Ccimatology. Rootstocks affect a number of horticultural and other characters of plants, the pronounced among those can be enumerated as:

Manipulating characters of rootstocks

1. Reduction in juvenality period of scion varieties.
2. Induction of tolerance against de-bilitating diseases (tristeza, phytopthora foot rot etc., and harmful pests such as nematodes etc.
3. Induction of adaptability in fruit plants against adverse conditions, as high soil pH and salinity etc; using suitable rootstocks.
4. Bringing earliness in bearing.
5. Enhancement in yields and quality of fruit.
6. Preservation of important traits of a certain variety on account of vegetative propagation.
7. Induction of hardiness in scion varieties against various stresses such as drought condition etc.
8. Manipulation of tree sizes (dwarfing or vigorous effects) to bring alterations in planting geometry of orchard establishments.

Since citrus constitutes to be the major fruit crop of the country hence continuous efforts were directed towards making recommendations on suitable scion/stock relationships. The work on this important aspect has undergone three different phases at Horticultural Research Station, Sahiwal, which was started as early as 1942 and remained continued thereafter.

Research Efforts

Phase 1

Screening of indigenous rootstocks for different commercial cultivars.

Phase 2

Evaluating the suitability of hybrid rootstocks “citranges” for Kinnow and Feutrell’s early mandrins and Valencia late orages.

Phase 3

Initiation of new trials to replace Rough lemon with salt and high pH tolerant rootstocks and to enhance quality of fruit for domestic and off-shore citrus trade.

The result of these research efforts are produced as under.

Table 1: Influence of Different Rootstocks on Musambi Sweet Orange

Rootstocks	Average height (m)	Average spread (m)	Average yield (No.s)	Juice (%)	Acid ratio (%)
Sylhet lime	2.35	2.18	78.0	25.6	7.7
Kharna Khatta	2.54	3.33	139	39.0	7.8
Jatti Khatti	3.04	3.66	189	41.7	8.4
Seville Kimb	2.65	3.71	135	39.1	8.1
Sour Orange	2.54	3.17	141	38.6	8.1
Volkameriana	2.39	3.96	214	43.7	7.9

Table 2: Influence of Different Rootstocks on Feutrell's Early

Rootstocks	Average height (m)	Average spread (m)	Average yield (No.s)	Juice (%)	Acid ratio (%)
Jatti Khatti	3.90	5.29	405	43.7	11.2
Kharna Khatta	3.92	5.45	553	42.3	11.6
Nasnaran	3.83	5.25	401	41.6	11.7
Sylhet lime	4.12	5.64	490	42.5	11.2
Seville Kimb	3.73	4.89	370	43.9	11.4
Mithi	3.56	4.76	379	44.4	11.5
Jallandhri Khatti	4.08	5.47	447	43.8	11.3
Jambheri Ceylon	4.10	5.75	668	42.8	11.3
Jambheri Lyallpur	4.01	5.59	511	45.8	11.2

Table 3: Influence of Different Rootstocks on Kinnow Mandarin

(Year 1976-78)

Rootstocks	Average Height (m)	Average Spread (m)	Average Yield (No.s)	Juice (%)	Acid Ratio.
Mithi	5.04	5.52	378	44.6	9.1
Kharna Khatta	4.96	6.01	633	45.8	8.9
Jatti Khatti	4.27	4.89	298	41.6	10.2
Seville Kimb	4.61	5.93	357	43.6	8.1
Gada Dehi	5.40	6.74.	835	46.5	11.5
Jallandhri Khatti	4.32	5.27	281	42.3	9.3
Jambheri Lyallpur	4.57	5.71	347	41.2	9.4

Table 4: Influence of Different Rootstocks on Blood Red Sweet Orange

Root-stocks	Average height (m)	Average spread (m)	Average yield (No.s)	Juice (%)	Acid ratio
Jambheri Ceylon	3.48	4.58	257	39.0	12.9
Mithi	3.11	3.97	242	39.4	13.7
Jallandhri Khatti	3.20	2.26	207	39.3	13.2
Mitha	3.39	4.41	243	40.7	13.4
Kharna Khatta	3.53	4.86	282	43.5	10.9
Jatti Khatti	3.49	4.75	271	41.3	14.1
Jambheri Lyallpur	3.43	4.76	247	41.0	13.7

Table 5: Influence of Different Rootstocks on Valencia Late Sweet Orange

Root-stocks	Average height (m)	Average spread (m)	Average yield (No.s)	Juice (%)	Acid ratio
Jatti Khatti	3.51	4.46	230	54.6	9.60
Troyer Citrange	2.35	2.72	143	41.6	15.0
Carrizo Citrange	2.68	3.50	155	43.8	10.3
Yuma Citrange	3.27	4.19	156	48.3	9.70

Table 6: Studies on the Suitability of Some Hybrid Rootstocks (Citranges) In Comparison to Rough Lemon on Kinnow Mandarin

Root-stocks	Average Height (m)	Average Spread (m)	Average Yield (No.s)	Juice (%)	Acid ratio
Troyer Citrange	2.40	2.47	970	42.6	17.4
Carrizo Citrange	3.22	2.99	1103	47.5	22.7
Rough Lemon.	3.31	3.22	1210	45.2	17.6

Table 7: Effect of six different rootstocks on Salustiana Sweet Orange

Root stocks	Average Height (m)	Average Spread (m)	Average Yield (No.s)	Juice (%)	Acid ratio
Gada dehi	3.76	3.88	84	11.35	18.30
Carrizo citrange	3.61	3.76	52	11.35	19.56
Troyer citrange	3.40	3.37	70	10.65	19.56
Mithi	3.54	3.42	59	10.77	19.01
Kharna Khatta	3.52	3.70	49	10.65	17.95
Jambheri Ceylon	3.52	2.85	88	11.11	17.34

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Table 8: Double Grafting Trial in Musambi Sweet Orange

Root stocks	Average Height (m)	Average Spread (m)	Average Yield (No.s)	Juice (%)	Acid ratio
Kinnow as interstock	3.08	4.05	186	35.4	8.0
Orlando as interstock	3.17	4.30	156	37.7	9.5
Rough lemon as interstock	2.36	2.36	58	37.4	8.1

Rootstock recommendations

#	Scion.	Year of initiation	Rootstock recommendation
1.	Sangtra local	1942	Nasnaran and Kharna Khatta proved better in order of sequence.
2.	Malta local	1942	Kharna Khatta and Nasnaran were found better rootstocks.
3.	Malta blood red	1942	Jatti Khatti (Rough Lemon).
4.	Malta Valencia late	1943	Jallandhri Khatti excelled the lot.
5.		Seed less	Jambheri and mithi were found better.
6.	Feutrell's Early	1960	Jambheri was found better rootstock followed by Jatti Khatti.
7.	Kinnow	1960	Gada Dehi has proved to be the best stock.
8.	Musambi	1982	Volkameriana produced better results.

Present challenges

1. High soil pH.
2. Brackish under ground water.
3. Drought conditions.
4. Early tree decline or reduced productive life span of trees.
5. Phytophothora foot rot increasing soil salinity.
6. Degradation of fruit quality.

In the face of the aforesaid challenges, a need has been felt to replace rough lemon with hardy, disaster and salt tolerant rootstocks, which could produce better results under the above mentioned conditions. Hence, a three pronged approach has been started according to the followings.

Multidimensional approach for the development of desirable rootstocks

1. Re-shuffling of genes through conventional breeding rendering the rough lemon disease and salt tolerant rootstock and development of other rootstocks.
2. Introducing salt and high pH tolerant rootstock in citrus sector through direct budding/grafting of

commercial scion varieties on such rootstocks.

3. Studyies on the suitability of double grafting technique to address the dual problem of soil salinity and quality deterioration in one breath, using Rangpur Lime as a salt excluder rootstock and the bud wood of quality improving citrus scion and rootstock varieties as inter stem.

that a wide array of scion varieties are still being grafted on Rough Lemon rootstock, with its repurcussions on tree health and quality of the fruit as a sale able commodity. Moreover, due to the high pH of our soils most of the Citranges proved worthless. Overall situation therefore has created inevitability to develop salt high pH and drought tolerant rootstocks ensuring better quality of fruit of kinnow and other commercial citrus varieties. Given the situation, new efforts mentioned in this write up have been contemplated to face the new challenges to our citrus sector confronted. These efforts are expected to produce pragmatic results in the best service of the country's citriculture from rootstock view point, enabling the citrus growers for better rootstock choices, to erect a strong edifice of citrus industry.

Parentage	**Specific objective**
Rough Lemon X	To induce phytophthora tolerance in Rough Lemon
Poncirus trifoliate x Volkameriana	To induce salt tolerance in Volkameriana
Cleoptra mandarin x *Poncirus trifoliate*	To induce salt and drought tolerance in trifoliate Oranage

On going efforts on the development of rootstocks

Breeding work

Induction of new root stock trials involving salt tolerance, high pH, quality improving and disease tolerant rootstocks in our research pursuits:

1. Rangpur Lime
2. C-35 Citrange
3. Volkameriana
4. Jambheri Ceylon
5. Runidoux trifoliate

Bottom lines

Coming years are very challenging for the healthy flourishing of our citrus sector in the back drop of emerging trade horizons and WTO's criteria regarding quality of fruit commodities in the global trade arena. Such a situation calls for enhanced but qualitative yields of our citrus fruits.

Rough Lemon under the drastically altered soil and climatic conditions do not seem to be a suitable rootstock for citrus. Compounding to the situation is