

EXPERIMENTS WITH ETTINGER CULTIVAR GRAFTED ON CLONAL AVOCADO ROOTSTOCKS, IN ISRAEL

A. Ben-Ya'acov¹, Esther Michelson¹ and I. Sela¹

¹ "Granot" Regional Research Center. D.N. Chefer 38100. Israel.

E-mail: mirzil@shaham.moag.gov.il

SUMMARY

Three experiments were established at Ein-Ha'choresh during the years 1981-1983. Mostly, Mexican avocado rootstocks were evaluated in the experiments, and the tree productivity of VC40 and VC57 was comparably better than the other six. These two withstand lime conditions as well. In the absence of lime, the salt resistant VC51 rootstock exhibited the best productivity. This rootstock is probably a West-Indian x Guatemalan hybrid in origin. VC28, a West-Indian rootstock, was included in one experiment only, where lime was present, and induced good productivity there.

Other than the cumulative yield, the article includes data about tree size, tree efficiency, alternate bearing and uniformity (by calculation of CV). As a result of the experiments the recommended rootstocks showed superiority with regard to alternate bearing and uniformity as well the yield.

At Kibbutz Bahan, clonally propagated avocado rootstocks were evaluated. The experiment orchard had almost heavy soil with some calcareous spots and the water quality was good. The main experiment included four combinations of rootstock and scion that were duplicated from outstandingly productive Ettinger trees, as well as other groups of trees. Two of the duplicated groups proved to have high ranking, and induced productivity with 69% more yield than the trees grafted on the seedling rootstock.

The second experiment included Mexican rootstocks that had previously been selected for salinity tolerance. Of these, one rootstock - vc24 - was found to induce very high productivity when grafted Ettinger. In both experiments, the high productivity induced by the rootstocks was also accompanied with high uniformity in productivity, whereas on seedling rootstocks the productivity had high variation.

Key Words: Clonal rootstocks, Ettinger cultivar, salinity, lime, alternate production, uniformity.

v.c. = vegetative clone.

c.v. = Coefficient of variance.

INTRODUCTION

The large scale selection of clonal avocado rootstocks commenced in Israel since 1978 resulted in 220 different rootstocks. Parallel, clonal propagation of those rootstocks took place in some of the nurseries. Re-evaluation of the clonal rootstocks has been done in 350 experiments, planted as commercial orchards. The whole process of clonal rootstock selection and the actual inventor of them were earlier published (Ben-Ya'acov and Zilberstaine, 1999).

The variability of avocado seedling population is extremely high. In order to grow more uniform orchards, it is necessary to propagate the rootstocks by clonal means. Clonal rootstocks needed also to contain resistance to soil stress factors and have better productivity. Once rootstocks are selected, their abilities should be re-investigated under field orchard conditions. We already know that in the Israeli cultivar Ettinger – the trees in the orchards are relatively much more uniform in comparison to other cultivars. The most productive tree among trees of the same scionic combination in a certain orchard, produce about 50-60% more yield than the average production of this group of trees, while in Fuerte and Hass cultivars the corresponding values are about 100%. Another factor that should be taken into account is the source of scion; in Ettinger cultivar we have not found any difference among different sources of scion (Ben-Ya'acov, 1995). For this reason rootstocks evaluation can be treated as such.

In the following article, five rootstock experiments for the Ettinger cultivar are described. The questions handled are: Are population of trees grafted on clonal rootstocks more uniform than trees on seedling ones? Do rootstocks taken from very productive Ettinger trees induce better productivity compared with the grafted Ettinger cultivar? What is the productivity on such different rootstocks in general, and in relation to the tree size? How do rootstocks selected for productivity behave under different soil conditions, in their appearance and productivity? What is the productivity of rootstocks selected for salt resistance?

MATERIAL AND METHODS

General information about methods developed and used for the whole rootstock research system was published earlier (Ben-Ya'acov, 1996; Ben-Ya'acov and Zilberstaine, 1999).

In regard to the five experiments hereby described, it should be mentioned:

Experiments at Ein-Ha'choresh were planted on heavy alluvial soil, and irrigated with medium level saline water, i.e. chlorine content of 150-180 p.p.m. Lime concentration in the soil was higher in 1983 planting (Experiment No. 242) than in earlier plantings.

At Bahan 1980, plantings were on heavy well drained soil, on hilly margins. Lime spots are typical to this soil. The water quality was good with less than 100 ppm chlorine in it.

Rootstocks used in the experiments originated from different mother trees:

Mexican rootstocks produced from very productive Ettinger trees: VC 37, 40, 52, 57, or from tolerant trees: VC 13, 15, 19, 24.

West-Indian hybrid type, also produced from productive Ettinger tree: VC 51.

West-Indian type, resistant to lime and salinity: VC 28.

Mexican seedling rootstocks: Schmidt and 18/4.

Experimental design: The five experiments hereby described were designed according to the "randomized blocks".

RESULTS AND DISCUSSION

Results of the experiments are presented in Tables 1-4.

Although Ettinger is considered as uniform in productivity, the data shows a wide range of productivity either at Ein-Ha'choresh (137-306 kg/tree, accumulated yield) or in Bahan (178-347 kg/tree).

Under saline conditions, VC 51 (W.I. Hybrid) show some advantage relative to the best productive Mexican rootstock, (Exp. 158, 208).

This order of ranking is changed when lime is present (exp. 242) or when salinity is absent (exp. 9).

In general, some of the clonal rootstocks duplicated from very productive trees managed to conserve this trait (VC 40, 51, 52, 57), but others did not (VC 37).

In two of the experiments, seedling rootstocks were included as well. In experiment 208, at Ein-Ha'choresh well known seedling commercial rootstock Schmidt produced 161 kg accumulated yield for the whole period in comparison to 245 kg of VC 51 and 237-225 kg of two other clonal rootstocks (Mexicans like Schmidt). It means, that these three rootstocks have a better performance with about 50% more yield, compared to Schmidt. Yield per unit area was about 9-10 kg/m², but only 7.3 kg/m² for Schmidt and its alternate bearing was also smaller. Very important is the C.V. value: Value of 17.9% for VC 51 shows that this rootstock (and the other clones as well) has a very good uniformity in its population, while Schmidt seedlings got C.V. Value of 34.8%. All values for V.C. 37 were even better than Schmidt, so that this rootstock failed to stand the re-evaluation.

In experiment No.9 at Bahan, the seedling rootstock was No. 18/4. Here also, total yield and yield per unit area were much smaller than for the best clones, and the variability (56.8% C.V.) much higher than on the best clones (24.1% C.V., for VC 40).

In the other Bahan experiment (No.11), big difference in productivity between rootstocks earlier selected for salt resistance was found. Na'an 25 (VC 24) was found to be a very productive rootstock, and had a very uniform population as well.

CONCLUSIONS

This article is based on five experiments with avocado cultivar Ettinger, grafted on clonal rootstocks, and is part of a re-evaluation system of 350 experiments dealing with the same subject. Some of the examined rootstocks were achieved earlier from very productive Ettinger trees. Majority of them - VC 40, 51, 57 – managed to conserve the positive characteristics, and grew to be very productive trees. The re-evaluation also affects efficiency (yield per unit area), alternation and uniformity, positively. Under saline conditions VC 51 had advantages, but with lime it failed.

Other clonal rootstocks – also achieved earlier from very productive Ettinger trees – did not pronounce any advantage (VC 37).

Relative to seedling rootstocks – the good clones had better productivity, having 50% more yield and much better uniformity (by coefficient of variance calculation).

During the re-evaluation process it was necessary to test the productive rootstocks with regard to their adaptation to different soil conditions and vice versa testing productivity of the rootstocks known for their resistance to soil stress factors. In this article, such evaluation is also included with a clear advantage of VC 24, relative to other rootstocks.

Salinity in avocado orchards is increasing, so most of the rootstocks (mainly belonging to the Mexican race) can not serve the industry any more.

Acknowledgements

The authors wish to thank the grower teams of Ein-Ha'choresh and Bahan for their help in the collection of data and for their will in handling the long-term experiments in their orchards.

Also thanks to Dr. A. Genizi and Mrs. M. Zarchi for the statistical analysis.

REFERENCES

BEN-YA'ACOV A. 1995. A sum-up of experiments with seedling avocado rootstocks and scion sources: I A comparison of scion sources of the Ettinger cultivar. Alon Ha'Norea, Vol. 49 (5), (in Hebrew).

BEN-YA'ACOV A. 1996. Development of methods for avocado rootstocks selection in Israel. Revista Chapingo serie horticultura, 5: 25-31.

BEN-YA'ACOV A. AND E. MICHELSON 1995. Avocado rootstocks. Horticultural Reviews 17: 381-429.

BEN-YA'ACOV A. AND E. MICHELSON, M. ZILBERSTAIN, Z. BARKAN AND I. SELA 1992. Selection of clonal avocado rootstocks in Israel for high productivity under different soil conditions. Proc. 2nd World Avocado Congr. Riverside, CA, 2: 521-526

BEN-YA'ACOV A. AND M. ZILBERSTAIN 1999. Clonal avocado (*Persea americana* Mill) rootstocks in Israel. Revista Chapingo Serie Horticultura 5 Num. Especial 39-42

Table 1. Partial results of experiment No. 208 at Ein-Ha'choresh, Ettinger cultivar, planted 1821¹

Rootstock VC No.	No. of trees	Yield Kg/tree	Project Area, m ²	Yield per unit area Kg/m ²	Alternation %	C.V. %	Rootstock type
51	27	245.3 a	26.0 a	9.5 ab	25.1 de	17.9	WI Hybrid
57	52	237.4 ab	24.0 ab	9.9 a	26.6 cde	27.4	Mexican
40	24	225.0 ab	25.6 a	8.9 ab	32.9 bc	24.6	Mexican
52	14	200.0 b	22.0 bc	9.3 ab	42.6 a	14.7	Mexican
Schmidt Seedling	23	161.1 c	22.4 bc	7.3 cd	33.7 bc	34.8	Mexican
37	18	136.6 c	20.8 c	6.6 d	42.3 a	44.7	Mexican
Significance level		**	**	**	**		

¹ Accumulated yield for 6 years: 1986-1991.

Explanation for data calculation, Ben-Ya'acov A., 1996

Values followed by different letters are significantly different at P = 0.01 level.

Table 2. A comparison between accumulated yield data of three experiments at Ein-Ha'choresh¹

Rootstock VC No.	Rootstock type	Exp. 158 Planted 1981	Exp. 208 Planted 1982	Exp. 242 Planted 1983
58	West-Indian			208
37	Mexican	214	137	
40	Mexican	262	228	207
51	WI Hybrid	306	245	180
52	Mexican	244	200	
57	Mexican	267	237	220
Schmidt Seedling	Mexican		161	

¹ Accumulated yield for 6 years

Table 3. Partial results of experiment No. 9 at Bahan, Ettinger cultivar, planted 1980

Rootstock VC No.	No. of trees	Yield Kg/tree		Project Area, m ²		Yield per unit area Kg/m ²		C.V. %	Rootstock type
40	23	300.0	a	18.5	a	16.1	ab	24.1	Mexican Clonal
51	26	257.0	ab	16.6	ab	16.1	ab	31.0	WI Hybrid Clonal
37	16	218.5	bc	16.9	ab	12.3	c	38.0	Mexican Clonal
13	20	201.5	c	15.2	b	13.1	bc	40.1	Mexican Clonal
18/4	13	178.4	c	15.8	b	11.0	c	56.8	Mexican Seedling
Significance level		**		*		**			

Accumulated yield- Until the age of 10.5 years.

Significance: ** : $p=0.05$ level; * : $p=0.01$ level;

Values followed by different letters are significantly different

VC = Vegetative Clone

C.V. Coefficient of variance.

Rootstocks No. 40, 51, 37 were achieved from very productive trees

Rootstock 13 was achieved from tree that stood inundation.

Clonal Rootstock 13 was achieved from tree 18/4, from which the seeds also were taken

Table 4. Results of experiment N°. 11 at Bahan, Ettinger cultivar, planted 1980

Rootstock VC No.	No. of trees	Yield Kg/tree		Project Area, m ²		Yield per unit area Kg/m ²		C.V. %	Rootstock name
24	28	347.4	a	18.1	a	19.3	a	16.7	Na'an 25
15	25	282.5	b	16.3	b	16.9	b	30.5	Binyamina
19	28	258.8	b	15.9	b	16.0	b	27.6	Mexicola 3
Significance level		**		**		**			

Notes: See relevant notes under table No.3

The three rootstocks were selected for salinity tolerance, as Mexican seedlings.