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AVOCADO ROOTSTOCK-SCION RELATIONSHIPS: A LONG-TERM, LARGE-SCALE FIELD RESEARCH PROJECT.

II. DATA COLLECTED FROM FRUIT-BEARING ORCHARDS[1]

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The rootstock and the scion source are both known to have far-reaching effects on the development as well as the fruitfulness of many fruit tree species. Very little is known about this subject in avocado trees. In a previous paper we presented the problem in detail and described a large-scale field study which has been set up to investigate the problem in a comprehensive and detailed manner. As in all fruit tree trials of this type, final results are obtainable only after a considerable period of time. In addition to the above mentioned wide-scale trials, observations are being conducted in fruit-bearing orchards. Most of the orchards included in this survey were planted between 1960 and 1963, and though they were not planned as experimental plots, careful records of the source of the rootstocks and scions have been kept. In most cases, comparisons between rootstock-scion combinations can be made, but the effects due to the stock or scion alone cannot be separated. In many cases the distribution of plants of the different groups within the orchard is unsuitable and therefore comparisons between them cannot be made. This information is extremely important in planning the propagation for, and planting of, new orchards in the next few years, until better data will be obtained in the planned trial orchards.

RESULTS AND DISCUSSION

Certain definite differences between different sources of propagation material have already been observed, in spite of the great variability found between seed propagated avocado rootstocks. Yield data from a number of orchards are presented in order to illustrate some of the trends indicated so far.

In recent years, West Indian rootstocks have replaced the Mexican types in new plantations. This sharp changeover has followed the use of less suitable water and planting on calcareous soils. Comparing root-stocks of these two types is therefore of special interest,

A number of commercial orchards were planted on West Indian and Mexican rootstocks alternately. This has enabled us to make good comparisons. One example is the orchard at Lehavot Haviva which was planted in 1963. So far three 'Ettinger' yields and

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four 'Fuerte' and 'Hass' yields have been harvested; of these, only the last was a commercial yield.

From data presented in Table 1 it seems that for the cultivar 'Ettinger', the specific combination (i.e. rootstock and scion source) plays the important role and not the fact that the stock belongs to a particular horticultural race. Thus in group A_1, trees on Mexican rootstocks were superior to those on West Indian rootstocks, whereas the converse was true of group A_2. The cultivar 'Fuerte' behaved in a similar manner. In group B_1, marked differences were found in trees originating from different sources of the 'Fuerte' scion when grafted on the same Mexican stock. However, the outstanding combination in this group was the one on West Indian stock. It is impossible to determine whether the superiority of the 'Barkai 6' x 'Ashdot 16' combination is due to characteristics of the stock or of the scion. In group C, the outstanding trees were again those on West Indian stock. In the cv. 'Hass' we were unable to recognize any definite effects which the source of either stock or scion had on the yield.

Data which was collected in the Ma'agan Mikha'el orchard are of interest too. The orchard is planted on West Indian and Mexican root-stocks alternately, but the source of these rootstocks was not recorded. Table 2 summarizes the yields and trunk diameters in a certain section of the orchard. The superiority of West Indian stocks was apparent in this orchard.

The main advantage of these stocks was their effect on early bearing. There is no doubt that at Ma'agan Mikha'el the superiority of West Indian rootstocks, as expressed by faster tree development as well as earlier yields, was largely due to the conditions in the orchard, *i.e.,* saline water and calcareous soil. West Indian stocks are known to be relatively tolerant to these conditions.

Early bearing of 'Fuerte' trees grafted on certain West Indian rootstocks was also observed at Enat. (Table 3) This orchard, which was planted in 1965, is a commercial one but differs from the other orchards described in that it was planned as part of an experiment for comparing avocado rootstocks growing under conditions of high salinity. Eight rootstocks of the different avocado races are included in the experiment, which is arranged in 21 blocks. One or two trees of each rootstock type are included in each block. The scions in the whole plot come from the same source. The rootstock types 9/13, 11/13 and 6/16 are all West Indian seedlings which are morphologically typical of this race. Trees grafted on seedling stocks from these trees came into bearing early, yielding a crop already in 1969. In 1970 and 1971 the yields from these trees were higher than those from trees grafted on other stocks. Although no great significance may be attributed to the data from these early yields, it is interesting to note that there were high yields from each of these three rootstocks. This occurred in spite of the fact that the stocks were seedlings from different seedling mother trees which are open-pollinated.

The trees in Enat are growing under saline conditions and leaf scorch is evident on trees grafted on Mexican rootstocks. The extent of leaf scorch has decreased with time and is now relatively low. Trees grafted on 'Fuchs' are also sensitive to salinity. Trees planted on 'Nabal' root-stocks are chlorotic and are developing slowly. Trees planted on 'Hall', 'Lula' and 'Fuchs' stocks are well developed, as seen from their trunk

circumference, but are markedly slower in coming into bearing than trees on seedling West Indian stocks.

The avocado orchard at Taiyiba is planted with cultivars from various sources, and grafted on Mexican rootstocks only, but these stocks come from various mother trees. The cv. 'Fuerte' was chosen for comparing different sources of propagating material. Both the stock and the source of the scion were found to affect the fruitfulness of the trees. An example of the importance of the stock-scion combination is given in Table 4.

The combination 'Naeh 21' on 'Glickson 8' is especially unfruitful. It seems that this phenomenon is due to the particular combination, since when either the scion or the stock were changed, the resulting trees gave satisfactory yields.

TABLE 1. Yield and trunk circumference of avocado trees at Lehavot Haviva. (1963 planting, scions from various sources planted on Mexican and West Indian rootstocks from various sources. 1 acre includes 108 trees).

Cultivar	*Comparison group*	*No. of trees in group*	*Rootstock race*	*Rootstock source*		*Scion source*	*Trunk circumfer. (cm) 1971*		*Combined yield* per tree (kg.)*
Ettinger		26	Mexican	Ramat HaKovesh	81	Ramat HaKovesh	12	56	124
	A_1	30	West Indian	Ma'ayan Zvi	5	Barkai	9	51	70
		18	Mexican	Ramat HaKovesh	81	Ramat HaKovesh	11	55	92
	A_2	17	West Indian	Ashdot	8	Barkai	3	63	126
Fuerte		22	Mexican	Arzi	7	Barkai	1	56	20
	B_1	11	Mexican	Arzi	7	Barkai	2	64	73
		25	West Indian	Ashdot	16	Barkai	6	73	120
	C	29	Mexican	Givat Hayyim		Unidentified		59	56
		28	West Indian	Ashdot	16	Barkai	6	70	129

* Combined yields of 3 Ettinger yields and 4 Fuerte Yields.

TABLE 2. Yields and trunk circumference of 'Fuerte' avocado trees grafted on Mexican and West Indian rootstocks at Ma'agan Mikha'el (1961 planting; 1 acre include 108 trees)

Rootstock race	*No. of trees in group*	*Yield (kg/tree)*						*Trunk*
		1966	*1967*	*1968*	*1969*	*1970*	*5-year total*	*circumf. 1971 cm*
West Indian	21	20.2	22.2	25.6	44.0	86.8	198.8	68.0
Mexican	20	6.0	10.0	14.6	30.2	64.4	125.2	60.2
F		*	*	N.S.	N.S.	*	**	**

* Significant at the 5% level.
** Significant at the 1% level.
N.S. Not significant

TABLE 3. Yields, trunk circumference and degree of leaf scorch on 'Fuerte' avocado trees grafted on different rootstock types in Enat (1965 planting)

Stock	No. of trees in group	Degree of leaf scorch (1)		Trunk circum-ference (cm)	Yield (kg/tree)	
		1967 (2)	1971	1971	1970/71	1971/72
Mexican	20	2.52[a]	1.47	52.4	4.00	20.1
Nabal	17	0.43[c]	0.06	51.7	0.88	8.1
Lula	21	0.81[c]	0.19	58.3	4.28	17.5
Hall	20	0.49[c]	0.10	64.9	2.71	18.8
West Indian 11/13	19	0.55[c]	0.08	55.4	10.50	18.8
Indian 9/13	39	0.61[c]	0.05	61.0	7.26	28.4
Indian 6/16	39	0.93[c]	0.06	57.1	7.39	34.0
Fuchs	42	1.33[b]	0.26	63.1	3.66	22.5
F		**				

[1] Degrees of leaf scorch damage, from 0 = green trees to 5 = serious damage and death.

[2] Values followed by different letters are significantly different at $P < 0.05$.

CONCLUSIONS

In spite of the great variability found among seedling rootstocks, certain effects on tree characteristics — especially yields — which are due to rootstock and scion source, can be recognized.

In some orchards, certain West Indian stocks were outstanding: 'Fuerte' trees grafted on them came into bearing earlier than on other stocks. In other cases differences were found between scion-source, between different rootstocks, and between different stock-scion combinations.

In general, it seems that differences between certain stocks within one horticultural race may be considerable, and therefore when comparisons are made between stocks from different races, no generalizations can be made as to the advantages of one or another race .Each particular rootstock must be considered on its own merit. This conclusion is similar to that expressed by Prof. F. F. Halma (*) in the light of data collected by him in many experimental plots in California.

*Goodall, G. E., Personal Communication, 1970.

TABLE 4. Yields and trunk circumference of 'Fuerte' avocado trees originating from different stock-scion combination at Taiyiba (1963 planting).

Combination		No. of	Yield (kg/tree)					(cm)
Scion	Stock	trees in group	1967	1968	1969	1970	4-year total	Trunk circum-ference
Naeh 21	Glickson 8	49	1.0	13.4	0	22.4	36.8[b]	69.9[a]
Naeh 9	Glickson 8	11	35.4	26.4	32.6	60.0	154.4[a]	62.1[b]
Naeh 21	Glickson 5	29	28.0	16.0	31.6	44.8	120.4[a]	73.6[a]
F							**	**

** Significant at the 1% level.
Values followed by different letters are significantly different at $P \leq 0.05$.

REFERENCE

1. Ben-Ya'acov, A. (1972). Avocado rootstock-scion relationships: A long terms large-scale field research project. I. Preparation of the experimental set-up in the planting of commercial avocado orchards in Israel. Yb. Calif. Avocado Soc. 55: 158-161.