

**PERFORMANCE OF COORG MANDARIN (*Citrus reticulata* Blanco;
ON DIFFERENT ROOT STOCKS UNDER THE AGROCLIMATIC
CONDITIONS OF WYNAD**

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Investigations on the performance rootstocks of commercial varieties of mandarins have been conducted in different parts of India and abroad by several workers. (Brown, 1920; Singh and Singh, 1942; Batchelor and Bitters, 1952; Singh and Nagpal, 1954; Bajwa *et al.*, 1955; and Aiyappa *et al.*, 1974). These studies have assumed greater importance lately in the context of citrus dieback investigations on stionic incompatibility which plays a dominant role in the symptom expression of this malady. It is also established that rootstocks exercise remarkable influence on the vigour of the scion, its precocity of bearing, production and quality of fruits, resistance to diseases, longevity, adaptability to environmental factors etc. In Wynad tract in Kerala, mandarin orange (*Citrus reticulata* Blanco) had flourished in the forties and fifties of this century and then gradually declined during the last two decades mainly on account of this baffling problem of citrus die-back syndrome. At the Horticultural Research Station, Ambalavayal, a root stock trial with 6 promising rootstocks for Coorg mandarin was initiated in 1974 as part of the citrus die-back investigations and the performance of these rootstocks under the unique agroclimatic conditions of Wynad is presented in this paper based on the growth aspects recorded for the preceding five years.

Materials and Methods

A rootstock trial in randomised block design replicated four times was laid out in August 1974 with Coorg mandarin as scion. The rootstocks employed were:

- 1) Rangpur lime (*Citrus limonia* Osbeck)
- 2) Rough lemon (*Citrus jambhiri* Lush)
- 3) Trifoliolate orange (*Poncirus trifoliata*(L) Raf)
- 4) Cleopatra mandarin (*Citrus reshni* Tanaka)
- 5) Troyer Citrange fC. *sinensis* x *Poncirus trifoliata*)
- 6) Carrizo Citrange (C. *sinensis* x *P. trifoliata*)

No. of plants/treatment : 15;

Total plants/experiment: 360

The plants under the trial were maintained properly by adopting the package of practices recommended by Kerala Agricultural University (Anon. 1974). The measurements on growth aspects were recorded every year during April-May. The stock girth was measured at a fixed point viz., 5cm below bud joint; and scion girth at 4 cm above bud joint (marked with black paint). The height of the plant was measured from the marked point from which the stock girth was measured. The spread of the

tree was measured in north-south and east-west directions. The assessment of chlorosis of trees was made by visual estimation technique (Aiyappa *et al.*, 1974), The scionic compatibility or congeniality was evaluated in terms of scion/stock ratio (Singh, 1962), The volume of the tree was deducted by applying the formula $\frac{4}{3}\pi ab^2$ where 'a' is semi-major axis (height in cm from the point of branching) and 'b' is semi-minor axis (diameter in cm) (Anon., 1977).

Results and Discussion

Height: Significant effects were obtained among the treatments in 1975 and 1977 only (Table 1). Troyer Citrange was found to be significantly superior to Trifoliolate orange while it was on par with the rest in 1975. In 1977, Carrizo Citrange had recorded significantly more tree height than that of Cleopatra mandarin, Trifoliolate orange and Rangpur lime whereas it was on par with Troyer Citrange and Rough lemon. There was no significant variations in height among the treatments during 1976, 1978 and 1979. Trifoliolate orange had recorded minimum height consistently during the 5 years under study. This concur with the fact that Trifoliolate orange has dwarfening effect in the early stages of growth.

Stock girth: Significant results were obtained among the treatments in 1975, 1977 and 1978 only (Table 2). Troyer Citrange was found to be significantly superior to Trifoliolate orange whereas it was on par with others. But Carrizo Citrange was found to be significantly superior to Trifoliolate orange and Rangpur lime in 1977 while it was on par with Troyer Citrange, Cleopatra mandarin and Rough lemon. However, no significant variation was observed among the treatments during 1976, 1978 & 1979. But Carrizo Citrange, Rough lemon and Cleopatra mandarin had recorded comparatively higher stock girth during these years.

Scion girth: Significant difference in scion girth was observed among the treatments during the year 1975, 1977 and 1978 only (Table 3). Among the root stocks, Rough lemon had recorded significantly higher scion girth than that of Trifoliolate orange and Carrizo Citrange in 1975 and in 1978. It was also found to be significantly superior to Cleopatra mandarin, Troyer Citrange, Trifoliolate orange and Rangpur lime.

Scion/Stock ratio: In 1975, Rangpur lime was found to be significantly superior to Trifoliolate orange, Cleopatra mandarin, Troyer Citrange and Carrizo Citrange and it was on par with Rough lemon (Table 4). In 1973, Rangpur lime had recorded significantly higher scion/stock ratio than that of Rough lemon, Trifoliolate orange, Troyer Citrange and Carrizo Citrange whereas it was on par with that of Cleopatra mandarin. But in 1977, Cleopatra mandarin was found to be significantly superior to Rough lemon, Trifoliolate orange, Troyer Citrange and Carrizo Citrange and it was on par with that of Rangpur lime. Rangpur lime was significantly superior to the rest of the treatments except Cleopatra mandarin. The data revealed that the root-stocks Rangpur lime and Cleopatra mandarin have given better performance than the others during the years under study.

Among the rootstocks under investigations good stionic congenialities were observed in Rangpur lime and Cleopatra mandarin under Wynad conditions during the period under study.

Spread: The data on spread (east-west) of the tree (Table 6) showed significant variation among the treatments only during 1975 and Rough lemon was found to be significantly superior to Trifoliolate orange while it was on par with the rest. Consistently higher spread was recorded in Cleopatra mandarin and Rough lemon root stocks throughout the period of study with slight variations.

Tree volume: No Significant difference was noticed in this aspect among the rootstocks studied during the period (Table 8). Carrizo Citrange and Rough lemon had recorded comparatively higher tree volume among the rootstocks studied.

Fruit yield: There was no significant variations in the fruit yield of different treatments (Table 8). However, Carrizo Citrange gave the maximum yield (657) followed by Rangpur lime (595) Troyer Citrange (564) and Rough lemon (543). The minimum number (399) was obtained from Cleopatra mandarin.

It was observed that none of the rootstock employed in these studies gave consistent good performance. The variability of growth pattern exhibited by rootstocks of mandarin had been reported by many workers under different agroclimatic conditions in the country (Brown, 1920; Singh 1942; Singh and Singh, 1962; and Aiyappa, 1964). Carrizo Citrange was found to be best suited for early establishment and in the overall performance in respect of vigour and yield under the agroclimatic conditions of Wynad closely followed by Rough lemon and Troyer Citrange. The performances of Coorg mandarin on Rangpur lime and Cleopatra mandarin were also found to be satisfactory while Trifoliolate orange was found to be poor. Trifoliolate orange exhibited retarded growth in the early stages and was comparatively free from chlorosis. Similar observations were made by Aiyappa *et al.* (1974) who had reported that Belladakithuli and Rough lemon showed better vigour for Coorg mandarin under Coorg conditions. Mandarin on rootstocks of hybrids of trifoliolate viz., Citranges, had given promising results and higher yields in California (Batchelor and Bitters, 1952). At Chethali, a region of simiilar agroclimatic conditions as in Wynad, Rough lemon, Kodakithuli and Kichili were more vigourous for Coorg mandarin (Aiyappa, 1964). In Bombay, rootstocks like Rough lemon and Rangpur lime were found to be reasonably satisfactory for Nagpur mandarin (Nagpal, 1954). In Nagpur region, Phadnis (1960) reported that rootstocks of Rangpur lime, Jambhiri, Jatti-Khatti, and sweet lime were performing well for Nagpursantra in respect of tree vigour and yield. In Uttar Pradesh, Singh (1962) reported that Florida Rough lemon was more vigourous than Kharna Khatta in the early stages for Srinagar and Rangtra mandarin varieties but later Kama Khatta was found more satisfactory as rootstock.

Table 1

Mean height (cm) of Coorg mandarin on different rootstocks for different years
(Mean of 60 plants)

Treatments	1975	1976	1977	1978	1979
Rangpur lime	103.08	174.00	178.80	227.66	263.8
Rough lemon	108.80	151.00	193.85	231.39	274.5
Trifoliolate orange	83.80	139.30	158.78	186.43	261.5
Cleopatra mandarin	99.56	151.80	177.72	193.17	260.0
Troyer Citrange	112.24	157.50	196.00	229.80	272.0
Carrizo Citrange	102.30	134.30	206.39	234.68	286.3
CD (p=0.05)	13.6**	N.S.	26.91*	N.S.	N.S.

**Significant at 1% level

* Significant at 5% level

N S. Not Significant

Table 2

Mean stock girth (cm) of Coorg mandarin of different root stocks for different years
(mean of 60 plants)

Treatments	1975	1976	1977	1978	1979
Rangpur lime	7.27	12.41	13.95	18.23	23.35
Rough lemon	7.91	11.89	16.89	20.38	28.36
Trifoliolate orange	6.96	11.92	12.85	18.03	23.83
Cleopatra mandarin	8.06	12.46	16.34	21.08	26.87
Troyer Citrange	8.32	11.20	16.51	19.72	25.05
Carrizo Citrange	7.64	12.26	16.97	21.92	28.05
C.D. (p=0.05)	0.81**	N.S.	2.36**	N.S.	N.S.

Table 3

Mean scion girth (cm) on different rootstocks for different years (mean of 60 values)

Treatments	1975	1976	1977	1978	1979
Rangpur lime	5.99	9.56	12.06	14.84	21.27
Rough lemon	6.22	10.00	13.53	17.67	23.52
Trifoliolate orange	4.14	8.81	9.50	12.93	19.69
Cleopatra mandarin	5.84	11.23	13.67	14.82	23.95
Troyer Citrange	5.64	8.68	12.68	15.22	20.28
Carrizo Citrange	5.28	9.58	12.80	16.80	22.70
C.D. (P=0.05)	0.65**	N.S.	1.92**	2.11**	N.S.

Table 4
Mean scion, stock ratio of different rootstocks during different years
(means of 60 values)

Treatments	1975	1976	1977	1978	1979
Rangpur lime	0.81	0.86	0.86	0.82	0.91
Rough lemon	0.78	0.80	0.80	0.81	0.83
Trifoliolate orange	0.60	0.73	0.74	0.72	0.83
Cleopatra mandarin	0.73	0.85	0.89	0.77	0.89
Troyer Citrange	0.68	0.77	0.77	0.78	0.81
Carrizo Citrange	0.69	0.75	0.75	0.78	0.81
C.D. (P=0.05)	0.04 **	0.04 **	0.04 **	N.S.	0.06**

Table 5
Difference (cm) of stock and scion girth of different rootstocks

Treatment	1975	1976	1977	1978	1979
Rangpur lime	1.39	2.19	1.89	3.40	3.09
Rough lemon	1.94	3.07	3.12	2.76	4.89
Trifoliolate orange	2.83	3.34	3.35	5.01	4.15
Cleopatra mandarin	2.25	2.66	2.66	5.70	2.92
Troyer Citrange	2.68	3.83	3.83	4.50	4.67
Carrizo Citrange	2.38	4.16	4.09	4.80	5.30
C.D. at 5% level	0.54 **	1.10*	1.06 **	N.S.	1.40**

Table 6
Tree spread (east-west) of different rootstocks during the 5 years, cm

Treatment	1975	1976	1977	1978	1979
Rangpur lime	43.25	57.70	60.75	89.87	130.00
Rough lemon	49.75	61.25	76.39	102.47	138.25
Trifoliolate orange	36.25	46.75	54.93	86.72	128.50
Cleopatra mandarin	46.50	66.60	78.30	107.45	131.50
Troyer Citrange	44.25	50.50	68.84	94.30	121.25
Carrizo Citrange	43.75	50.50	70.73	99.59	144.75
C.D. at 5% level	7.16*	N.S.	N.S.	N.S.	N.S.

Table 7
Spread (north-south) of different rootstocks during 5 years, cm

Treatment	1975	1976	1977	1978	1979
Rangpur lime	42.75	53.50	58.42	85.68	127.25
Rough lemon	46.00	60.75	78.30	102.35	134.00
Trifoliolate orange	40.75	49.25	54.44	85.17	128.50
Cleopatra mandarin	46.00	61.50	80.11	109.78	133.25
Troyer Citrange	42.50	56.60	70.10	94.54	120.25
Carrizo Citrange	47.26	46.50	72.20	101.17	139.50
C. D. at 5% level	N. S.	N. S.	13.32**	N. S.	N. S.

Table 8
Mean values of volume and fruit yield of Coorg mandarin on different root stocks for different years

Treatments	Volume, m ³					Yield in numbers
	1975	1976	1977	1978	1979	1979
Rangpur lime	0.125	0.318	0.388	1.009	2.424	595
Rough lemon	0.095	0.298	0.618	1.369	2.690	643
Trifoliolate orange	0.131	0.338	0.270	0.762	2.303	447
Cleopatoa mandarin	0.121	0.339	0.567	1.277	2.403	399
Troyer Citrange	0.177	0.243	0.539	1.128	2.160	564
Carrizo Citrange	0.228	0.318	0.586	1.318	3.077	657
C. D. at 5% level	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.

Summary

Performance of six promising rootstocks of mandarin under the climatic conditions of Wynad was evaluated for the first five years after planting. The data presented in this paper indicated that Carrizo Citrange, Rough lemon and Troyer Citrange had given better performance than others in respect of most of the parameters under study. Rangpur lime and Cleopatra mandarin were also performed satisfactorily whereas Trifoliolate orange had given poor performance. However, consistent good performance was not seen in any of the rootstocks under study presumably due to the variability of growth pattern as influenced by the rootstocks during the early years of growth. General observation revealed that Trifoliolate orange exhibited retarded growth during the early stages and was comparatively free from chlorosis.

സംഗ്രഹം

മത്താരിൻ ഓറഞ്ചിന്റെ ഹൈപ്പോട്ടോട്ടിക് ആദിനം മൂലകാണ്ഡങ്ങൾ (റൂട്ട് സ്റ്റോക്ക്) ഉപയോഗിച്ചുള്ള ഒരു പരീക്ഷണം. ഈ സ്റ്റോക്കുകളിൽ നടത്തിയതിൽ, വയനാട്ടിലെ കാലാ

വസ്ഥകൾ അനുയോജ്യമായവ കറീസ്റ്റോ സിട്രാൻജ്, റഫ്ലമൺ, ട്രോയർ സിട്രാൻജ് എന്നിവ (കമപ്രകാരം) ആണെന്ന് തെളിഞ്ഞിരിക്കുന്നു. ബഡ്ചെയ്ത ചെടികൾ നട്ട് ആദ്യത്തെ അഞ്ചുവർഷത്തെ വളർച്ചയുടെ വിവിധ ഫിഫ്ത്സ്ട്രാസിഗ് രീതികൾ (reT(T)h3ff3-as-lai36ro) ഈ നിഗമനത്തിൽ എത്തിച്ചേർന്നത്. ട്രൈഫോളിയേറസ് ഓറഞ്ചിന്റെ വളർച്ച മറ്റുള്ളവയേ raw പേക്ഷിച്ച് വളരെ മോശമായും കാണപ്പെട്ടു. എങ്കിലും ഈ കാലയളവിൽ സ്മിരമായുള്ള മെച്ചപ്പെട്ട വളർച്ച ഈ മൂലകാണ്ഡങ്ങളിൽ നെറിലും കണ്ടിരുന്നില്ല.

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