

PROLIFERATION OF ISRAELI AVOCADO VARIETIES IN CALIFORNIA

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INTRODUCTION

The low and erratic production of the Fuerte variety has become one of the major problems of the California avocado industry. Long the mainstay of the California avocado industry the Fuerte has declined in popularity among growers since the introduction of the Hass variety. The CAAB predicts production for the 77-78 season:

32,330,000 lbs. of Fuertes and

84,340,000 lbs. of Hass (1)

The ten-year average (1963-1973) production (2) of Fuertes was 4,114 lbs. per acre, while Hass averaged 7,175 lbs. per acre. Also a problem to the grower and to the industry is the erratic production of the Fuerte. The state-wide average production of Fuertes was 1,257 lbs. per acre in 1964-65 and 1,175 lbs. per acre in 1971-72. Clearly these were distress years for the Fuerte grower and the industry.

Two generations of professional and lay researchers have worked to improve the low and erratic production of the Fuerte. Problems have been defined as follows:

1. Unpredictable reaction of scion and rootstock
2. Sensitivity of blossom to night low temperatures
3. Inability of Class B flower to deliver sufficient pollen during hours pistil is receptive.

Fuertes grown in the major avocado-producing regions of Mexico are said to bear large and regular crops. Israel has the same problems found in California. Problem 1 is being solved by vegetative propagation of the roots of a high-yielding rootstock-scion combination and grafting scions from the top of the same tree to the vegetatively produced rootstock. It remains to be seen if this process will be economically feasible.

Problem 2 might be solved by use of orchard heaters. Problem 3 can be solved by interplanting or ingrafting with effective cross-pollinators. At this time the Topa-Topa, Zutano, and Covacado varieties are in common use as cross-pollinators. Another solution might be the introduction of a new high-quality, heavy, and regular producing winter variety. When Don Gustafson returned from a sabbatical leave in Israel in 1969 he brought back bud-wood of four promising new Israeli varieties. Buds of these four varieties were budded to Topa-Topa rootstocks and held in US and California quarantine for two years in the Atkins Nursery. After the quarantine requirements were satisfied Mr. Atkins planted the trees in the edge of a block of trees of similar age. Mr. Gustafson prepared and circulated a table: Avocado Varieties from Israel in which the

main features of these four varieties were described. These varieties were selected by Mr. Ephraim Slor from a windbreak of 5,000 seedlings. Mr. Gustafson gave permission to reproduce this table herein, see TABLE 1. Also by permission a line showing flower types has been added. Inspection of this table shows that the Horshim variety has the qualities needed to replace the Fuerte.

TABLE 1. CHARACTERISTICS OF ISRAEL VARIETIES

Characteristics	NETAIM	HORSHIM	TOVA	NORDSTEIN
Shape and size of original tree	Tall and broad 10 m (30 ft.)	Round shape 16 m (50 ft.)	Round shape 5 m (15 ft.)	Tall and broad 9 m (30 ft.)
Fruitfulness	Very high (alternate)	Very high (alternate) (450-550 #) every 2nd yr.	Excellent (220 #) Note: small tree	Very high (400 #)
Season of ripening	Feb. 1 - June 1	Nov. 1 - Apr. 15	Dec. 1 - Mar. 1	Sept. 15 - Nov. 15
Shape of fruit	Pear shape with broad neck	Pear shape with long neck	Pear shape with broad neck	Pear shape with broad neck
Color of fruit	Dark green	Light green	Shiny green	Shiny green
Skin of fruit	Leathery with symmetric warts (easily peeled off)	Thin with symmetric warts	Leathery (very easily peeled off)	Thin (like Fuerte)
Average Weight	10 - 12 oz.	8 - 12 oz.	8 - 11 oz.	8 - 11 oz.
Taste	Good + +	Excellent	Good +	Good +
Texture	Very good	Excellent	Very good	Very good
Color of flesh	Yellowish cream	Light color (no darkening when open)	Yellowish cream	Light color
Aroma	Very good	Excellent	Very good	Very good
% of kernel	18%	13%	17%	16%
% of oil during picking season	12 - 20%	12 - 25%	12 - 22%	9 - 18%
Special remarks		Best quality among our known varieties		
Flower type	B	B	A	Not known

HISTORY

Mr. Atkins gave permission to take grafting wood from the Horshim trees in his grove, and also suggested taking grafting wood of the other three varieties. As will be seen later in this article Mr. Atkins' suggestion led to the most significant finding of the project.

In February 1974 grafting wood was taken from Mr. Atkins' trees sufficient to topwork six 9-year old Bacons to the Israeli varieties. One was topworked to Horshim, one to Netaim, one to Nordstein, and three to Tova in the grove of the writer.. This grove is located in the Couser Canyon area, 10 miles north of Valley center, in San Diego County. Mr. Alvin Lypps has selected and cut all the grafting wood, and has done all the grafting and budding. He has achieved a remarkable record in that all 236 of the trees he topworked are today healthy trees.

From the residue of the topworking wood 36 nursery trees were budded. The nursery trees were planted in a new part of the same grove. The area in which the nursery trees

were planted seems to be a warm micro-climate. The nursery trees of the Israel and other varieties planted in this area seem to bloom and the fruit to mature 15 to 30 days before similar varieties in the area of the topworked trees. Further proliferation of the Israel varieties in 75, 76, and 77 is shown in

RESULTS

Insofar as can be observed in three years results agree substantially with TABLE 1. Fruit of California varieties grown in Israel tends to mature one month earlier than in California. Conversely, it could be expected that Israel varieties grown in California would mature a month later than in Israel. In fact, this deduction was valid for season 75-76 and 76-77. Weather in the winter of 76-77 was mild and resulted in three setting periods so that early, medium, and late sets appear in the 77-78 crop. These conditions affected both Israel and California varieties.

Fruit set in the Couser Canyon area for the crop year 77-78 is poor to moderate. Bacon trees which had set well every year mostly did not bloom. The Bacon crop is about 10% of normal. Fuertes set no more than a moderate crop. Hass have set about 35% of normal. Nursery Horshims and the 75 topworks have good crops. The Netaim crop is erratic, some trees are bare and a few well set. The nursery Nordsteins produced a good crop; the topworked Nordstein practically none. The Tovas produced a good crop which will soon be picked.

Fruit of the Israel varieties has been tested for oil at the time of expected picking. Results are in substantial agreement with TABLE 1.

Topworked trees tend to be taller and more slender than shown in

TABLE 1, probably due to crowding. The blocks containing topworked trees were planted on a 15 ft. x 15 ft. spacing. Trees topworked in 74 and 75 were in the outer rows of the blocks. Nursery trees conform to the shapes described in TABLE 1. Typical present heights and widths of the various varieties and ages of trees are given in TABLE 3.

TABLE 2. COUNT OF BUDDED AND GRAFTED TREES

	BUDDED 74	GRAFTED 74	GRAFTED 75	GRAFTED 76	GRAFTED 77	TOTALS
HORSHIM	9	1 B	5 F	30 F	50 F	95
NETAIM	6	1 B	5 F	29 F	41 F	82
NORDSTEIN	15	1 B	5 B	9 B	None	30
TOVA	6	3 B	8 B	48 B	None	65
TOTALS	36	6	23	116	91	272

B - Grafted on Bacon
F - Grafted on Fuerte

TABLE 3. TYPICAL DIMENSIONS OF VARIETAL AND AGE GROUPS

	BUDED 74	GRAFTED 74	GRAFTED 75	GRAFTED 76	GRAFTED 77
HORSHIM	7½ X 9	25 X 12	20½ X 15	20 X 14	11 X 10
NETAIM	11 X 9	18½ X 13	20½ X 17	19 X 15	14 X 11
NORDSTEIN	10 X 10	19 X 17	19 X 15	18 X 15	None
TOVA	9 X 5	18 X 14	12 X 13	10 X 10	None

Dimensions are given in feet, height first and width second.

DATA NOT AVAILABLE

No data are available on the frost tolerance of the Israel varieties. Frost seldom occurs in Israel. No frosts have occurred in this grove during the three years of the test. It is not known whether height and width data given in TABLE 1 were taken for trees on Mexican rootstock or West Indian rootstock. The latter tends to produce larger trees. Dr. Bergh (3) gives an Israeli consensus of flavor ratings:

Excellent: Horshim

Very good: Benik, Ettinger, Fuerte, Hass

Good: Nabal, Netaim, Tova

Fair: Bacon, Reed

Poor: Zutano

Horshim

This variety seems very attractive as a substitute for the Fuerte in future plantings. Both Dr. Bergh (3) and Mr. Gustafson (TABLE 1) deem it the highest quality of known varieties. Taste tests of California grown fruit tend to confirm this opinion. Fruit is pear shaped with a long neck. The flesh ripens evenly so that neck and body of the fruit are ready to eat at the same time. This variety has a long picking season and a long shelf life, which are qualities esteemed by both growers and packers. In contrast to the Bacon which sets a preponderance of fruit in its top, the Horshim sets most of its fruit in the lower part of the tree. The open growth habit of branches and leaves permits the picker to find fruit rapidly, another contrast to the Bacon, which upon setting a fruit immediately grows a cluster of leaves to hide it.

The only bad traits of this variety are alternate bearing (TABLE 1) and Dr. Bergh (3) indicates its "Production so far has not been too impressive." It has been discovered during this project that the production of the Horshim like the Fuerte can be greatly

increased by use of the Tova as a pollinator. In a block of 200 interplanted Fuertes and Bacons the Fuertes were cut and topworked to Horshim in 76 and 77. Presently the Bacons are being cut and will be topworked to Tova in February 78. In a few years it can be seen if this combination produces heavy-yielding Horshims.

Netaim

Fruit production of the various trees of this variety has been erratic. Set runs from nothing to overloaded. Fruit of the overset trees is undersized. Shape of the fruit tends to be oval rather than pear shaped. More years of observation are required before definite conclusions about this variety can be drawn.

Nordstein

Outstanding features of this variety are its early season, high quality, and high and regular production. Faults are short picking season and short shelf life. These faults may be of little consequence in an early variety.

Picking can start September 15 and end by October 15. The grower of this variety must be alert to note when his fruit reaches maturity and start picking immediately since the fruit deteriorates soon after reaching maturity. Oil content at picking time is typically 15%. The flavor can be described as rich and mud. Fruit shape is long oval. Weight runs from 9 to 13 ounces. The nursery trees of this variety have been high and regular producers. The grafted trees have yet to produce a good crop.

This variety may be of value to California growers. It is a high and regular producer. Fruit is marketable during a typically high-price season. Whereas the fall varieties commonly grown in California:

Bacon, Covocado, and Zutano are our most frost resistant, nothing is known about the cold tolerance of the Nordstein.

Tova

This is an unusual, highly productive variety, with many unique and valuable characteristics. The tree is small and self-limits its height to 15 feet. This variety is the most potent cross-pollinator yet found for varieties with Type B flowers.

Dr. Bergh (3) reports that in Israel the appearance of the fruit of this variety deteriorates soon after picking due to anthracnose caused by the colletotrichum fungus. No such deterioration has been observed during this project. Hopefully, this fungus is not present in California.

Dr. Bergh (3) also reports average crops of over 20,000 lbs. per acre can be expected from this variety in Israel. This yield cannot be verified by results of this project since the trees were cut back during years 75 and 76 to get grafting and bud wood. One tree, grafted in 74, did yield 3 field boxes of fruit in the 76-77 season. All of the trees grafted in 74 and 75 have yielded fruit even though cut back severely. A good crop will be picked in January 78.

An unexpected bonus has been received from this variety. Mr. Shepherd stated in address to the annual meeting of the California Avocado Society (Ventura, California October 7, 1977) that Fuerte yields of 18,000 lbs. per acre were being attained in Israel. When questioned after the address he explained this yield is accomplished by interplanting Tova with Fuerte in a ratio 1:8. Results in this project show that cross-pollination by a nearby Tova has more than doubled the production of Fuerte, Horshim, and Bacon trees (4).

The small size of the Tova tree is another boon to the grower. Picking can be done without ladders. It is estimated that picking cost will approximate $\leq t$ per pound, whereas costs for picking tall Bacons runs 30 to 90 per pound. It has been suggested that use of the Tova on the steep slopes now being planted in San Diego County will ease the burdens of picking.

CONCLUSIONS

Tova. Fuerte growers should consider providing Tova cross-pollination in part of each grove. In-branching, top-working, and inter-planting methods could be used.

Horshim. Test plantings with and without Tova for cross-pollination are indicated.

Netaim. Further testing is indicated.

Nordstein. Testing for cold tolerance is indicated. Data presently available do not determine the economic feasibility of planting this variety in warm locations.

REFERENCES

1. California Avocado Advisory Board, October 1977, Grower Advisor, Vol. VI, No. 10.
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4. MYERS, Alan E. Experimental Blossoms, Avocado Grower, Nov. 1977, Vol. 1, No. 2, p35, et seq.