

TREÈ BIEN - TU BISHEVAT PROGRAMMING

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Foundation for Family Education

Rabbi Barry Dov Lerner, President

Tu BiSh'vat PROGRAMMING

Dear Friends,

Until now there have been several generations of Tu BiSh'vat programs for educational institutions – synagogues, religious schools day schools and yeshivot: (1) assembly with music and a speaker or film, followed by a push to plant trees in Israel through Jewish National Fund [JNF] with or without the famous blue boxes; (2) program when the weather or climate is amenable to have a tree planting at the institution, and where possible add to or begin a Biblical or Israeli garden for fruits and/or nuts; (3) more recently we have seen the renewal of the Tu BiSh'vat Seder with a variety of “seder” texts available from JNF and other websites. Of course there are always a wide variety of arts and crafts programs for the different age ranges either supplementing one of the above or standing alone.

The following program is intended to teach about the geography of the Land of Israel that made it such an ideal garden spot; a moment in which to appreciate and celebrate God's bounty; the special relationship of the Jewish People to the Land of Israel; to offer an opportunity for discussion of the meanings for each type of fruit and the time frame in which it originated; to emphasize how Israel was a land bridge between continents for good and bad political consequences – then and now; and the content material for Tu BiSh'vat with a more contemporary “spin:” the smoothie or fruit and nut “shake.”

Moreover, it was my intention as creator, compiler and editor of this/these program ideas that they be shared, copied, adapted, adopted, forwarded for all to use without fee. However, any use for commercial purposes or for profit is expressly prohibited. The material is far from complete, and I would welcome any and all suggestions, supplements and/or corrections.

Bless, eat and enjoy this “fruit of my labor” as you enjoy 4000 years of the produce of the Land of Israel, its fruits and nuts across the course of history as well as the literary heritage of Israel in its texts and teachings.

Rabbi Barry Dov Lerner

SUGGESTED EDUCATIONAL STRATEGIES:

1. Select and study Rabbinic texts appropriate to the range of interest, study time and ability of the students.
2. Study the history and geography of Israel as it relates to growing fruits and trees, the background for the historical Tu BiSh'vat.
3. Present the fruit by historical period, cutting them into bite-size pieces on a platter and provide "taste" time-line of fruit in Israel, the Holy Land.
4. Offer "smoothies" using the fruits of Israel (1) during each historical period, (2) at the end of each or (3) as a grand finale at the end of the program – so much being produced for export and domestic consumption today – using some of the recipes attached; don't forget the opportunity to teach berakhot.
5. Celebrate a Tu BeShevat Seder which is relatively familiar today.

1. RABBINIC TEXTS:

A. Rabbi Yohanan ben Zakkai taught: If you have a fruit-tree on your hands and someone says to you: Here is the Messiah. Go and finish plating your fruit-tree just the same, and afterwards go out and welcome the Messiah. (Avot d'Rabi Natan 31).

- *The Tree and the Mashiach (The Messiah)*
 - *Danny Siegel*
 - *No matter what reasonable people or foaming enthusiastic youth tells you: that this messiah or that messiah is imminent – plant!*
 - *The Mashiach is in no rush.*
 - *When you have planted down the last clods of dirt*
 - *And watered your pines, your cedars, your gum trees and cypresses,*
 - *he will still be wherever he is supposed to be, and more than happy to admire the sapling with you.*
 - *Messiahs don't come to uproot things*

B. What was the tree from which the first Man ate? Rabbi Meir says a vine, for nothing brings greater lamenting to Man than wine does. Rabbi Nehemiah says that it was the fig, by which our forebears were both corrupted and corrected, for is it not written that Adam and Eve did sew fig-leaves? (BT Ber. And San).

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- C. What was the tree whereof Adam and Eve ate? R. Meir said that it was wheat, for when a person lacks knowledge, please say, “that man has never eaten bread of wheat.” But it says “tree.” “It grew lofty like the cedars of Lebanon. . . . R. Judah bar Illa’l said: It was grapes, for it says, “their grapes are grapes of gall, they have clusters of bitterness [sorrow] into the world.” R. Abba of Acco said: It was the etrog (citron) for it was written, “and when the woman saw that it was good for food” [the only tree whose wood is as tasty as its fruit]. R. Yosi said: They were learning the obscure from the explicit and the meaning of a statement from its context [the fig tree provided leaves out of guilt]. . . . R. Azariah and R. Judah b. R. Simon in the name of R. Joshua ben Levi: Heaven forbid [that we should conjecture what the tree was]! The Holy One, blessed be He, did not and will not reveal to man what that tree was. (Midrash Rabbah 15. 8).
- D. Israel is compared to the walnut-tree. We clip and prune it for its own good. Why? It is like the hair that is trimmed and is replaced, or finger-nails that we pare and new ones grow. In the same way, whatever Israel saves his labor and dedicates to works of Torah [whatever a Jew spares from his earnings and gives to charity] is to his own advantage in this world multiplying his happiness and will be a blessing for him the world to come.
- E. Once while Hone HaMa’agal (the circle-maker) was walking down the road, he saw a man planting a carob tree. Honi asked, “How many years will it take for this tree to bear fruit” The man answered that it would take 70 years. Honi said, “Are you so healthy that you expect to live that long to enjoy its fruit?” The man answered, “I found a fruitful world, because my forebears planted for me. Thus I shall do for my children.” (BT Ta’anit 23a)
- F. There are four New Years. On the 1st of Nisan is the New Year for Kings and Festivals; on the 1st of Ellul is the New Year for the tithe of cattle; . . . on the 1st of Tishrei is the New Year for years, for Sabbatical years, Jubilee years, for planting and for vegetables; on the 1st of Shevat is the New Year for trees, according to the view of the School of Shammai, but the School of Hillel say, on the 15th of Shevat. (Mishnah Rosh HaShana 1:1)
- G. The world is judged at four periods in the year: at Passover for grain; on Shavuot for the fruits of trees; on Rosh HaShana all the inhabitants of the world pass before Him like flocks of sheep; and on Sukkot they are judged for water. (Mishnah Rosh HaShana 1:2)
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- H. For Seeing or Hearing Hebrew All Around You
Danny Siegel
- *I’ll tell you how much I love Hebrew:*
 - *Read me anything –*
 - *Genesis*
 - *or an ad in an Israeli newspaper*

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- *and watch my face.*
- *I will make half-sounds of ecstasy*
- *and my smile will be so enormously sweet*
- *you would think some angels were singing psalms*
- *or God Himself was reciting to me.*
- *I am crazy for her Holiness*
- *and each restaurant's menu in*
- *or Bialik poem*
- *gives me peace no Dante or Milton or Goethe*
- *could give.*
- *I have heard Iliads of poetry*
- *Omar Khayyam in Farsi,*
- *and Virgil sung as if the poet himself*
- *were coaching the reader.*
- *and they move me –*
- *but not like*
- *the train schedule from Haifa to Tel Aviv*
- *or the choppy unsyntaxed note*
- *from a student who got half the grammar I taught*
- *him*
- *all wrong*
- *but remembered to write with Alefs and Zayins and*
- *shins.*
- *That's the way I am.*
- *I'd rather hear the weather report*
- *on Kol Yisrael*
- *than all the rhythms and music of Shakespeare.*

H. The Rabbis had special blessings when you have an opportunity to walk through the fields and orchards and pick some fruit or produce.

Kama na'ah t'nuvat hasadeh zo (name the food)

Barukh haMakom sheb'ra'ah.

How good is this (name of food) Blessed is God who created it.

Before eating fruit from trees add:

Barukh ata Adonai Eloheinu melekh ha'olam borei pri ha-etz.

Blessed is Adonai, our God, for creating the fruit of the trees.

2. BACKGROUND OF FRUIT IN THE LAND OF ISRAEL:

The classical source of fruits and vegetables in the Torah, the “seven species:” Wheat, barley, grape vines, figs, pomegranates, olives (fruit and oil) and honey (date palm) [Dt. 8:8]

Seven Species Glossary:

- Wheat - Hita
- Barley – Se’orah
- Grapes – Anavim
- Fig – Te’enah
- Pomegranate – Rimmon
- Olive - Zayit
- Honey - D’vash

In the Paleolithic Age - 14,000-12,000 BCE -, there were wild carobs, jujubes (*Zizyphus*) and sycamores (*Ficus sycamorus*), pistachio (*Pistacia palaestina*) and perhaps dates. In forest encircling the Sea of Galilee and on Mt. Carmel were indigenous olives, azaroles (*Crotaegus azarolus*), almonds, carobs, figs and grapes.

In Mesolithic – 11,500 – 8000 BCE - and Neolithic – 7800-4000 BCE - humanity began to tend and develop fruit trees and press grapes for wine. Olives were pressed for oil. Israel is believed to be within the Mediterranean Basin and the Middle East the primary source for carob, olive, azarole, jujube and the almond.

In the Bronze Age – Chalcolithic, 4000-1200 BCE, fig and pomegranate, citron and the date were introduced from India and Egypt, from the south and south-east. From the north and north-east came the vine, the apple, the pear and the peach, the pistachio, the plum, the mulberry, the quince and the walnut. All of this horticultural “immigration” continued during the 12 centuries of the First and Second Temple and Byzantine period.

Israel and Jewish fruit / horticulture thus advanced civilization in the areas of pruning and trimming, grafting, irrigating, of rooting hormones, forestalling disease and insects. They mastered and taught skills in the use of local materials for salting and pickling, mixing with lime to protect trees, sulphur to dust or fumigate, copper and sulphur for dusting as copper sulphate, untreated iron was made into ploughshares, raw copper for pots and pans, bitumen to keep insects from crawling up the trees, plugging the trunks of live trees with bitumen to protect against decay; clay made the storage jars; sand produced glass for bottling wine and oil; fruit-tree timber for indoor and outdoor use.

Of all this virtually nothing has remained as a record of our ancestors. What is left is Theophrastus and Pliny the Elder making small notes extolling, e.g. “nicolavsin” dates of Judea; al-Makdisi confirming the fig “sbai” from Israel in the 10th century; the grapes known as “dura” or “dabouki” as the Arabs call them today coming from Hebron with the “inuni” coming in second; and the pomegranate renown everywhere.

Flavius Josephus – 37-95 - glorified: olives of Galilee, vineyards of Judah and Samaria,

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figs of the Plain, date-palms of the Jordan Valley, and here and there almonds, walnuts, quinces, pomegranates, peaches, plums of which there are survivors today.

Jewish agricultural revival in Palestine/Israel came at the end of the 19th century bringing in grape vines, olives, almonds, bananas, citrus, peaches, plums, apricots, walnuts, quinces, pomegranates from Europe with the newest methods. The most fervent in renewing Israel's productivity was Baron Edmond de Rothschild who founded horticultural schools and brought vine cuttings in particular.

Why is Israel such a horticultural "paradise?" Geographically there are at least three major climatic zones: Mediterranean, Steppe and Desert climates. Israel is between the sea and the desert, and it has a significant range in topography – from high mountains to below sea-level: Mt. Hermon at 6779 above sea level in the Golan, Mt. Meiron and the Galilee at roughly 3000 feet above sea level, smaller mountain ranges running north to south at 1500 feet above sea level, a seashore the entire length of the country, the Jordan River running from the Golan to the lowest place in Israel and the world, the Dead Sea, at 1250 feet below sea level.

In addition, there are seasons in each locale, punctuated by dry windstorms (hamsin or the sha'rav / kadim), cold winters in the mountains with occasional thunder storms while the near or below sea level sites are generally warmer and drier. There are four different Seas which also affect the climate: Mediterranean, Sea of Galilee, the Dead Sea into which the Jordan flows and stops, and the Red Sea coast.

Thus there is a wide spread of water from rain (and melting snow and ice) in seven typical regions, ranging from Tzfat with 715 mm, Tiberias with 400 mm, Haifa and Tel Aviv with 550 mm, Jerusalem with 600 mm, Sodom with 40 mm and Eilat with 30 mm.

The Mediterranean area including the coastal plain and the mountain ranges, is the richest area in flora with an average of 350 mm. Annually. In this terra rossa and alluvial soil in the valley areas were historically vast forests and evergreen woods; most were felled during the 19th century awaiting the return of the Jews and the reforestation of the land. Jerusalem pine, oaks of several varieties, wild carob trees, imported in modern times the Australian eucalyptus (to dry the swamps of the Sharon region), olives, almonds, figs, grapes which thrive in this soil and the etrog in addition to other citrus – the last being the largest crop in the Jordan Valley and Jezreel Valley. Summer fruits are apricots, peaches, plums and pears, while fresh-growing dates fill the Jordan Valley. One also finds the imported in modern times the cactus known as the sabra.

The Irano-Tranic area includes the southern portion of the Jordan Valley, eastern slopes of the Judeans hills and the Northern Negev. Rainfall is 150-30 mm. annually, although too often it just runs off and can't be used. JNF in particular today is building a variety of projects to keep the water from running off, e.g. catch basins, cisterns, terraced hills, planting especially strong plants whose roots bind the soil. One of the tropical plants grown here is the banana.

The Saharo-Sindic area is part of a dry expanse stretching from the Sahara in North Africa, includes the Sinai and most of the Negev, the most southern Jordan Valley

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known as the Arava and the lower part of the Jordanian plain. It has a small rainfall of 50-60 mm annually and is composed of not so hospitable sand, rocks, salty marshes and riverbed earth of pebbles and soil. Little is grown here and it can only be seasonal (or irrigated artificially) and Israel has pioneered here cultivated vegetables and fruits.

3. FRUIT IN ERETZ YISRAEL:

[Note: This is a section that is continually being updated and expanded as we learn more about the products of trees in Israel.

Israel for millenia has been a land bridge for three continents: Europe, Asia, Africa. Plants, animals and human beings have traveled through Israel, and in doing so Israel has been a major resource in the development of fruit and nut trees. Both the products and also the young trees have passed through Israel from one land to another, in addition to making Israel a major producer of both the trees and also their fruits.

Some fruits and nuts also may have had their origins before Abraham 4000 years ago. They may have been cultivated partially during one period and then continue to be the subject of horticultural experimentation, hybridization, transportation from one climate to another. One example is the olive which grew wild before the Jews came into Israel, was partially cultivated during the early Biblical period for the olive fruit from which precious oil was extracted but not used as a food product. Olives became food when they were treated with pickling and salting techniques during the late Second Temple and Talmudic period. Thereafter, they were used for oil and food, for domestic use and export, in addition to importing and exporting various shoots and cuttings for continuing experimentation and hybridization.]

A. TORAH PERIOD

The “Seven Species” (Hebrew: שבעת המינים, *Shiv'at HaMinim*) are seven agricultural products - two grains and five fruits - that are listed in the Hebrew Bible (Deut 8:8) as being special products of the Land of Israel.

The seven species are traditionally eaten on Tu Bishvat, the Jewish "New Year for Trees", on Sukkot, the "Festival of Booths", and on Shavuot, the "Festival of Weeks". In halakha (Jewish law), they are considered more important than other fruits, and a special blessing is recited after eating them. Additionally, the blessing prior to eating them precedes those of other food items, except for bread.

The Sages of the Talmud often cited them in the order they appear in the Torah text, Deuteronomy 8:8: (אֶרֶץ חִטָּה וּשְׂעִירָה, וְגִבְעַן וּתְאֵנָה וְרִמּוֹן אֶרֶץ-זֵית שָׁמֶן, וּדְבַשׁ.) *a land of wheat and barley, and vines and fig-trees and pomegranates; a land of olive-trees and honey*). The following list is in alphabetical order.

ALMOND (*Amygdalus communis, Prunus amygdalus*) “shaked” The name of the tree and nut means “early rising” and it has been a symbol of the beginning of Spring. We believe that it originated in the Land of Israel in a wild form and was ultimately cultivated there, for domestic use and export. We know that another name for the almond was “luz” as in Gen. 28:19 and later in the Jerusalem Talmud (Taanit 4,7 because it is 21 days between blossoming and the forming of the fruit, exactly the same time between the

breaching of Jerusalem's walls and the destruction of the Second Temple.. Thereafter it became increasingly available in the sweet variety and thrived in Israel during the Second Temple period and thereafter. The Talmud notes later that the Sages banned grafting the peach and the almond but permitted attempts to graft almond and pistachio.

APPLE (*Malus sylvestris, Pyrus malus, Malus communis*) "tapuach" Wild apple trees were wide-spread, from Himalayas, Asia Minor to Europe. By 4000 to 3000 BCE a more cultivated apple emerged for food and juice, fresh or dried. By the Greek period, apples were the most populous of fruits. Theophrastus and then Pliny the Elder described many varieties. But from Joshua 12:17 onwards we know specifically of the apple, and we believe that it was cultivated there from 2000 BCE. From the family of pome fleshy fruits, *perot hartzaniyim*, apples grow in the temperate climate of the mountains of the Galilee and the Golan which is in the Northern area of Israel. *tapoochim* (pl.), apples.

CITRON (*Citrus medica*) "etrog" Also known as the "Assyrian apple" or the "Median apple." Probably has origin in India to China, traveling from India to Afghanistan, Iran, Iraq and to Israel and Egypt, with knowledge proven in Sumer at 4000 BCE. Name may be from Sanskrit "suranga" with the "n" fading out and meaning pleasant, lovely, fruit." "Etrog" in Lev. 23:40, together with the palm for Sukkot. Introduced into Israel before any other citrus variety possibly because of its sanctity and its use for medication as for nourishment. It is recorded extensively by Theophrastus and Pliny the Elder. It is in the Mishn, Tosefta, Talmud and Midrashim that teach us so much about the regions of citron-growing, almost always by irrigation. In the medieval period it is the lemon that is cultivated and begins to replace the etrog although today the etrog use continues among Arabs. In the early middle ages Rabbi Jacob Zahalom who lived in Rome in 17th century knew to use lemon and citron juice against scurvy.

Note: **Buddha's hand** (*Citrus medica var. sarcodactylis*) also known as "bushukan" (Japanese) or fingered citron, is a fragrant citron variety whose fruit is segmented into finger-like sections. The origin of Buddha's hand plant is traced back to Northeastern India or China.

DATE (*Phoenix dactylifera*) "tamar" The date palm has flourished in Israel since the Neolithic period near site of Jericho. Date as a name probably from the Greek "daktulos", derived from a cluster of dark-brown finger digits. No one knows the origin of the cultivated date, from India to mountains of NE Africa. There are at least three possible ancestors of trees producing wild dates now being planted in Israel as ornamental palms. It was grown for its leaves (lulav for Sukkot) and general thatching, wood, symbol of immortality or fertility; it had sweet fruit fresh or dried, date honey or syrup, date liquer, palm leaves could be woven for many items, fibers for ropes and such, woven baskets and brooms, sandals and fans. Apiculture or bee-hive raising was never a major industry of the Jews, and thus it had to be date honey.

FIG (*Ficus carica*) "Te'elah:" possibly as early as 3000 BCE in wild varieties with origin in Arabian peninsula or the Mediterranean Basin and can be traced back to Neolithic

Age: products include fresh or dried, pressed cakes or on a string or beehive/cube, and distributed for cooking, medicine, shade-tree, sturdy and symbolic of peace, sap of unripe figs, milk of ripe figs, strong drink from dried figs on a par with barley or mulberry beer, and the timber was used on the Temple altar for sacrifices since they did not produce smoke.

GRAPE (*Vitis vinifera*) “gefen:” cultivated grapes possibly as early as 3000 BCE with its origin in south-eastern Europe to India and found in early Bronze Age: products include grapes, wine, sale and distribution of cuttings, medicine, vinegars, raisins.

OLIVE (*Olea oleaster*) “zayit” Originally a wild tree perhaps as early as Palaeolithic period near the Carmel from which the Jews in the earliest period used olives to produce olive oil – not an olive to eat – oil to supplement what was previously used, sesame and walnut oil. Cultivation of edible olives was a Second Temple / Talmudic period accomplishment, and a cultivated fruit tree was developed and then carried eastwards.. From Israel and Syria cultivated olive made its throughout the Mediterranean. A major reference in the TaNaKH, it was a major part of the economy.

POMEGRANATE (*Punica granatum*) “apple of Carthage” (*Malum punicum*) “Rimon:” possibly as early as 3000 BCE; products include juice, fruit, cuttings, medicine, wine, ground-up rinds, the wood for a skewer of the paschal offering, and inspiration for artistry for the rimonim on the Torah.

WALNUT as wild nuts grew in Israel, but they were not cultivated domestically until the Second Temple period. Similarly for the ALMOND, HAZEL, PECAN and PISTACHIO.

B. SECOND TEMPLE FRUIT PRODUCE IN ERETZ YISRAEL

ALMOND (*Amygdalus communis*) *Prunus amygdalus*) “shaked” The name of the tree and nut means “early rising” and it has been a symbol of the beginning of Spring.

APRICOT (*Mela armenica*) “mishmish” Not mentioned in Bible or Mishnah and we feel that it came into the Holy Land at the end of the Second Temple period.. We do know that they were in first century BCE in Greece and Italy and thus suppose similar time of transition from Armenia to the Mediterranean basin. Some did suggest that it was the “apple of gold” in the Song of Songs, while Greek and Roman sources speak of the “praecocion” meaning an early-ripening or precocious fruit. But to the Arab this term became “barkok” and “prakok” and remained such until the middle ages when “mishmash” somehow began. The book of Ben Sira mentions both apharsek and the “parsak” – and we wonder whether he was describing both peach and apricot.

CAROB (*Ceratonia siliqua*) “haroov” also known as St. John’s bread, locust, devash nehot (Gen. 43:11), rozky in Russian. The seed pod reminds one of a horn, and thus in Greek is “keratia” with a Theophrastian form of “keronia” = horn. “Siliqua” is Latin for container or pod. There is word-play between “herev” and “haroov” meaning either that

it's sickle-shape is like an ancient sword, or that it grows best on wasted and stony soil, such as would be the destruction of a land after a war. The carob seed are extremely hard and can "corrupt" / destroy one's teeth [word-play in the Midrash] and the Hebrew word "gerah" gave rise to the weight of a very small coin [20 to a shekel] and later to the word for "carat" in weighing out precious stones. Most unusual is that if one cuts down a carob tree to ground level, it will regenerate itself. For this reason it is the tree of preference in Yad VaShem in Israel for the trees lining the path in honor of the Righteous Gentiles. Its wood was beautiful; animals could be fed its pods – in particular goats; the fresh pods were refreshing [chocolate in flavor] and could be candied; wine and a kind of brandy were distilled from it. Leaves served as stationery, used in tanning because of their tannic content, and green pods would produce light-golden dyes.

MELON include members of the plant family Cucurbitaceae with edible, fleshy fruit e.g. gourds or cucurbits. The word "melon" can refer to either the plant or specifically to the fruit. Many different cultivars have been produced, particularly of muskmelons. Although the melon is a botanical fruit, some varieties may be considered culinary vegetables rather than fruits. The word melon derives from Latin *melopepo* which is the latinization of the Greek "melopepon" meaning "melon", itself a compound of "melon," "apple" + "pepon", amongst others "a kind of gourd or melon". Melons originated in Africa and southwest Asia, but they gradually began to appear in Europe toward the end of the Roman Empire. Melons were among the earliest plants to be domesticated in both the Old and New Worlds. Early American settlers are recorded as growing honeydew and casaba melons as early as the 1600s.

Melons and other members of *Cucurbitaceae* family include (while most gourds and many melons are regarded as culinary vegetables) generally regarded as fruits: Bitter melon, Cantaloupe, Galia, and Honeydew

OLIVE (*Olea oleaster*) "zayit" Now the Jews were producing not only olive oil, but they had developed many techniques of salting, brining and pickling the various varieties of olives, even as they continued to perfect the art of raising olive trees.

PEACH (*Amygdalus persica*) "apharsek" Traveled from Israel to Egypt and North Africa and then Greece and Italy. It was offered to the Egyptian god of Tranquility because the fruit resembled a heart and the leaf a tongue. First mentioned in the Mishnah in Hebrew and occurs thereafter regularly, and the peach it is assumed was grown successfully in the last centuries before the Common Era. It is described as a fruit that possesses an affinity with almonds (Kelim 1:4) [peaches look like almonds on the outside].

PISTACHIO (*Pistacia vera*) is a small tree originally from Persia (Iran), which now can also be found in regions of Syria and Middle East reaching to possibly Afghanistan (especially in the provinces of Samangan and Badghis), as well as in the United States, specifically in California. The tree produces an important culinary nut. Pistachios have been a part of the human diet at least since the late Paleolithic, and became common certainly by the time of the Second Temple. The pistachio is one of two nuts mentioned in the Bible. The pistachio is mentioned only once (Genesis 43:11 although the almond

is mentioned many times. The earliest records of pistachio in English are around roughly year 1400, with the spellings "pistace" and "pistacia". The word pistachio comes from medieval Italian *pistacchio*, which is from classical Latin *pistacium*, which is from ancient Greek *pistákion* and *pistáke*. Pistachio is a desert plant, and is highly tolerant of saline soil. It has been reported to grow well when irrigated with water having 3,000–4,000 ppm of soluble salts. Pistachio trees are fairly hardy in the right conditions, and can survive temperatures ranging between ?10°C (14°F) in winter and 40°C (104°F) in summer. They need a sunny position and well-drained soil. The trees are planted in orchards, and take approximately seven to ten years to reach significant production. Production is alternate bearing or biennial bearing, meaning the harvest is heavier in alternate years. Peak production is reached at approximately 20 years.

PLUM (*Prunus microcarpa*) “shazif” First mentioned in the Talmud and there are three varieties listed, including a fresh and dried fruit: dormaske (Damascus), ‘ahonit (tart cherry plum) and pega (European). A number of varieties were introduced into Israel by the Crusaders, while they also took back Israel saplings to France and Italy. When resettlement in Israel resumed, Jewish horticulturalists first worked European varieties, but soon turned to the Japanese plum as better suited to Israel’s climate. In 1930 50 acres yielded each a ton of fruit; and recently 2500 acres yielded 13,500 tons.

The stone fruits, drupes of genus *Prunus* include: Apricot (*Prunus armeniaca* or *Armeniaca vulgaris*), Cherry, including sweet, black, sour, and wild species, Chokecherry, Greengage, Nectarine, Peach, Plum of several species, and hybrids of the preceding species such as plumcot/apriplum, pluot, aprium, and peacotum.

PEAR (*Pyrus syriaca*) “agas” with forest neighbors of the oak (*Prunus ursine*) and the almond. There are both European and Asian pear varieties, and there is a mention of the pear in the Mishnah and Talmud. There is an interesting technique recorded of “punishing” the tree by gnashing the trunk – also of the almond and fig tree.

WALNUT (*Juglans regia*) “egoz” The walnut was imported from Persia about 2000 BCE and is first mentioned in Song of Songs 6:11. (the walnut tree is the “egoza”). The walnut appears in Talmud Sukka 1:7, 10a in ruling that when used as a decoration for the sukka, one may not eat them “off the walls” until the very last day of the Hag. While not mentioned in the seven species, post-Biblical texts are mentioned frequently, put into the same tax-class as carob, grapes, almonds, pomegranates, dates and olives (Mishnah Peah 1, 5). There are three varieties of walnuts in the Mishnah: soft-shelled, medium-hard and truly hard-shelled, and it was the first of most significance.

WATERMELON (*Citrullus lanatus*) is a vine-like (scrambler and trailer) flowering plant originally from southern Africa. It was identified by Carl Peter Thunberg a student of Linnaeus in late 17th century, known as the father of South African botany. It is not known when the plant was first cultivated, botanists note evidence of its cultivation in the Nile Valley from at least as early as 2000 BCE, the XIIth Dynasty. By the 10th century CE, watermelons were being cultivated in China, which is today the world's single largest watermelon producer. Its fruit, which is also called watermelon, is a special kind referred to by botanists as a pepo, a berry which has a thick rind (exocarp) and fleshy

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center (mesocarp and endocarp). Pepos are derived from an inferior ovary, and are characteristic of the Cucurbitaceae. The watermelon fruit, loosely considered a type of melon – although not in the genus Cucumis – has a smooth exterior rind (green, yellow and sometimes white) and a juicy, sweet interior flesh (usually pink, but sometimes orange, yellow, red and sometimes green if not ripe). It is also commonly used to make a variety of salads, most notably fruit salad.

C. MEDIEVAL FRUIT PRODUCE IN ERETZ YISRAEL:

BANANA (*Musa cavendishii*) “banana” or the Arabic “muz. While it originated in the Far East 5000 BCE, it took a long time for the tree that we know to establish itself in Israel. It is not mentioned as such in Rabbinic source although the “muz” is recorded in later Rabbinic writing. Pliny the Elder does describe such a fruit as a “poma” or apple. Crusaders wrote extensively about the banana, fascinated by the pattern of growth and “resurrection” of the plant, the unusual form and taste. Some of them claimed that to cut through the width of a banana would show you the figure of the Cross although others claimed to see the “tooth marks” of Adam!

Interestingly enough, Jewish commentators were suggesting that the banana plant was the forbidden fruit in the Tree of Good and Evil, based on an ancient Sanskrit Asian tradition. In the 17th century it was called the “fig of Paradise” and the suggestion made that Adam and Eve made garments from the leaves – which would have been most modest! Returned to Israel in earnest by Rothschild in 1907 who brought rhizomes = suckers from Algeria, and it is a major product for domestic and export.

LOQUAT (*Eriobotrya japonica*) arrived in Israel in the medieval period and thereafter in the modern period Israel has developed uniquely skilled production for export.

MANGO (*Mangifera indica*) arrived from south-east Asia on the spice route where it was known for at least 4000 years, and originally known as the “clingstone” or “clingskin”

D. MODERN FRUIT PRODUCE IN ERETZ

[Now **YOU** can do additional research on all of these fruits and nuts below that are currently being grown in Israel for either domestic use or export or both. Consider the following list of fruits a worksheet that allows you to fill in the details beyond those to which I have been adding.

2.8% of the country's GDP is derived from agriculture. Of a total labor force of 2.7 million, 2.6% are employed in agricultural production while 6.3% in services for agriculture. While Israel imports substantial quantities of grain (approximately 80% of local consumption), it is largely self-sufficient in other agricultural products and food stuffs. For centuries, farmers in Israel have grown varieties of citrus fruits, such as grapefruit, oranges and lemons. Citrus fruits are still Israel's major agricultural export. In addition, Israel is one of the world's leading greenhouse-food-exporting countries.

Israeli export has grown hugely since the country's foundation in 1948. How much? It's grown 13,400-fold, says a government report. Israel's annual exports have risen from \$6 million 63 years ago to \$80.5 billion, says the report from the Israel Export and International Cooperation Institute, an arm of the Ministry of Industry, Trade and Labor, released on the eve of Independence Day.

Analysis of the export data reveals that since 1948, North America and Europe have remained the main destinations of Israeli exports. In the 1950s and 1960s, about 70% of Israel goods sold abroad went to Europe, while currently only about 32% of Israeli exports go to European customers. About 33% of Israel's exports currently go to North America.

Citrus fruits are the third largest agricultural export with hundreds of thousands of tons of oranges, grapefruits, lemons, and pomelos exported yearly. Citrus fruits account for 7.1% of Israel's total agricultural produce. Grapefruits and especially the White Grapefruits are grown in inland valleys. Another popular grapefruit is the Sunrise variety that has a red peel and meat.

From the family of citrus fruits, *pri hadar*. Oranges and specially Shamouti oranges are Israel's major citrus product. Also known as Jaffa oranges, they are seedless and sweet. First grown by Arab farmers in Palestine in the mid-19th century and was first produced for export in Jaffa. Jaffa oranges are harvested between November and March and more than half exported to the European Union. *tapoozim* (pl.), oranges.

From the family of citrus fruits, *pri hadar*. Lemons are one of the main ingredient of an Israeli salad. It is used widely in Israeli cooking such as on fish. *limonim* (pl.), lemons.

In the 1950s, only about 1% of the country's exports were sold to Asian customers, while now 24% of Israeli merchandise headed abroad goes to Asian destinations.

NOTE: The Israeli high-tech sector, including research and development services, generated about \$28.5 billion in exports last year, representing about 35% of Israel's

total exports.

Due to the diversity of the land and climate across the country, Israel is able to grow a wide range of crops. Field crops grown in the country include wheat, sorghum and corn. On 215,000 hectares of land, these sorts of crops are grown, 156,000 hectares of which are winter crops.

Fruit and vegetables grown include citrus, avocados, kiwifruit, guavas and mangoes from orchards located on the Mediterranean coastal plain. Tomatoes, cucumbers, peppers and zucchini are grown commonly throughout the country, whilst melons are grown during winters months in the valleys. Subtropical areas in the country produce bananas and dates, whilst in the northern hills apples, pears and cherries are grown. Furthermore, grape vineyards are found across the country, as the country's wine industry has developed to become a world-player.

Israel is one of the world's leading fresh citrus producers and exporters, including oranges, grapefruit, tangerines and the pomelit, a hybrid of a grapefruit and a pomelo, developed in Israel.

More than forty types of fruit are grown in Israel. In addition to citrus, these include avocados, bananas, apples, cherries, plums, nectarines, grapes, dates, strawberries, prickly pear (tzabbar), persimmon, loquat (shesek) and pomegranates. Israel is the leading producer of loquat (shesek) after Japan.

In 1973, two Israeli scientists (Haim Rabinowitch and Nachum Kedar) developed a variety of cherry tomato with slower ripening than ordinary tomatoes in a hot climate.[13] The Tomaccio tomato was developed by Hishtil Nurseries which conducted a 12-year breeding program using wild Peruvian tomato species to create a sweet snack tomato

In 1997, \$107 million worth of cotton was grown in Israel with most of this sold in advance on the futures market. The crop is grown on 28,570 hectares of land, all of which is drip irrigated. 5.5 tons per hectare of raw cotton is averaged for the Acala crop whilst the Pima crop averages 5 tons per hectare, which are yields amongst the highest in the world.

Consider also what you believe will be the next Israeli fruit breakthrough for domestic use or export. I'm betting on the Ugli fruit (pronounced "oo-gee"). Developed in Jamaica in 1934 and now imported into the US through Florida, it could be soon an Israeli commodity. Check it out.]

ALMOND (*Amygdalus communis*, *Prunus amygdalus*) "shaked" The name of the tree and nut means "early rising" and it has been a symbol of the beginning of Spring. In 1882 there were no more than 5000 almond trees in the Land of Israel. But although Baron de Rothschild established his horticultural project on planting grapevines, very soon he realized the need for a second crop. That crop was the almond, until in 1900 there were 800 acres of almond orchards and at the outbreak of the First World War there were 10,000 acres of almond orchards belonging to Jews and 750 acres in Arab orchards.

ATEMOYA (*Annon hybrid*) of the cerimoya and the sugar apple

AVOCADO (*Persea americana*) is a tree native to Central Mexico, classified in the flowering plant family *Lauraceae* along with cinnamon, camphor and bay laurel. An avocado is a fruit and not a vegetable! Avocado or alligator pear also refers to the fruit (botanically a large berry that contains a single seed of the tree, which may be pear-shaped, egg-shaped or spherical. The avocado originated in the state of Puebla, Mexico. The native, undomesticated variety is known as a criollo, and is small, with dark black skin, and contains a large seed.[3] The oldest evidence of avocado use was found in a cave located in Coxcatlán, Puebla, Mexico, that dates to around 10,000 BC. The avocado tree also has a long history of cultivation in Central and South America; a water jar shaped like an avocado, dating to AD 900, was discovered in the pre-Incan city of Chan Chan.[4] The earliest known written account of the avocado in Europe is that of Martín Fernández de Enciso (c.1470–c.1528) in 1518 or 1519 in his book, *Suma De Geographia Que Trata De Todas Las Partidas Y Provincias Del Mundo*. [5][6] The first written record in English of the use of the word 'avocado' was by Hans Sloane in a 1696 index of Jamaican plants. The plant was introduced to Indonesia in 1750, Brazil in 1809, the Levant in 1908, and South Africa and Australia in the late 19th century.

BANANA (*Musa acuminata*, *Musa balbisiana*) Banana is the common name for herbaceous plants of the genus *Musa* and for the fruit they produce. In popular culture and commerce, "banana" usually refers to soft, sweet "dessert" bananas. By contrast, *Musa* cultivars with firmer, starchier fruit are called plantains or "cooking bananas". The distinction is purely arbitrary and the terms 'plantain' and 'banana' are sometimes interchangeable depending on their usage.

Bananas come in a variety of sizes and colors when ripe, including yellow, purple, and red. Almost all modern edible parthenocarpic bananas come from the two wild species – *Musa acuminata* and *Musa balbisiana*. They are native to tropical South and Southeast Asia, and are likely to have been first domesticated in Papua New Guinea. The banana may have been present in isolated locations of the Middle East on the eve of Islam. The spread of Islam was followed by far-reaching diffusion. There are numerous references to it in Islamic texts (such as poems and hadiths) beginning in the 9th century. By the 10th century the banana appears in texts from Palestine and Egypt. From there it diffused into north Africa and Muslim Iberia. During the medieval ages, bananas from Granada were considered among the best in the Arab world.

In 650, Islamic conquerors brought the banana to Palestine. Bananas were introduced to the Americas by Portuguese sailors who brought the fruits from West Africa in the 16th century. The word banana is of West African origin passed into English via Spanish or Portuguese. Today, they are cultivated throughout the tropics. They are grown in at least 107 countries, primarily for their fruit, and to a lesser extent to make fiber, banana wine and as ornamental plants.

Some sources assert that the banana's genus, *Musa*, is named for Antonio Musa, physician the Emperor Augustus. Others say that Linnaeus, who named the genus in

1750, simply adapted an Arabic word for banana, *mauz*. The word banana itself might have come from the Arabic *banan*, which means "finger", or perhaps from the Senegalese Wolof word *banaana*.

BERRIES The botanical definition of a berry is a fleshy fruit produced from a single ovary. Grapes are an example. The berry is the most common type of fleshy fruit in which the entire ovary wall ripens into an edible pericarp. They may have one or more carpels with a thin covering and fleshy interiors. The seeds are usually embedded in the flesh of the ovary. A plant that bears berries is said to be bacciferous. Many species of plants produce fruit that are similar to berries, but not actually berries, and these are said to be baccate.

In non-technical usage, "berry" means any small fruit that can be eaten whole and lacks objectionable seeds. The bramble fruits, compound fruits of genus *Rubus* (blackberries), are some of the most popular of these that are not true berries: Blackberry, including many species and hybrids - Cloudberry, Loganberry, Raspberry of several species Salmonberry, Thimbleberry, Wineberry

The true berries are dominated by the family *Ericaceae*, many of which are hardy in the subarctic: Bearberry, Bilberry, Blueberry, Crowberry, Cranberry, Falberry, Huckleberry, Lingonberry, Strawberry Tree

Other berries not in *Rosaceae* or *Ericaceae* include: Açai, Barberry, Currant, Elderberry, Gooseberry, Hackberry, Honeysuckle, Mulberry, including red and white mulberry, Mayapple, Nannyberry, Oregon grape, Sea-buckthorn, Sea Grape, Ugniberry Wolfberry

BLOOD ORANGE (*Citrus sinensis*) The blood orange is a variety with crimson, almost-blood-colored flesh. The fruit is smaller than an average orange. The distinctive dark flesh color is due to the presence of anthocyanins, a family of pigments common to many flowers and fruit, but uncommon in citrus fruits. The flesh develops its characteristic maroon color when the fruit develops with low temperatures during the night. Sometimes there is dark coloring on the exterior of the rind as well, depending on the variety of blood orange. The skin can also be more tough and harder to peel than other oranges. While all oranges are likely of hybrid origin between the pomelo and the tangerine, blood oranges originated as a mutation of the sweet orange. The three most common types of blood oranges are the Tarocco (native to Italy), the Sanguinello (native to Spain), and the Moro, the newest variety of the three.

BLUEBERRY

BUDDHA'S HAND *Citrus medica* var. *sarcodactylus*

CACTUS PEAR (*Opuntia species*) "sabra" *Opuntia*, also known as "nopales" or paddle

cactus is a genus in the cactus family, *Cactaceae*. Currently, only prickly pears are included in this genus of about 200 species distributed throughout most of the Americas. Chollas are now separated into the genus *Cylindropuntia*, which some still consider a sub genus of *Opuntia*.

Like all true cactus species, prickly pears are native only to the Western hemisphere; however, they have been introduced to other parts of the globe. The most commonly culinary species is the "Indian Fig *Opuntia*" (*O. ficus-indica*). Most culinary uses of the term "prickly pear" refer to this species.

The fruit of prickly pears, commonly called cactus fruit, cactus fig, "Indian fig" or "tuna" in Spanish is edible, although it has to be peeled carefully to remove the small spines on the outer skin before consumption. Prickly pears (mostly *Opuntia stricta*) were originally imported into Australia in the 18th century for gardens, and were later used as a natural agricultural fencing - similarly in Israel - and in an attempt to establish a cochineal dye industry. Red dye produced from the cochineal beetle that feeds on this cactus is however not kosher.

Sabra (Hebrew: צָבֵר , pronounced *tsabar*, *sabra*) is a term used to describe a Jew born in Israel. The term is also usually inclusive of Jews born during the period of the establishment of the state of Israel. The word "sabra" is Arabic and Hebrew. Immigrants to Palestine began using it in the early 1930s, according to the *The Dictionary of Slang* (Hebrew) written by Israeli Rubik Rozental. The allusion is to a tenacious, thorny desert plant with a thick hide that conceals a sweet, softer interior, suggesting that even though the Israeli Sabra are rough and masculine on the outside, they are delicate and sensitive on the inside.

Cacti and other succulents yield edible fruits, which are important traditional foods for some Native American peoples: Cardón, Dragonfruit, Prickly pear, Saguaro, *Cereus peruvianus*, and numerous other cactus species

Sabra liqueur is a chocolate-orange flavored liqueur produced in Israel. The primary flavor of Sabra is a rich, bittersweet chocolate. The dense chocolate is cut by the sweet and sour taste of Jaffa oranges.

CALABAZA

CARAMBOLA

CARISSA

CHAYOTE

CHERIMOYA (*Annona cherimola*) mid 20th century native to South America

CLEMENTINE (*Citrus reticulata*) developed by Father Rdier in 1900 in Algiers

CITRANGE (*Citrus sinensis* × *Poncirus trifoliata* or *C. sinensis* × *C. trifoliata*) is a hybrid of the sweet orange and the trifoliolate orange.

COCONUT

DRAGONFRUIT

ETROG (CITRON) Citron (*Citrus medica*) Etrog, a group of citron cultivars (the term originally just means "citrus fruit"). Citron varieties with sour pulp: Diamante citron, Florentine citron, Greek citron and Balady citron. Citron varieties with sweet pulp: Corsican citron and Moroccan citron.

GUAVA (*Psidium guayava*) arrived in Israel in the 20th century with a fascinating blended taste of strawberry/banana/pineapple and possessing an incredibly magnificent aroma.

KIWI (*Actinida deliciosa*) formerly known as the *Actinida chinensis*, and available in China but not used. New Zealand developed and popularized the fruit, and Israel is a wonderful climate in which to grow for domestic and export. Known as the *Chinese gooseberry*, the fruit was renamed for export marketing reasons in the 1950s; briefly to *melonette*, and then later by New Zealand exporters to *kiwifruit*

KUMQUAT (*Citrus halimii*; *Citrus indica*; *Citrus macroptera*; *Citrus latipes*; *Fortunella* species) China golden orange and previously a citrus, 19th century 4-5 species from East Asia ranging into Southeast Asia

LIME Key Lime (*Citrus aurantifolia*;) Omani Lime, from India; Finger Lime (*Citrus australasica*); Australian Round Lime (*Citrus australis*); Desert Lime (*Citrus glauca*).

LONGAN

LYCHEE The lychee (*Litchi chinensis*, and also known as the leechi, litchi, laichi, lichu, lizhi) is the sole member of the genus *Litchi* in the soapberry family, *Sapindaceae*. The lychee has a history of cultivation going back as far as 2000 BC according to records in China. Cultivation began in the area of southern China, Malaysia, and Vietnam. It is a tropical and subtropical fruit tree native to southern China and Southeast Asia, and now cultivated in many parts of the world. The fresh fruit has a "delicate, whitish pulp" with a "perfume" flavor. Since this perfumy flavor is lost in canning, the fruit is usually eaten fresh.

An evergreen tree reaching 10–28 meters tall, the lychee bears fleshy fruits that are up to 5 cm (2.0 in) long and 4 cm (1.6 in) wide. The outside of the fruit is covered by a pink-red, roughly-textured rind that is inedible but easily removed to expose a layer of sweet, translucent white flesh. Lychees are eaten in many different dessert dishes, and are especially popular in China, throughout Southeast Asia, along with South Asia and India. The lychee is cultivated in China, Thailand, Vietnam, Japan, Bangladesh and

northern India (in particular Bihar, which accounts for 75% of total Indian production). South Africa and the United States (Hawaii and Florida) also have commercial lychee production.

MANGO (*Anacardiaceae mangifera*) The mango is a fleshy stone fruit belonging to the genus *Mangifera*, consisting of numerous tropical fruiting trees in the flowering plant family *Anacardiaceae*. The mango is native to India from where it spread all over the world. It is one of the most cultivated fruits of the tropical world. While other *Mangifera* species (e.g. horse mango, *M. foetida*) are also grown on a more localized basis, *Mangifera indica* – the common mango or Indian mango – is the only mango tree commonly cultivated in many tropical and subtropical regions, and its fruit is distributed essentially worldwide.

MINNEOLA TANGELO (*Citrus x tangelo*) is sometimes misspelled "Mineola" is a cross between a Duncan grapefruit and a Dancy tangerine, and was released in 1931 by the USDA Horticultural Research Station in Orlando. It is named after Minneola, Florida. Most Minneola tangelos are characterized by a stem-end neck, which tends to make the fruit appear bell-shaped. Because of this, it is also called the "Honeybell" in the gift fruit trade

MIRACLE FRUIT

MONSTERA

PAPAYA

PAPEDAS (*Citrus halimii*; *limau kadangsa*; *limau kedut kera*) from Thailand and Malaya; (*Citrus indica*) Indian Wild Orange, from the Indian subcontinent; (*Citrus macroptera*) from Indochina and Melanesia; "Khasi Papeda" (*Citrus latipes*) from Assam, Meghalaya, Burma.

PASSION FRUIT (*Passiflora edulis*) is a vine species of passion flower that is native to South America. Its common names include "passion fruit" (UK and US) and "passion fruit" (Australia and New Zealand). It is cultivated commercially in warmer, frost-free areas for its fruit. The passion fruit is round to oval, either yellow or dark purple at maturity, with a soft to firm, juicy interior filled with numerous seeds. The fruit is both eaten and juiced; passion fruit juice is often added to other fruit juices to enhance the aroma. The yellow variety is used for juice processing, while the purple variety is sold in fresh fruit markets.

PERSIMMON (*Diospyros kaki*) "Sharon Fruit" is the popular name for the Israeli variety of persimmon also known as the Japanese persimmon. They are generally light yellow-orange to dark red-orange in color. As with all pollination-variant-astringent persimmons, the fruit are ripened off the tree by exposing them to carbon dioxide. The

sharon fruit has no core, is seedless, particularly sweet, and can be eaten whole. Commercially, there are generally two types of persimmon fruit: astringent and non-astringent.

The heart-shaped Hachiya is the most common variety of astringent persimmon. Astringent persimmons contain very high levels of soluble tannins and are unpalatable (or "furry" tasting) if eaten before softening. The astringency of tannins is removed through ripening by exposure to light over several days, placing the fruit in a paper bag with a source of ethylene, such as an apple. *Punica granatum* has more than 500 named cultivars.

PLANTAIN (*Musa acuminata x balbisian*) is the common name for herbaceous plants of the genus *Musa*. The fruit they produce is generally used for cooking, in contrast to the soft, sweet banana (which is sometimes referred to as the dessert banana). There is no formal botanical distinction between bananas and plantains, and the use of either term is based purely on how the fruits are consumed.

North America was first introduced to the fruit as "banana plantain", and in the United States and Europe "banana" generally refers to that variety. The word "banana" is sometimes used to describe other plantain cultivars, and names may reflect local uses or characteristics of cultivars: cooking plantain, banana plantain, beer banana, bocadillo plantain, etc.

POMEGRANATE (*Punica granatum*) is a fruit-bearing deciduous small tree growing between five and eight meters tall. The name pomegranate derives from medieval Latin *pomum* "apple" and *granatum* "seeded." Native to the area of modern day Iran, the pomegranate has been cultivated in the Caucasus since ancient times. From there it spread to Asia, Africa and the Middle East. Introduced into Latin America and California by Spanish settlers in 1769.

Pomegranates were known in ancient Israel as the fruits which the scouts brought to Moses to demonstrate the fertility of the "promised land" [The Book of Exodus describes the me'il ("robe of the ephod") worn by the Hebrew High Priest as having pomegranates embroidered on the hem. According to the Books of Kings the capitals of the two pillars (Jachin and Boaz) that stood in front of Solomon's Temple in Jerusalem were engraved with pomegranates. It is said that Solomon designed his coronet based on the pomegranate's "crown" (calyx). [61]

It is traditional to consume pomegranates on Rosh Hashana because the pomegranate, with its numerous seeds, symbolizes fruitfulness. Also, it is said to have 613 seeds, which corresponds with the 613 mitzvot or commandments of the Torah.

The pomegranate appeared on the ancient coins of Judea. When not in use, the handles of Torah scrolls are sometimes covered with decorative silver globes similar in shape to "pomegranates" (rimmonim) Some Jewish scholars believe that the pomegranate was the forbidden fruit in the Garden of Eden. [68] Pomegranates are one

of the Seven Species (Hebrew: שבעת המינים - *Shiv'at Ha-Minim*) of fruits and grains enumerated in the Hebrew Bible (Deuteronomy 8:8) as being special products of the Land of Israel. The pomegranate is mentioned in the Bible many times, including this quote from the Songs of Solomon, "Thy lips are like a thread of scarlet, and thy speech is comely: thy temples are like a piece of a pomegranate within thy locks." (Song of Solomon 4:3). Pomegranates also symbolize the mystical experience in the Jewish mystical tradition, or kabbalah, with the typical reference being to entering the "garden of pomegranates" or *pardes rimonim*; this is also the title of a book by the 16th-century mystic Moses ben Jacob Cordovero.

POMELIT (*Citrus grandis*; *Citrus maxima*) A hybrid grapefruit with the appearance and high juice content of the grapefruit and sweet flavor of the pomelo. Major dispute whether the hybrid was developed in UC or Israel.

PUMMELO (*Citrus maxima* or *Citrus grandis*) is a crisp citrus fruit native to Southeast Asia. It is usually pale green to yellow when ripe, with sweet white (or, more rarely, pink or red) flesh and very thick albedo (rind pith). It is the largest citrus fruit, 15–25 centimetres (5.9–9.8 in) in diameter, and usually weighing 1–2 kilograms (2.2–4.4 lb). Other spellings for pomelo include pummelo, and pommelo, and other names include Jeruk Bali, Chinese grapefruit, jabong, lusho fruit, pompelmous from Tamil *pampa lim* = [pompous lemon] and shaddock.

RAISIN GRAPES

SAPOTE

STRAWBERRY (*Fragaria vesca*) commonly called wild strawberries or woodland strawberry, is a plant that grows naturally throughout the Northern Hemisphere. It is believed that they were common since Stone Age. Other names for this species include Alpine Strawberry, Fraises des Bois, Wild Strawberry, and European

Garden strawberries (*Fragaria virginia* or the hybrid *Fragaria x ananassa*) such as we eat today are native to North America, and the Indians used them in many dishes. The first colonists in America shipped the native larger strawberry plants back to Europe as early as 1600. Another variety was also discovered in Central and South America, which the conquistadors called *futilla*. Early Americans did not bother cultivating strawberries, because they were abundant in the wilds. The first garden strawberry was grown in France during the late 18th century. Prior to this wild strawberries and cultivated selections from wild strawberry species were the common source for the fruit.

SURINAM CHERRY

TANGELO (*C. reticulata* x *C. maxima* or *C. x paradisi*; *Citrus x tangelo*); the tangelo is a hybrid between the pomelo and the tangerine. It has a thicker skin than a tangerine and is less sweet. It has been suggested the orange is also a hybrid of the two fruits. Other pomelo hybrids include grapefruits and mandelos

TABLE GRAPES - The appearance of the “Common Grape Vine” on earth has been dated to between 130 to 200 million years ago. Mankind’s relationship to this plant dates to the Neolithic period.

UGLI (*Citrus reticulata* × *C. maxima* or *C. × paradisi*) Ugli is the trademark of Cabel Hall Citrus Limited and under which it sells its “Jamaican tangelo,” a citrus fruit created by hybridizing a grapefruit (or pomelo), an orange and a tangerine. Its species is *Citrus reticulata* × *Citrus paradisi*, discovered growing wild (possibly having developed in the same way grapefruit was created) in Jamaica where it is mainly grown today. It has an unsightly appearance with rough, wrinkled, greenish-yellow skin, wrapped loosely around the orange pulpy citrus inside. The light green surface blemishes turn orange when the fruit is at its peak ripeness. A tangelo fruit is usually slightly larger than a grapefruit (but this varies) and has fewer seeds. The flesh is very juicy and tends towards the sweet side of the tangerine rather than the bitter side of its grapefruit lineage, with a fragrant skin. The taste is often described as more sour than an orange and less bitter than a tangerine, however, and is more commonly guessed to be a lemon-tangerine hybrid.

WINE GRAPES (*Vitis vinifera*) Wine is an alcoholic beverage, made of fermented fruit juice, usually from grapes. Archaeological evidence suggests that the earliest known production of wine, made by fermenting grapes, took place as early as 8,000 years ago in Georgia, 7000 years ago in Iran, and 6,100 years ago in Armenia. The natural chemical balance of grapes lets them ferment without the addition of sugars, acids, enzymes, or other nutrients. Grape wine is produced by fermenting crushed grapes using various types of yeast. Yeast consumes the sugars in the grapes and converts them into alcohol. Different varieties of grapes and strains of yeasts produce different types of wine. Wine is usually made from one or more varieties of the European species *Vitis vinifera*, such as Pinot Noir, Chardonnay, Cabernet Sauvignon, Gamay and Merlot. When one of these varieties is used as the predominant grape, the result is a varietal, as opposed to a blended, wine.

E. ORGINS OF CUIINARY FRUITS BY GEOGRAPHIC ORIGIN

Fruits native to Africa or of African origin:

African mango
Coffee
Marula
Miracle Fruit
Safou
Spiny Monkey-orange
Tamarind
Watermelon

Fruits native to Asia or of Asian origin:

Arhat
Batuan
Bignay
Bilimbi
Breadfruit
Buddha's Hand
Bael
Mango
Carambola
Charichuelo
Calamondin
Button Mangosteen
Chinese Quince
Che
Durian
Gac
Goumi
Jambul
Hardy Kiwi
Indian gooseberry
Kiwifruit
Mundu
Lanzones
Lapsi
Longan

Lychee
Mangosteen
Marang
Mock Strawberry
Nungu
Peach
Oriental persimmon
Pomelo
Rambutan
Rhubarb
Sageretia
Salak
Santol
Wild Mangosteen

Fruits native to Latin America or of Latin American origin.

Plants are of South American origin, except as noted.

Açaí, Amazon basin
Avocado, Mesoamerica
Barberry
Cainito
Capuli cherry
Cherimoya
Coconut, Americas
Feijoa
Giant Columbian blackberry
Guarana, Brazilian Amazon
Guava, Mesoamerica
Keule
Lardizabala
Mamey, Mesoamerica
Maqui
Mora Común
Mortiño
Naranjilla
Papaya
Peumo
Pineapple
Sapote, Mesoamerica

Sea grape
Strawberry
Soursop
Sugar-apple
Ugni

Fruits of North American origin

Canada and the United States are home to a surprising number of edible plants, especially berries; however, only three are commercially grown/known on a global scale (grapes, cranberries, and blueberries.) Many of the fruits below are still eaten locally as they have been for centuries and others are generating renewed interest by eco-friendly gardeners (less need for bug control) and chefs of the region alike.

American Chestnut
American Black Elderberry
American grape
American Hazelnut
American Mayapple
American persimmon
American plum
American Red Elderberry
American Red Raspberry
Beach Plum
Black cherry
Black raspberry
Black Walnut
Blueberry
Buffaloberry
Chokecherry
Coco plum
Cranberry
Eastern May Hawthorn
False-mastic
Florida strangler fig
Ground Plum
Huckleberry
Maypop
Muscadine

Pawpaw
Pecan
Prickly pear
Pigeon plum
Red mulberry
Salal
Salmonberry
Saskatoonberry
Saw Palmetto
Southern Crabapple
Texas Persimmon
Thimbleberry
Toyon

Fruits native to Oceania or of Oceanian origin:

Oceania is a region centered on the islands of the tropical Pacific Ocean.

Atherton Raspberry
Black Apple
Blue tongue
Bolwarra
Broad-leaf Bramble
Burdekin Plum
Bush tomato
Cedar Bay cherry
Cherry ballart
Cluster fig
Cocky apple
Common apple-berry
Conkerberry
Davidson's plum
Desert banana
Desert fig
Desert lime
Dodder laurel
Doubah
Emu Apple
Emu berry
Fibrous Satinash
Finger Lime

Illawarra Plum
Kakadu lime
Kakadu plum
Karkalla
Kutjera
Lady apple
Lemon aspen
Lillypilly
Little gooseberry tree
Midyim
Morinda citrifolia
Mountain pepper
Muntries
Native currant
Native gooseberry
Native raspberry
Nonda plum
Pigface
Pink-flowered Native Raspberry
Purple apple-berry
Quandong
Queensland Ebony
Riberry
Rose-leaf Bramble
Rose myrtle
Sandpaper Fig
Small-leaf tamarind
Snow berry
Sweet apple-berry
Tanjong
White aspen
Wild grape
Wild orange
Wild peach
Wild plum (munydjudj)
Wild plum
Wongi
Yellow plum
Zig Zag Vine

F. METHOD OF PLANT PROPAGATION / REPRODUCTION

Plant propagation is the process of creating new plants from a variety of sources: seeds, cuttings, bulbs and other plant parts. Plant propagation can also refer to the artificial or natural dispersal of plants.

Sexual propagation (seed)

Plant breeding is the art and science of changing the genetics of plants in order to produce desired characteristics. Plant breeding can be accomplished through many different techniques ranging from simply selecting plants with desirable characteristics for propagation, to more complex molecular techniques (see: cultigen and cultivar).

Plant breeding has been practiced for thousands of years, since near the beginning of human civilization. Classical plant breeding uses deliberate interbreeding (crossing) of closely or distantly related individuals to produce new crop varieties or lines with desirable properties. Plants are crossbred to introduce traits/genes from one variety or line into a new genetic background. For example, a mildew-resistant pea may be crossed with a high-yielding but susceptible pea, the goal of the cross being to introduce mildew resistance without losing the high-yield characteristics. Progeny from the cross would then be crossed with the high-yielding parent to ensure that the progeny were most like the high-yielding parent, (backcrossing).

Seeds and spores can be used for reproduction (through e.g. sowing). Sexual propagation involves the union of the pollen (male) with the egg (female) to produce a seed. The seed is made up of three main parts: the outer seed coat, which protects the seed; a food reserve (e.g., the endosperm); and the embryo, which is the young plant itself. When a seed is mature and put in a favorable environment, it will germinate, or begin active growth.

Seeds are typically produced from sexual reproduction within a species, because genetic recombination has occurred plants grown from seeds may have different characteristics from its parents. Some species produce seeds that require special conditions to germinate, such as cold treatment. The seeds of many Australian plants and plants from southern Africa and the American west require smoke or fire to germinate. Some plant species, including many trees do not produce seeds until they reach maturity, which may take many years. Seeds can be difficult to acquire and some plants do not produce seed at all.

Traits that breeders have tried to incorporate into crop plants in the last 100 years include:

- Increased quality and yield of the crop
- Increased tolerance of environment (salinity, extreme temperature, drought)
- Resistance to viruses, fungi and bacteria
- Increased tolerance to insect pests
- Increased tolerance of herbicides

Asexual propagation (vegetative)

Plants have a number of mechanisms for asexual or vegetative reproduction. Asexual propagation, multiplication without passage through the seed cycle, is the best way to maintain some species, particularly an individual that best represents that species.

Some of these have been taken advantage of by horticulturists and gardeners to multiply or clone plants rapidly. People also use methods that plants do not use, such as tissue culture and grafting. Plants are produced using material from a single parent and as such there is no exchange of genetic material; therefore vegetative propagation methods almost always produce plants that are identical to the parent.

Vegetative reproduction uses plants parts such as roots, stems and leaves. In some plants seeds can be produced without fertilization and the seeds contain only the genetic material of the parent plant. Therefore, propagation via asexual seeds or apomixis is asexual reproduction but not vegetative propagation.

Clones are groups of plants that are identical to their one parent and that can only be propagated asexually. The Kieffer pear and the Peace Rose are two examples of clones that have been asexually propagated for many years.

The major methods of asexual propagation are cuttings, layering, budding and grafting. A cutting is a vegetative plant part which is severed from the parent plant in order to regenerate itself, thereby forming a whole new plant. Cuttings involve rooting a severed piece of the parent plant; layering involves rooting a part of the parent and then severing it; and budding and grafting is joining two plant parts from different varieties.

Techniques for vegetative propagation include:

- Air or ground layering
- Division
- Grafting and bud grafting, widely used in fruit tree propagation
- Micropropagation
- Stolons or runners
- Storage organs such as bulbs, corms, tubers and rhizomes
- Striking or cuttings
- Twin-scaling

Grafting (one very common technique)

Grafting or *graftage* is a horticultural technique whereby tissues from one plant are inserted into those of another so that the two sets of vascular tissues may join together. This vascular joining is called "inosculation." In most cases, one plant is selected for its roots and this is called the stock or rootstock. The other plant is selected for its stems, leaves, flowers, or fruits and is called the *scion* or *cion*. The scion contains the desired genes to be duplicated in future production by the stock/scion plant. For successful

grafting to take place, the vascular cambium tissues of the stock and scion plants must be placed in contact with each other. Both tissues must be kept alive until the graft has 'taken', usually a period of a few weeks.

In stem grafting, a common grafting method, a shoot of a selected, desired plant cultivar is grafted onto the stock of another type. In another common form called bud grafting, a dormant side bud is grafted onto the stem of another stock plant, and when it has inoscultated successfully, it is encouraged to grow by pruning off the stem of the stock plant just above the newly grafted bud.

F. NEW CROPS AS A SOLUTION FOR THE ISRAELI EXPORT MARKET

Y. Mizrahi and A. Nerd

Israel is small country (~5 million people and 22,000 km²) that is self sufficient in agricultural production. The local market is tiny and is subject to dramatic fluctuations in supply and demand. When extra few tonnes of fresh fruits and/or vegetables are dumped onto the local markets, prices plummet and farmers cannot make a living. In contrast the export market, mainly Europe, with hundreds of millions of consumers is unlimited from an Israeli point of view. Thus, Israel is basically an export oriented producer. At its peak, the export volume of fresh agriculture produce (mainly fruits, vegetables, and flowers) from Israel was valued around US\$1 billion/year. In the 1960s the fruit export industry (mainly citrus, with the famous 'Jaffa' orange being the main product) constituted one of the main sources of foreign currency (out of a total export market of US\$211 million agricultural produce comprised about US\$64 million, i.e., 30.3% of the total!). Today, Israel is an industrial exporting country with total annual export value of US\$14 billion while exports of agricultural fresh produce amount to US\$547 million, a mere 3.9% of the total (Statistical Abstracts 1994). It is obvious that a small country such as Israel has to compete in world markets in terms of quality rather than quantity. As a result, millions of R&D dollars have been invested in the past two decades to enable Israel to compete in the world markets with the best possible products giving the highest possible return to the growers. Despite the huge input of R&D in the agricultural sector, the production of the citrus is diminishing (Fig. 1) due to lack of profitability (Fig. 2) and farmers are complaining. Citrus sales have diminished by 30.6% from 1990 to 1993 and profitability in terms of revenue's buying power has declined to 57.3% when inflation is taken into account (Fig. 2; Statistical Abstracts 1994; BDO 1995). The Israeli tomato export industry has stagnated at 8,000 t annually for the past few years, despite the enormous R&D efforts that have produced the world's finest quality (Statistical Abstracts 1994). Israel has additional cost limitations on its competitiveness. Water is a major limiting factor and its actual price is very high (US\$0.22 per m³) and the alternative price is even higher. Labor is very expensive, since farmers are in the upper middle class strata. More than 90% of the agricultural community in Israel is either a kibbutz (community farm) or a moshav (family farm) with minimum hired labor, where most of the work is performed by the farm owners and their families. Gross income below US\$100 and even 150 US\$/day is considered very low. Israel's competitors in the world markets pay to agricultural workers 10% and less of this sum! Finally, energy is expensive, since almost all the country's energy is imported.

These problems have led many experts in Israel to raise the possibility of giving up agricultural production, even for the local markets, and purchasing all the country's agricultural needs abroad, as do Singapore and Hong Kong. We subscribe to a totally different approach. We believe that supplying the new crops niche in the world markets will serve as a remedy for the troubled Israeli agricultural export industry.

NEW CROPS INITIATIVE

In the light of the fruit exports dilemma discussed above, we initiated in 1984 an R&D project for the "Introduction and domestication of rare and wild fruit and nut trees as new crops to the Israeli Negev Desert" (Nerd et al 1990; 1993). This project includes about 40 different fruit tree species (Table 1) from all over the world that are considered to be potential new export crops. For the project, four sites were selected in the Negev Desert and one location in the Judean Desert, each site differing from the others in terms of climate, soil, and water (Nerd et al. 1990, 1993).

The first stage, which lasted about 10 years, was devoted to assessing the survival, growth, phenology, yields, and quality of seedlings of the investigated species. For all the species we preferred to start with seedlings, which provide wide base of genetic backgrounds, rather than to concentrate on a very narrow base of vegetatively propagated preselected genotypes. Many species did not survive, and others are still at various stages of R&D, far away from any considerations of economic potential. Four types of fruit have already been moved to the second stage of this program, which will enable us to provide economic evaluation, such as the cost of various inputs per unit area and the output during the years up to the time that the orchards will reach the full production stage. In this second stage of the project, vegetatively propagated specimens are also being tested in a cultivar trial. The expected small quantities that will be produced at this stage (20-30 t/year/crop) will also enable us to evaluate the marketing and find solutions to post-harvest problems. The market figures will enable farmers to take decisions whether or not to enter into the arena of these new crops.

The species that are currently in the second stage of the project include: (1) climbing trellised cacti growing in net houses--*Selenicereus megalanthus* and three species of *Hylocereus*; (2) the outdoor-grown cactus *Cereus peruvianus*, also known as apple cactus; (3) white sapote (*Casimiroa edulis*); and (4) Ber (*Ziziphus mauritiana*) also known as "desert apple," a species introduced from India. Two more species are under consideration for moving to the second R&D stage: (5) marula (*Sclerocarya birrea* subsp. *caffra*), for which 10 clones are currently being propagated and will be ready for planting next year, and (6) argan (*Argania spinosa*), a wild oil tree from Morocco, which will be promoted to the second stage after the selection of the current fruiting year.

Crawling Cacti

These species which are native to Central and north South America, climb on tree trunks in the tropics and may be epiphytic (Gibson and Nobel 1986). Their fruits have various sizes, tastes, shapes, and colors. Some have spines that abscise upon ripening and others have scales of various shapes and colors. The pulp also varies in color from white to various hues of red and purple, while the abundant seeds may be soft and

edible (Mizrahi et al. 1996). The reproductive biology of these species is described in a review by Nerd and Mizrahi (1996). Five genotypes are already growing in an area of 2 ha, mainly in net houses since they require shade (Nerd et al. 1990; Raveh et al. 1993; Mizrahi et al. 1996). One clone of *Selenicereus megalanthus*, also known as yellow pitaya, is being cultivated (Weiss et al. 1995). Yellow pitaya is already an established crop that is being exported worldwide from Colombia (Arcadio 1986; Cacioppo 1990; Mizrahi et al. 1996). Other clones include one of *Hylocereus polyrhizus*, one of *H. undatus* and two of *Hylocereus* sp. (Barbeau 1990), all our selections. These clones have been planted in two plantations, each of 0.5 ha. Each clone was planted in a different row to allow cross pollination from the neighboring rows (Weiss et al. 1994b). All were planted in the late summer of 1993 as rooted cuttings removed from the same mother plants, and all started to fruit in 1994. In these plantations two net houses were planted, one with 50% shade in the Arava valley, having a hot climate and saline water (EC 4 dS/m), and the other with both 30% and 60% shade sections in the Besor area, which is characterized by good quality water (EC 1 dS/m) and moderate temperatures with only rare frosts (Nerd et al. 1993). The second hectare was planted in the Yad Mordekhay area, with sub-freezing temperatures as low as -4deg.C; here, plastic houses were planted to accommodate selected and non-selected plants. All started to fruit one year after planting.

Cactus Apple

Of many columnar cacti tested by us as potential new crops, one species--*Cereus peruvianus*--grew the fastest. It started to flower and fruit four years after seeding (Nerd et al. 1993; Weiss et al. 1993). Rooted cuttings of seven clones of this cactus, selected from over 300 seedlings, were planted in the Arava valley and the Besor, with a total area of 2 ha. All cuttings were planted as a mixture of clones, since this species demonstrates self-incompatibility (Weiss et al 1994a). The reproductive biology of this cactus is also described in the review of Nerd and Mizrahi (1996). All clones started to flower and fruit two years after planting. Over 1,000 seedlings have been planted for further selection.

White Sapote

White sapote (*Casimiroa edulis*, Rutaceae) is an evergreen medium-size tree native to the highlands of Mexico and Central America. The fruits are green-yellow, with a thin skin and a creamy white-yellow sweet flesh (Morton 1987). Selected clones are available, mainly in Southern California (Chambers 1984; Morton 1987), and some effort has been made to introduce the species into New Zealand and Australia (Dawes and Martin 1988; George et al. 1988). A small commercial plantation (16 hectares) with selected cultivars is being grown in Carpenteria near Santa Barbara, California and the fruits can be found as an exotic item in the United States and Australia. Early tests in the Israeli Negev Desert demonstrated partial tolerance to salinity (Nerd et al. 1992). In autumn 1992 and spring of 1993, 21 grafted clones were planted in Qetura and Besor; 16 were introduced as bud-wood from Fallbrook, Southern California (from R.R. Chambers orchard), while the remaining five were propagated as grafted bud-wood from our own selections. Nine replications from each clone were planted in three blocks at each location. In 1995 some clones started to flower and set fruits in these two locations.

Desert Apple

Desert apple (*Ziziphus mauritiana*, Rhamnaceae), also known as ber or Indian jujube, is an evergreen, medium-size, thorny tree believed to be of African origin (Alexander, 1979). The fruits can reach plum size, turning yellow from green as ripening starts, and becomes sweet and sour in taste, both the flesh texture and taste being reminiscent of apples. The fruit has a unique aroma, similar to that of carob, which becomes too strong for "Western" tasters when fully ripe, at which stage the color turns brown. The fruit can be consumed dry, similar to its relative the "Chinese date" *Z. jujube*. Ber is grown commercially as a desert crop (hence the name desert apple) in India. Seedlings and introduced cultivars from India developed and yielded very well (over 100 kg/tree annually) in all our introduction orchards, including areas with frequent sub-freezing temperatures and highly saline water (Nerd et al. 1990). Three Indian cultivars were planted at Neot Hakikar, the lowest point on earth -400 m below sea level with 3,960 mm evaporation/year and saline water (EC 4 dS/m) with Na and Cl as the major ions (Nerd et al. 1993). Most of our introduced fruit tree species did not survive under these conditions, but ber has fruited heavily from very early ages. A semi-commercial plantation was planted by a farmer in 1993, and the first yield was sold in 1995 in the local market, mainly to immigrants from India who are familiar with the fruit.

Marula

Marula (*Sclerocarya birrea* subsp. *caffra*, Anacardiaceae) is a large, dioecious, deciduous tree, which grows wild in southern Africa. Female trees bear plum-sized fruits with a thick yellow peel and a translucent, white, highly aromatic sweet-sour fruit, which is eaten fresh, like a small mango, or used to prepare juices, jams, preserves, dry fruit rolls, and alcoholic beverages. The seeds, which are eaten as a delicate nut, are highly appreciated by the locals and hence the name "the kings nut." The nut has high nutritive value and a high oil content (56%) with very good dietetic ratio of saturated to unsaturated fatty acids (Weinert et al. 1990). Trees were established very well at introduction sites in the Negev Desert and produced abundant fruits from early ages, mainly when grown in a hot area with saline water (Qetura) (Nerd and Mizrahi 1993). Trees were badly damaged after a spell of sub-freezing temperatures of -6° and -7°C; all recovered but never set fruits, and thus this species is not recommended for areas with such low temperatures. At Qetura, some pistillate trees are bearing well, over 400 kg/tree annually, and we have moved the species to the second stage of our R&D program to test selected clones on a semi-commercial basis. Ten selected clones are being propagated and will be ready for planting in 1996.

Argan

Argan (*Argania spinosa*, also known as *A. sideroxyton*, Sapotaceae) is a medium, thorny, evergreen tree native to south western Morocco. The tree bears plum-sized fruits, which are eaten by goats which often climb the trees. The fruits have a bitter pericarp around a stone-like structure, containing one to three kernels with a high oil content (over 50%). The oil has high dietetic value, total unsaturated fatty acids/total saturated fatty acids being around 4.5, a ratio similar to that of olive oil (Morton and Voss 1987; Prendergast and Walker 1992). The oil has a unique aroma and is considered as the best culinary oil by Moroccans, who are the only people familiar with

the oil. In Israel, where 600,000 immigrants from Morocco reside, imported argan oil is sold for US\$43/liter in comparison with \$4/liter for olive oil. Attempts to domesticate this wild tree in Israel started about 10 years ago. The species demonstrated adaptability to the hot hostile environment of the Arava valley when irrigated with brackish water; yields of oil per tree at Qetura were double those at Ramat Negev, which has much milder environmental conditions (Nerd et al. 1994). The oil yield of best specimens was around 1 kg/tree annually. Some seedlings died as a result of infection with *Fusarium oxysporum*. Until tolerant rootstocks can be found, we decided to plant grafted trees from the best yielding ones and to plant additional seedlings from various habitats in Morocco. Even though this species is not in as advanced stage of introduction as the marula, we consider it to be a high-priority species because of its rarity and the high demand in Israel for its oil.

We anticipate that at least some of these newly introduced species will become export items with profit levels that will be sufficiently high to revive the fruit export industry and replace the old "dying-out" export crops. The high profitability of new fruit crops was demonstrated for kiwi fruit by New Zealand in the world market and for avocado by Israel in the European market. There is no reason why such new exotic fruits will not be the commodities of the future. We should not forget that no crop can stay at its peak forever, and low profits always loom in the future. Mr. Dan Rymon (pers. commun.), found that it took 17 years from the first sales of flower crops in the European markets until Israel was chased out by its competitors. With fruit trees, it may be much much longer, as was the case with the kiwi fruit from New Zealand (47 years) and the 'Shamuti' ('Jaffa') orange from Israel (80 years).

4. WHAT CAN YOU DO WITH FRUIT WITH A CLASS / GROUP:

(1) Make up platters of various fruits and nuts that as you reach the historical period in your discussion you can sample; or you can save them for the conclusion. You can also serve other sweets, e.g. cookies or candies made from these fruit ingredients, the classic sesame candy, banana bread, etc.

(2) Make “Smoothies” – using a blender or a smoothie maker. Basic rule, however, is that you always must have some liquid in the jar if you are using frozen fruit or ice. Don't attempt to pulverize ice or frozen items in your smoothie machine or blender without liquid – e.g. orange juice, apple juice or even some milk or yogurt. Otherwise the motor may burn out under the strain, and you'll be left having taught, lectured and the students or participants will be greatly disappointed.

I encourage the students to pick a smoothie by historical period and then remember what fruits were available at that time in Israel.

Some Tools for the Smoothies: Above all, you will need a powerful blender or smoothie maker, preferably 450 watts or more. Having two or three blenders is very helpful for meeting atime schedule and also to hve a dairy blender for using yoghurt with the fruits, and also pareve blenders for fruit only. [Some people are lactose intolerant and you should check in advance. Similarly check on any other food, fruit or nut allergies before serving.] In addition, vegetable peelers, paring knives, chef's knife, cutting boards, toothpicks, garbage can (can be used for compost heap for the your Spring garden), plenty of small cups for tasting and also an ample supply of napkins, plates, forks/knives.

The following have been borrowed or adapted from items on the Internet, Fruit Cookbooks and the brochures that came with my smoothie machines; I have kept at least one for dairy and two for pareve. No attempt is being made to intend originality although I would encourage every teacher and program presenter to mix and match ingredients. I have not yet used nuts in my machines because of the increasing awareness of nut allergies although nuts were known in Israel from the earliest time. Drink and enjoy.

(3) Recipes:

Recipes:

(a) FRUIT SMOOTHIE

Serving Size : 4 Preparation Time :0:00

Categories : Beverages Fruits

Low-Fat

1 md Ripe peach

3/4 c Fresh OR frozen strawberries
1/2 Banana -- peeled
2 c Skimmed evaporated milk-chilled
4 ts Frozen orange juice concentrate
1 t Vanilla
4-6 ice cubes
Cinnamon -- optional

Combine everything in blender except ice and cinnamon. With blender running, add ice cubes one

at a time. Divide Smoothie into 4 chilled glasses and sprinkle with cinnamon.

(b) BANANA BERRY SMOOTHIE

2 bananas
1/2 cup blueberries
1 cup plain yogurt

Peel bananas, slice and place on a cookie sheet. Put in freezer and freeze until solid. Remove from freezer and place in blender. Slice berries and add to blender. Pour in yogurt. Blend until smooth. Pour into glass and serve.

(c) FRUIT 'N' HONEY

1 Scoop Vanilla frozen yogurt
8 ounces apple juice
frozen fresh fruit
a squeeze of honey
ice

blend in blender until smooth

(d) POWER BREAKFAST

1 cup orange juice
3/4 cup pear -- peeled and diced
1 banana -- frozen
3/4 cup plain low-fat yogurt
1 teaspoon vanilla extract
3 tablespoons smooth peanut butter

2 tablespoons wheat germ

Place all ingredients into blender and blend until smooth.

(e) GREEN ENVY AVOCADO SMOOTHIE

1 avocado

2 bananas

2 cups orange juice

1 cup of strawberries (preferably fresh, but frozen will do) 1 cup of orange or strawberry sherbet

1 cup ice

5. BIBLIOGRAPHY OF FRUIT TREE RESOURCES

1. California Rare Fruit Growers <http://www.crfg.org/fg/xref/xref-a.html>
2. England's Orchard and Nursery - A Kentucky nursery specializing in nut trees but with other things of interest, such as pawpaws
3. Fruit Links <http://www.brevardrarefruit.org/fruitlinks.html>
4. Fruit Trees Nursery of Moshe Wallach, an Israeli Fruit trees Nursery. Common fruit trees and also over 50 kinds of exotic fruit trees for sale.
5. Garden of Delights in Davie, Florida has an excellent selection of rare fruit trees. They even have the "Red Genova" Ilama that was featured in the September/October 1998 Fruit Gardener, and they can ship it to CA.
6. Minor Tree Fruit Species Project. Coordinators: E. Bellini - E. Giordani, Dipartimento di Ortoflorofruitticoltura, Florence, Italy Covers: fig, strawberry tree, pomegranate, cornelian cherry, persimmon, medlar, loquat, jujube, cactus pear, azerole, quince, sorb, European chestnut, mulberry tree, pistachio, carob tree
7. Olive Tree Sources - nurseries in Northern California who carry fruiting olive trees <http://www.cooc.com/fresources.html>
8. The Banana Tree Inc. tropical plants and seeds The Banana Tree Inc. tropical plants and seeds: online catalog of tropical plants and seeds from around the world.
9. The Fruits of the Hold Land , Asaph Goor and Max Nurock. (New York: Israel Universities Press, 1968).
10. Your Biblical Garden: Plats of the Bible and How To Grow Them, Allan A. Swenson (New York: Doubleday and Company, Inc. 1981).
11. Uncommon Fruits and Vegetables: A Commonsense Guide , Elizabeth Schneider. (New York: William Morrow and Company, Inc.,

Tu BiSh'vat Seder

Preparation for the Tu B'Shevat Seder

You will need to purchase both red and white wine or grape juice and 15 (numerical value of the Hebrew letters spelling "TU" – Tet and Vav) - different types of fruits and nuts; five from each of the following three categories:

1) fruits or nuts with an inedible outer shell and an edible inner core: sabra, pineapple, coconut, orange, pumello, banana, walnut, pecan, grapefruit, starfruit, pinenut, pomegranate, papaya, brazil nut, pistachio, or almond. (Note: purchase the whole fruit or nut so you can remove the outer shell during the seder).

WARNING: Check carefully in advance regarding any allergies to peanuts, nuts and fruits AND if any processed food or beverage to be served is prepared on equipment used for dairy or nuts.

2) fruits with edible outer flesh and pithy, inedible cores: olive, date, cherry, loquat, peach, apricot, jujube, persimmon, avocado, plum, or hackberry. (Note: purchase the whole fruit so you can remove the pit or core during the seder).

3) fruits which are edible throughout. Here no protective shells, neither internal nor external are needed. The symbolic fruits may be eaten entirely and include: strawberry, grape, raisin, fig, raspberry, blueberry, cranberry, carob, apple, pear, kiwi or quince.

Some Tools for the Seder

Vegetable peeler, paring knife, chef's knife, cutting board, toothpicks, garbage can (scraps can be used for compost heap for your garden in the Spring), plenty of small cups, napkins, plates, forks/knives

CHECK LIST FOR YOUR TU BISH'VAT SEDER: 15+ Different Fruits, Nuts, Wine/Juice: These are suggestions; you can substitute your own ingredients

1. Fruit with a hard outer shell

Coconut

Almonds

Walnuts

Pecans

2. Fruit with an inner pit

Dates

Olives

Cherries

Plums

3. Fruit with an outer shell and inner pit

Carob

Avocado

Pomegranate

Orange

4. Fruit that is entirely edible

Figs

Raisins

Strawberries

Grapes

Sabra

5. Four different Israeli wines and/or grape juices: white, blush, zinfandel and red

6. Wheat / Barley / Rye / Oat / Multi-grain crackers

7. Jams/Jellies/Fruit Spreads/ Marmalades from Israeli produce and production

8. Song sheets for each person

9. Hagaddot for each person

BACKGROUND OF SEVEN SPECIES AND TU B'SHEVAT SEDER

The “Seven Species” (Hebrew: שבעת המינים?, *Shiv'at HaMinim*) are seven agricultural products - two grains and five fruits - that are listed in the Hebrew Bible (Deut 8:8) as being special products of the Land of Israel.

Deuteronomy 8:8 “a land of wheat and barley, and vines and fig-trees and pomegranates; a land of olive-trees and honey;

אֶרֶץ חֹטֶה וּשְׂעֵרָה, וְגִפְנוֹ וּתְאֵנָה וְרִמּוֹן; אֶרֶץ-זֵית וְדֹבֶשׁ

Wheat (*Triticum dicoccon*, Emmer Wheat or *Triticum aestivum L.*) It was one of the first crops domesticated in the Near East and widely cultivated in the ancient world. Wheat is mentioned together with barley 13 times in the Bible, and eight times alone. Scientists believe the wheat of the Bible to have been *Triticum aestivum L*, a cultivated summer and winter wheat, though other varieties grew both wild and cultivated. "Corn" is mentioned no less than 71 times but the intention of course is not American corn (*Zea mays o L*, a.k.a. Indian corn or maize) but rather the general term "grain". It is the various translations of the original Hebrew *dagan*, that have misled many to think it unusual that tortillas never caught on in the native diet.

Barley (*Hordeum vulgare ssp. spontaneum* Wild barley). The earliest evidence of wild barley in an archaeological context comes from the Epipaleolithic - between 10,000 and 2,000 years ago - at Ohalo II at the southern end of the Sea of Galilee.

Grapes (*Vitis vinifera*) - Common Grape Vine The appearance of the Common Grape Vine on earth has been dated to between 130 to 200 million years ago. Mankind's relationship to this plant dates to the Neolithic period.

Figs (*Ficus carica*) The common edible fig is one of the first plants that were cultivated by humans dating to about 9400–9200 BC in the Jordan Valley, north of Jericho.

Pomegranates (*Punica granatum*) Pomegranate is a fruit-bearing deciduous shrub or small tree growing to between five and eight meters tall. The pomegranate is native to Iran and has been cultivated and naturalized over the whole Mediterranean region and the Caucasus since ancient times.

Olives (*Olea europaea*), Olive Tree native to the coastal areas of the eastern Mediterranean region, from Lebanon, Syria and the maritime parts of Turkey and northern Iran at the south end of the Caspian Sea

Honey (bee or date?) (*Phoenix dactylifera*) The Date Palm has been cultivated since ancient times from Mesopotamia to prehistoric Egypt, possibly as early as 4000 B.C.

THE MOFET INSTITUTE

1. TEACHER GUIDE MATERIALS

Tu BiSh'vat – THE NEW YEAR OF TREES - BACKGROUND

Tu BiSh'vat is a minor holiday which falls on the 15th day of the Hebrew month of Shvat. The name of the festival literally means the fifteenth of Shvat. The New Year of the Trees occurs on this Hebrew date. This festival expresses a deep link between the Jewish people and the Land of Israel. It is marked by the eating of nuts and fruits, and planting trees or donating funds to the Jewish National Fund (Keren Kayemet L'Israel) so that they may plant trees in Israel. Tu B'Shvat also focuses on environmental issues, and in some communities a "Tu BiSh'vat seder" is held.

Tu BiSh'vat is not mentioned in the Bible. It is first mentioned in the Mishnah, which was completed circa 200 and is that part of the Talmud which contains the Jewish laws handed down since the time of the Bible. Tractate Rosh Hashanah 1:1 states that there are four new years. The four new years are the 1st of Nissan used in biblical times to date the reigns of kings, the 1st of Elul marking the new year for the tithe of cattle, the 1st of Tishrei or Rosh Hashanah and the 15th of Shvat or the New Year of Trees. Today only the latter two have any observances associated with them.

The question as to why the New Year of the Trees falls in the month of Shvat is also answered in the same Talmud Tractate (Rosh HaShana). By the middle of the month of Shvat the majority of the average annual rainfall has already fallen. Therefore, the trees have already started to grow, and this is the time when fruits begin forming on the trees. In Israel the 15th of Shvat is the day when new sap traditionally starts to rise in the trees. It is a time of rejuvenation, the beginning of Spring and everything is green.

Tu BiSh'vat is an agricultural holiday marking the date from which to count the age of the tree. In ancient times farmers were taxed on the fruit they produced between one Tu BiSh'vat and the next. The date also related to the maturation of the fruit tree. According to Leviticus 19:23-25 we are not allowed to eat the new fruit until the fourth year of its development.

One of the major customs associated with the New Year of Trees is tree planting. In Israel school children are taken to established and newly developed forests to plant trees. In the Diaspora money is collected and sent to Israel for the intended purpose of planting trees. This custom of contributing money for tree planting was initiated by the Zionist teachers at the beginning of the twentieth century, in order to emphasize the Jewish roots in Israel.

An ancient custom in Israel was to plant a tree in honour of a new born baby. The tree was planted on Tu BiSh'vat following the child's birth. If the baby was a boy, a cedar was planted. If the baby was a girl, a cypress was planted. As the children grew so did the trees. When the

children got married the wood from the trees built their chupah (wedding canopy). As the wood from the two trees were joined in the chupah so were the bride and groom in their marriage.

Another custom associated with Tu BiSh'vat is the eating of dried fruits from Israel. This emphasizes the link with the Land of Israel. There are varied customs regarding eating fruit on Tu B'Shvat. Some have the custom of eating the seven species of fruits that grow in Israel. Based on a verse in Deuteronomy (8:8) these fruits are wheat, barley, grapes, figs, pomegranates, olives and dates. In some communities it is the tradition to eat 15 (Tu) different kinds of fruits.

The idea of a Tu BiSh'vat seder goes back to the late 16th century Kabbalists of Safed who saw mystical symbols in trees and fruits. The idea was not adopted by the Ashkenazi communities although some Sephardi communities did embrace it. It has been revived with the Zionist movement. Today many kibbutzim hold a Tu BiSh'vat seder. In Neot Kedumim, an open-air educational institution near Jerusalem, the vegetation and agriculture of the Bible have been recreated on the hillsides there. They have also published a Tu BiSh'vat Haggadah.

The Tu B'Shvat seder is loosely based on the Passover seder. As in the Passover seder, four glasses of wine are drunk. However, in each glass the colour of the wine is varied. The first cup is all white wine to symbolize the dead of Winter. The second is mostly white mixed with some red to mark the start of Spring. The third is mostly red mixed with some white symbolizing the developing Spring season, and the fourth is all red wine symbolizing full-bodied Spring. A good part of the Tu B'Shvat seder liturgy is composed of excerpts mentioning trees from the Bible, Talmud, and other sources.

It is important that you read the introduction in order to put the activities that follow in their correct framework.

2. TEACHER GUIDE TO TU BISH'VAT

1. LEXICAL ITEMS

almond, bark, bough, blossom, branch, bud, fruit, leaf, leaves, roots, tree, trunk

2. IDEAS FOR DIFFERENT LEVELS

Grade 4: Word search 1 together with word bank. Find words and write at least 3 sentences using some of the words found.

Grade 5: Unscramble the words and find them in word search 2. Pupils can use the words in sentences.

Grade 6: Word search 3 to find different types of trees.

ACTIVITIES

Tu BiSh'vat Word Search 1

In the word search below you have words going in all directions: There are 10 things all related to the title.

TREE WORDS

H A P Y S S M S R S

B A L T L O P E R F
V A O M S T K V T V

W O R S O N O A U H R F O K U N U E W B E L A R W B D L R N B E T E Y H U A F Y Q
M R E L J N D K F Y O T T U C V L Q T K M P Y H N B D Q U
Word bank : almond, bark, blossom, branch, bud, leaf, leaves, roots, tree, trunk

Tu BiSh'vat Word Search 2

Unscramble the following words related to trees, then find them in the word search below.

- | | |
|------------------|-----------|
| 1. abkr | 2. hguob |
| 3. soomlbs _____ | 4. abchnr |
| 5. ubd | 6. iufrt |
| 7. feal | 8. ortos |
| 8. erte | 10. knrtu |

Tu BiSh'vat Word Search 3

In the word search below these 10 words go in all directions:

TREE WORDS

N R K H B K B L T
J U V F T G L O E I
H

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LSROOUS AUBWEISGTOFRREKSBOVQBFZ

IOYOAYLYGQ

MURXNRTWOBHCNARBKSPZTRUNKLDUBA

JRN PQCNZUC

Word bank : bark, bough, blossom, branch, bud, fruit, leaf, roots, tree, trunk.

Tu BiSh'vat Word Search 4

In the word search below you have 14 names of trees going in all directions:

TREES

GTNSBJVRCSQGIFZGLY

OFXZPWOFKDBXDWHKKY

SGPINENWGBLLNUXRRR

YPYYFZMPXRRONFFOT

FVBQVMXSASJMSDFIY

DR

KDNDNQSUPEGRRCERNVEBDJFJCGULLEKLBZITT

ZAAKBWQKTDEBUDSALM

TAKFUANHQLRNZPDZO

MRF SOPUCSYCDVBOQZV

R

PCOPQTQCULFCORANGE

OELFGWHVEAUIVUOPKU

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PEOLK CZGLDBIOALAYQ

LKXDZVCMJCAHKLVLDEADBJZROYMRPRAOIMZNRMC AKN
UFQABMOUTVEIDMAADOZMCIBLVHRHEK

MNYPKNPPSZNJCYKNHS

Word bank: Almond, apple, cedar, date, fig, fir, lemon, maple, oak, olive, orange, palm, pine, poplar

SONGS

1. “**Ten green leaves**” (Tune: Ten Green Bottles)

There were ten green leaves hanging on the tree And
if one green leaf would accidentally fall There would
be nine green leaves hanging on the tree. There were
nine green leaves hanging on the tree And if one
green leaf would accidentally fall

There would be eight green leaves hanging on the
tree. There were eight green leaves hanging on the
tree And if one green leaf would accidentally fall
There would be seven green leaves hanging on the tree.

(Continue in this manner – 7/6; 6/5; 5/4; 4/3; 3/2; 2/1)

There was one green leaf hanging on the
tree And if one green leaf would
accidentally fall
There would be no green leaves hanging on the tree.

2. “**The Almond Trees are White**”

(Tune: “Almond Trees Are Blooming” - (Tg et dic t)

The almond trees are white,
The sun is shining bright.
Singing birds from every
dome Tell us Tu-b’Shvat has
come. The holiday of the
trees.

3. “**A Song for The New Year For**

Trees” (Tune: “*The Green Grass Grew All
Around*”)

There was a Tree
There was a tree, a pretty little tree,
The prettiest tree you ever did see,
The limb on the tree, the tree in a hole

The hole in the ground,
And the green grass grew all around, all around,
And the green grass grew all around.

And on this limb, there was a bough...
And on this bough there was a branch...
And on this branch there was a twig...
And on this twig there was a nest...
And in this nest there was a bird...
And on this bird there was a feather...
The prettiest feather you ever did see
The feather on the bird, the bird in the nest...

4. “The Green Beans Grew All Around”
(Tune: “*The Green Grass Grew All Around*”)

There was a hole (repeat)
In the middle of the ground. (repeat)
The prettiest hole (repeat)
That you ever did see. (repeat)
Well, a hole's in the ground
And the green beans grew all around and around
And the green beans grew all around!

Well, in this hole (repeat)
There was a seed. (repeat)
The prettiest seed (repeat)
That you ever did see.
Well, a seed in the hole
And a hole in the ground
And the green beans grew all around and around
And the green beans grew all around!

Well, from this seed
There came a plant.
The prettiest plant
You ever did see.
Well, a plant from the seed
And a seed in the hole
And a hole in the ground
And the green beans grew all around and around
And the green beans grew all around!

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ACTIVITIES

1. Title: "Fruits galore.

Level: Grade 3.

Materials: Fruits – collect fruits or pictures of fruits (figs, grapes, dates, apples, oranges, olives, pomegranates, bananas.)

Aims: -to teach lexical items of fruits

Description: Begin by asking the pupils some basic questions about the festival (What festival falls on the fifteenth of Shvat? What do we do on this festival?) After you have elicited the fact that we eat fruits on this day present the lexical items. Revise them several times and then ask for a volunteer. The volunteer has to get at least 5 of the items correct when asked "What is this?" Several pupils can be asked to volunteer to be tested in this way.

Have the pupils divide their page into four and draw four of the items. Use these pages to play bingo with the pupils.

2. Title: Family tree.

Level: Grade 4/5.

Materials: Family tree outline (optional), flashcards of family members (e.g. Mother, father, grandfather, grandmother, brother, sister, aunt, uncle)

Aims: -to re-enter and review lexical items connected to the family.

Description: Teacher explains that there are many different types of trees, and elicits different names of trees. If nobody comes up with "family trees" teacher writes it on the blackboard and asks pupils to explain what it is. (A family tree is a list of family history and relatives.) Teacher asks pupils to give the names of people in a family. Words such as grandparents, parents (mother, father), siblings (brother, sister) and extended family members (e.g. aunt, uncle) should be listed on the board in family tree format. Flashcards are useful here.

Pupils then draw or receive a family tree to complete.

3. Title: Tree parts.

Level: Grade 4/5.

Materials: Flashcards of the different parts of a tree (bark, root, leaf, tree), picture of a tree, cards with extra activities.

Aims: -to teach the lexical items related to a tree (bark, roots, leaf, branch, twig, trunk, flower, blossom)

-to have the pupils use the lexical items in writing.

Description: Present the different lexical items orally. (Show picture or item and have pupils repeat after you). Point to the items and have pupils supply the correct name. (This can be done as a team game) Have pupils come to the blackboard and write the names of the items.

Have pupils copy the list into their portfolios and illustrate them. As an extra activity or for those who finish quickly have the pupils choose at least one of the ideas on the activity card. (Tree things to do)

Activity cards. Make copies of the following list of ideas and stick them on card. They can be laminated and reused from year to year.

Tree things to do:

1. Make up your own word search using the words we learnt today.
2. Make up a crossword puzzle using the words we learnt today.
3. In a paragraph describe a tree. Try and use the words we learnt today.
4. Write a poem about a tree.

4. Title: Quiz time.

Level: Grade 5/6.

Materials: A copy of the quiz questions.

Aims: -to practise writing complete sentences.

-to review knowledge related to the festival.

Description: Play Hangman with the name of the festival, elicit the name of the festival, or simply write the name on the blackboard.

Brainstorm for associations and vocabulary related to the festival.

Tell your pupils you are going to see how much they know and hand out the question sheet. You can have them work individually, in pairs or in groups. Tell them that they must write the answers in complete sentences. If you feel the students will have difficulty answering the questions you can provide them with the clue sheet below.

Go over the answers and have the pupils place their work in their

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portfolios. a vineyard / an olive branch / exactly one month / fifteen /

four / in Eden / in the sixteenth century in Safed / minor /plant trees and eat dried fruits / the 15th of Shvat /the almond tree / the JNF (Jewish National Fund) /the tree of knowledge and the tree of good and evil / Yom Kippur, because it is a fast day.

5. Activity: The New Year of Trees Quiz sheet.

How many questions can you get right? Write the answers in complete sentences.

1. When is the New Year of trees?

2. Where was the first garden planted on earth?
3. What is the first tree to flower around Tu BiSh'vat?

4. On which holiday do we NOT eat fruits from Israel?
5. How long is it from Tu BiSh'vat until Purim?

6. Which organization has been planting trees in Israel for over one hundred years?
7. What did Noah plant right after the flood?

8. What branch of a tree did the dove bring back after the flood?
9. What were the two "named" trees in the Garden of Eden?

10. What does the word "TU" in Tu BiSh'vat mean?
11. How many glasses of wine are drunk at the Tu BiSh'vat seder?

12. Is Tu BiSh'vat a minor or major holiday?

13. When and where did the Tu BiSh'vat seder originate (begin)?

14. What are two things we do on Tu BiSh'vat?

The New Year of Trees Quiz sheet. Answer sheet.

1. When is the New Year of trees?
It is in the month Shvat. / It is on the 15th of Shvat

2. Where was the first garden planted on earth? It was planted in Eden.

3. What is the first tree to flower around Tu BiSh'vat?
The first tree to flower is the almond tree.

4. On which holiday do we NOT eat fruits from Israel?
We do not eat fruits from Israel on Yom Kippur, because it is a fast day.

5. How long is it from Tu BiSh'vat until Purim?
It is exactly one month.

6. Which organization has been planting trees in Israel for over one hundred years? The JNF (Jewish National Fund) has been planting trees for over one hundred years.

7. What did Noah plant right after the flood?
He planted a vineyard.

8. What branch of a tree did the dove bring back after the flood?
The dove brought back an olive branch.

9. What were the two "named" trees in the Garden of Eden? They were the tree of knowledge and the tree of good and evil.

10. What does the word "TU" in Tu BiSh'vat mean?
The word means fifteen.

11. How many glasses of wine are drunk at the Tu BiSh'vat seder?
Four glasses are drunk.

12. Is Tu BiSh'vat a minor or major holiday?
It is a minor holiday.

13. When and where did the Tu BiSh'vat seder originate (begin)? It began in the sixteenth century in Safed.

14. What are two things we do on Tu BiSh'vat?
We plant trees and eat dried fruits.

KABBALISTIC SIGNIFICANCE OF THE SEVEN SPECIES:

The special significance of the seven species is accentuated by the great Kabbalist Rabbi Isaac Luria. Isaac (ben Solomon) Luria Ashkenazi (1534 – 1572) (Hebrew: יצחק בן יצחק שלמה לוריא אשכנזי Yitzhak Ben Sh'lomo Lurya Ashkenazi), commonly known as "The ARI" (meaning "The Lion"), "ARI-Hakadosh" [the holy ARI] or "ARIZaL" [the ARI, Zikhrone Livrakha]. He attributes the spiritual energies of each fruit to one of the seven lower

Wheat חֶטֶה

Wheat corresponds to *chesed* (kindness), the first of the seven lower sefirot. The characteristic of chesed is expansion, to reach out and extend oneself toward others. Wheat likewise reflects the nourishing food of kindness and to this day remains our main sustaining food staple. According to the renowned rabbi and physician Maimonides, wheat strengthens the body and increases mother's milk, the ultimate nourishment and expression of chesed.

Barley שְׂעֵרָה

Barley corresponds to *gevura* (restraint). Its characteristic is contraction, reduction, and setting boundaries. This is reflected by each barley seed being enclosed in a strong hull (boundary) which remains intact even during threshing. Due to its contracting quality, barley is highly effective in reducing liquid when added to soup. A recent study by the FDA evidenced that barley reduces cholesterol and risk of coronary disease.

Grapes גֵּפֶן

Grapes grow in beautiful clusters and correspond to *tiferet* (beauty). This trait is characterized by the balance between its different and sometimes contrary components. Since tiferet is the perfect balance between chesed and gevura, grapes include both nourishing and eliminating qualities.

Grape-seed oil nourishes the skin, while also containing a very high content of antioxidants that help in eliminating free radicals. Grapes possess a diuretic quality, yet they are very nutritive replete with vitamins A, B, and C, while also treating blood and energy deficiency.

Figs תְּאֵנָה

Figs correspond to *netzach* (endurance), which engenders longevity. The fig tree reflects everlasting fruitfulness as it has one of the longest periods of ripening, spanning more than three months. Malbim explains that we need to watch the fig tree very carefully by picking its figs daily, since they ripen one after the other; likewise we need to observe our teachers daily in order to glean the fruits of their wisdom. According to Maimonides, "Figs, grapes and almonds are always the best fruits whether fresh or dried." Maimonides also taught that figs alleviate constipation, which is one of the main

tenets of longevity and health. Figs may benefit the elderly by strengthening the blood and arousing vitality.

Pomegranates רמון

Pomegranate, a very beautiful and majestic fruit, even has a crown. It corresponds to *hod*, which means majesty and glory. Hod is also related to the Hebrew word *toda* which means thanks and recognition.

According to Rav Yitzchak Ginsburgh, hod corresponds to our immune system. A healthy immune system is able to recognize our friends from our foes, and pomegranates boost our immune system. Pomegranate seed oil causes cancer cells to self-destruct; the juice of the fruit is toxic to most breast cancer cells, yet has almost no effect on healthy cells. Pomegranate juice has also been proven to decrease heart disease by decreasing LDL ("bad cholesterol") and increased HDL ("good cholesterol").

Olives זית שמן

Olive oil corresponds to *yesod* (foundation). Olive oil is the foundation of most Mediterranean foods. Maimonides explains that olive oil cleanses the liver and loosens stools. Drinking a teaspoon of olive oil every morning before eating can help prevent stones in the urinary tract. Olive oil protects against heart disease by lowering blood pressure, and has strong anti-bacterial properties. It also contains several antioxidants to help fight cancer. Thus olive oil can truly be called the foundation (*yesod*) of life.

Dates תְּבֵנִים

Dates correspond to *malchut* (kingdom). Malchut is the channel that allows everything to manifest below. Therefore malchut is connected with the digestive system. The Talmud teaches that dates heal intestinal illnesses (Ketubot 10b).

The palm tree has no waste, its hearts are used for prayer (*lulav*), its fronds for shade, its fibers for ropes, its twigs for a sieve, and its beams for houses. Likewise the people of Israel have no waste: they each master their own particular part of Torah learning or perform mitzvot and charitable deeds (Genesis Rabbah, 41).

URL's for Tu BiSh'vat Seder Texts and Background to the Seder:

1. "Why do trees need a birthday?"
www.learn.jtsa.edu/topic/kids/together/tubishevat
2. "Tu B'Shvat: Trees, Shabbat, And Israel's Ecology," COEJL, Jonathan Wolf
<http://www.coejl.org/tubshvat/documents/treeshabbatisfrael.shtml>
3. "TU BISHVAT: A New Year for Trees"
http://www.myjewishlearning.com/holidays/Tu_Bishvat/TO_Tu_Practices/Seder.htm
4. "TuB'shvatSeder"
<http://www.shemayisrael.co.il/tubishvat/sequence.htm>
5. "Tu B'Shvat Seder" from WUJS
<http://www.wujs.org.il/activist/programmes/programmes/tubishvat/programTU seder.shtml>
6. "TuB'Shvat Seder," Yavneh Olami
<http://www.hagshama.org.il/en/resources/view.asp?id=209>
7. "Some Tu BiShevat customs" www.akhlah.com
8. "Tu BiSh'vat Seder"
<http://www.akhlah.com/holidays/tubshvat/seder/hagaddah.php>
9. "A Tu Bishvat Seder For Every Personality"
http://www.myjewishlearning.com/holidays/Jewish_Holidays/Tu_Bishvat/Practices/Modern_Seder/tu-bishvat-seder-personalities.shtml
10. "The Trees are Davening: A Tu B'Shevat Haggadah," by Anonymous- 9/8/2001
<http://www.shalomctr.org/node/378>
11. "Pri Etz Hadar, a Tu Bish'vat Seder (Sefer Hemdat Yamim, 1731)
<http://opensiddur.org/2010/11/pri-etz-hadar/>
12. "One-page flowchart Haggadah plus more links", Rabbi David Seidenberg
http://www.neohasid.org/resources/tu_bishvat/more_tu_bishvat/

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1. SUGGESTED EQUIPMENT AND LOGISTICS LIST:

Preferably a location sufficiently near a kitchen or sink if possible for washing out the blender jars between smoothies, or a dish tub on site.

an extension cord and/or junction box for multiple outlets for the blenders.

one or two 6' tables, covered for working with the cutting board and blenders

Several cutting boards - plastic or wood

several sharp paring knives

several chef's knives 8-10"

LOTS of napkins, disposable small drinking cups, small plates, spoons

Several large trash cans with liners, at least 2 to maintain cleanliness

Large kitchen sponges

Rolls of paper towels - it's messy

2. INGREDIENTS

A. SHOPPING LIST FOR FRUITS FOR Tree Bien Program

1. CITRUS FRUIT (1-2 of any of the following; variety is more important than quantity; (Note that the * denotes most desired to teach historical sequence.)

Australian round lime (Citrus australis)

Blood lime

Blood Orange*

Citron (Citrus medica)*

Clementine (Citrus reticulata var. clementine)*

Grapefruit (Citrus paradisi)* (white/pink)

Jaffa Orange*

Kabosu (Citrus Sphaerocarpa)

Kaffir lime (Citrus hystix)

Key Lime (Citrus aurantifolia)* (a carton or more)

Kumquat (Fortunella spp.)*

Lemon (Citrus limon)*

Limequat (lime x kumquat)

Mandarin (Citrus reticulata)*

Meyer lemon (Citrus x meyeri)*

Naartjie (Citrus reticulata, Citrus nobilis)

Navel Orange*

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Orange, of which there are sweet (Citrus sinensis) and sour (Citrus aurantium) species
Orangelo*

Oroblanco (Citrus paradisi x C. grandis) Rutaceae (Also called the sweetie)

Palestine sweet lime (Citrus x limettioides)

Persian lime, also known as tahiti lime.

Pomelo (also known as the shaddock) (Citrus maxima)*

Rangpur lime, a mandarin orange - lemon hybrid

Sour Orange (Citrus aurantium) also called bigarade, bitter orange, Seville orange*

Sweet Lemon (Citrus limetta)

Tangelo* (tangerine x pomelo)

Tangerine* (Citrus x tangerina)

Ugli fruit* (Citrus reticulata x Citrus paradisi)

Suggested additional supplements (ripe, please) to eat and also for smoothies:
ALMONDS, APPLES, APRICOTS, AVOCADOS, BANANAS, BLUEBERRIES and other berries, CHERIMOYA, DATES, FIG, GRAPES, OLIVES of various varieties, KIWI, PEARS, PECANS, PISTACHIOS, PINEAPPLE, PLUMS, POMEGRANATES, STRAWBERRIES, WALNUTS

2. ADDITIONAL INGREDIENTS FOR SMOOTHIES:

a. Procure sufficient quantities for at least 5 blender recipes of parve fruit smoothies (fruits, juice, ice, flavoring) NOTE: that we use banana and apples as "base fruits" for the smoothies in addition to apple juice or inexpensive drink mixes.

b. Liquids/Juices/SkimMilk - You will need sufficient to provide liquid base for blenders, e.g. apple juice, citrus juice drink, a gallon each should be sufficient

c. CAROB (Have sufficient for each participant to taste! Try health stores and fruit importers. Can be stored in dry, clean containers as dried fruit for years - can then be microwaved with water to refresh; seeds can be planted.)

d. Flavorings: Vanilla extract , bottle of honey, powdered sugar, small wheat germ

e. Non-fat Yoghurt - several pints

f. Ice Cubes in sufficient quantity for each smoothie load, probably one 25#

j. CRACKERS that emphasize whole wheat, seeded sesame, etc. and/or whole wheat pita or pita chips

k. Hummous as an example of common middle eastern ingredient

HISTORY OF THE ISRAELI ORANGE/CITRUS PRODUCT (still evolving)

The genus *Citrus* has been suggested to originate in Southeast Asia. Prior to human cultivation, it consisted of just a few species, namely: Key Lime, from India; (including Australian limes; Finger Lime; Australian Round Lime; Desert Lime); Pomelo (pummelo, shaddock), from the Malay Archipelago; Citron, from India; Mandarin Orange, from China; Trifoliolate Orange, from Korea and adjacent China; Kumquats, 4-5 species from East Asia ranging into Southeast Asia; Papedas, (including limau kadangsa, limau kedut kera from Thailand and Malaya; Indian Wild Orange, from the Indian subcontinent; "Khasi Papeda" from Assam, Meghalaya, Burma).

Orange—specifically, the sweet orange— (*Citrus Sinensis* (L.) is the *Citrus sinensis* Osbeck) and its fruit. It is the most commonly grown tree fruit in the world. The orange fruit is a hesperidium, a type of berry.

Citrus is a common term and genus (*Citrus*) of flowering plants in the rue family, Rutaceae. Citrus is believed to have originated in the part of Southeast Asia bordered by Northeastern India, Myanmar (Burma) and the Yunnan province of China. Oranges probably originated in Southeast Asia and were cultivated in China by 2500 BC. The fruit of *Citrus sinensis* is called sweet orange to distinguish it from *Citrus aurantium*, the bitter orange. The name is thought to derive ultimately from the Sanskrit for the orange tree, with its final form developing after passing through numerous intermediate languages.

The orange is a hybrid of ancient cultivated origin, possibly between (*Citrus maxima*) and (*Citrus reticulata*). From a taxonomic perspective, hybrid refers to offspring resulting from the interbreeding between two animals or plants of different taxa.

The pomelo (*Citrus maxima* or *Citrus grandis*) is a crisp fruit native to Southeast Asia. It is usually pale green to yellow when ripe, with sweet white (or, more rarely, pink or red) flesh and very thick albedo (rind pith). It is the largest citrus fruit, 15–25 centimetres (5.9–9.8 in) in diameter, and usually weighing 1–2 kilograms (2.2–4.4 lb). Other spellings for pomelo include pummelo, and pommelo, and other names include Chinese grapefruit, jabong, lusho fruit, pompelmous from Tamil *pampa lim?su*, *pompous lemon*] and shaddock.

The Mandarin orange, (*Citrus reticulata*) also known as the mandarin or mandarine (both lower-case), is a small citrus tree with fruit resembling other oranges. Mandarin oranges are usually eaten plain or in fruit salads. Specifically reddish-orange mandarin cultivars can be marketed as tangerines, but this is not a botanical classification. The tree is more drought-tolerant than the fruit. The mandarin is tender, and is damaged easily by cold. It can be grown in tropical and subtropical areas.

In a number of languages, it is known as a "Chinese apple", e.g., Dutch *sinaasappel* ("China's apple") or *appelsien*, or northern German *Apfelsine*. In English, however, "Chinese apple" generally refers to the pomegranate.

Orange trees are widely cultivated in tropical and subtropical climates for the delicious sweet fruit, which is peeled or cut (to avoid the bitter rind) and eaten whole, or

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processed to extract orange juice, and also for the fragrant peel. In 2008, 68.5 million tons of oranges were grown worldwide, primarily in Brazil and the US states California and Florida.

ORANGE

Kingdom: Plantae

(unranked): Angiosperms

(unranked): Eudicots

(unranked): Rosids

Order: Sapindales

Family: Rutaceae

Genus: Citrus

Species: *C. x sinensis*

Binomial name

Citrus x sinensis

(L.) Osbeck[1]

MANDARIN ORANGE

Genus: Citrus

Species: *C. reticulata*

Binomial name

Citrus reticulata

POMELO

Genus: Citrus

Species: *C. maxima*

Binomial name

Citrus maxima

Merr.

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[**NOTE: FRUITS BY GEOGRAPHIC ORIGINS** *These lists have been taken from Wikipedia and therefore are subject to serious research review on each entry. J*

FRUITS NATIVE TO AFRICA OR OF AFRICAN ORIGIN:

Amatungulu (*Carissa macrocarpa*)
Kiwano (*Cucumis metuliferus*)
Marula (*Sclerocarya birrea*)
Spiny Monkey-orange (*Strychnos spinosa*)
Tamarind (*Tamarindus indica*)
Miracle Fruit (*Synsepalum dulcificum*; Sapotaceae)
Imbe (*Garcinia livingstonei*)

FRUITS NATIVE TO ASIA OR OF ASIAN ORIGIN:

Arhat (*Siraitia grosvenorii*; Cucurbitaceae) Also called longevity fruit
Batuan (*Garcinia morella*)
Bignay
Bilimbi
Breadfruit (*Artocarpus altilis*; Moraceae)
Buddha's Hand (variety of citron/etrog)
Woodapple (*Aegle marmelos*) ,commonly known as bael, found in eastern India.
Mango (*Mangifera*) ,tropical fruit of south Asia.
Indian gooseberry (*Phyllanthus emblica*)
Charichuelo (*Garcinia intermedia*)
Calamondin ("*Citrofortunella Microcarpa*")
Button Mangosteen (*Garcinia prainiana*)
Chinese Quince (*Pseudocdonia sinensis*)
Coconut (*Cocos nucifera*; Arecaceae)
Che (*Cudrania tricuspidata*; Moraceae) Also called Cudrania, Chinese Mulberry, Cudrang,

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Mandarin Melon Berry, Silkworm Thorn, zhe

Durian (*Durio* spp; Malvaceae)

Gac

Gamboge (*Garcinia gummi-gutta*)

Goumi (*Elaeagnus multiflora ovata*; Elaeagnaceae family)

Jambul (*Syzygium cumini*; Myrtaceae)

Hardy Kiwi (*Actinidia arguta*; Actinidiaceae family)

Kiwifruit or Chinese gooseberry (*Actinidia* spp.; Actinidiaceae)

Mock Strawberry or Indian Strawberry (*Potentilla indica*; Rosaceae)

Garcinia dulcis (Mundu)

Lanzones (*Lansium domesticum*; Meliaceae family)

Lapsi (*Choerospondias axillaris* Roxb. Anacardiaceae)

Longan (*Dimocarpus longan*; Sapindaceae family)

Lychee (*Litchi chinensis*; Sapindaceae family)

Mangosteen (*Garcinia mangostana*; Clusiaceae)

Marang

Nungu (*Borassus flabellifer*; Arecaceae)

Peach

Persimmon (aka Sharon Fruit) (*Diospyros kaki*; Ebenaceae)

Pomelo

Rambutan (*Nephelium lappaceum*; Sapindaceae family)

Rhubarb (*Rheum rhaponticum*; Polygonaceae)

Sageretia (*Sageretia theezans*; Rhamnaceae) Also called Mock Buckthorn

Salak (*Salacca edulis*; Arecaceae), also called snakefruit or cobrafruit

Santol (fruit)

Carambola (aka Starfruit)

Wild Mangosteen (*Garcinia indica*)

FRUITS NATIVE TO LATIN AMERICA OR OF LATIN AMERICAN ORIGIN:

Açaí (*Euterpe*), a palm fruit native to the Amazon region.

Avocado (*Persea americana*; Lauraceae)

Boquila (*Boquila trifoliata* ; Lardizabalaceae)

Calafate Barberry (*Berberis*; Berberidaceae)
Breadnut (*Artocarpus camansi*; Moraceae)
Cainito (Star apple)
Feijoa (Pineapple Guava or Guavasteen)
Keule (*Gomortega keule*; Gomortegaceae)
Guarana (*Paullinia cupana*; Sapindaceae)
Guava ("*Psidium guajava*"; Myrtaceae)
Lardizabala (*Lardizabala biternata*; Lardizabalaceae)
Mamey ("*Pouteria sapota*"; Sapotaceae)
Maqui (*Aristotelia chilensis*; Elaeocarpaceae)
Naranjilla (*Solanum quitoense*; Solanaceae)
Papaya (*Carica papaya*; Caricaceae)
Peumo (*Cryptocarya alba*; Lauraceae)
Pineapple ("*Ananas comosus*"; Bromeliaceae)
Sapote ("*Casimiroa edulis*"; Sapotaceae)
Sea Grape (*Coccoloba uvifera*; Polygonaceae)
Soursop ("*Annona muricata*"; Annonaceae)
Sugar-apple
Ugniberry (*Ugni molinae*; Myrtaceae)

FRUITS OF NORTH AMERICAN ORIGIN

Canada and the United States are home to a surprising number of edible plants, especially berries; however, only three are commercially grown/known on a global scale (grapes, cranberries, and blueberries.) Many of the fruits

below are still eaten locally as they have been for centuries and others are generating renewed interest by eco-friendly gardeners (less need for bug control) and chefs of the region alike.

American Chestnut (*Castanea dentata*; Fagaceae)

American Black Elderberry (*Sambucus canadensis*; Adoxaceae)

American grape: North American species (e.g., *Vitis labrusca*; Vitaceae) and

American-European hybrids are grown where grape (*Vitis vinifera*) is not hardy and are used as rootstocks

American Hazelnut (*Corylus americana*; Betulaceae)

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- American Mayapple (*Podophyllum peltatum*; Berberidaceae)
- American persimmon (*Diospyros virginiana*; Ebenaceae): Traditional for desserts and as dried fruit.
- American plum (*Prunus americana*; Rosaceae)
- American Red Elderberry (*Sambucus pubens*; Adoxaceae)
- American Red Raspberry (*Rubus strigosus*; Rosaceae)
- Beach Plum (*Prunus maritima*; Rosaceae)
- Black cherry (*Prunus serotina*; Rosaceae very popular flavoring for pies, jams, and sweets.
- Black raspberry (*Rubus occidentalis* or *Rubus leucodermis*; Rosaceae)
- Black Walnut (*Juglans nigra*; Juglandaceae)
- Blueberry (*Vaccinium*, sect. *Cyanococcus*; Ericaceae)
- Buffaloberry (*Shepherdia argenta*; Elaeagnaceae), which grows wild in the prairies of Canada
- Chokecherry (*Prunus virginiana*; Rosaceae)
- Cocoplum (*Chrysobalanus icaco*; Chrysobalanaceae)
- Cranberry (*Vaccinium macrocarpon*; Ericaceae)
- Eastern May Hawthorn (*Crataegus aestivalis*; Rosaceae, better known as mayhaw.)
- False-mastic (*Sideroxylon foetidissimum*; Sapotaceae)
- Florida strangler fig (*Ficus aurea*; Moraceae)
- Ground Plum (*Astragalus crassicaulus*; Fabaceae), also called Ground-plum milk-vetch
- Huckleberry (*Gaylussacia*, *Vaccinium*; Ericaceae)
- Maypop (*Passiflora incarnata*; Passifloraceae, traditionally a summer treat.)
- Muscadine (*Vitis rotundifolia*; Vitaceae)
- Pawpaw (*Asimina triloba*; Annonaceae, not to be confused with Papaya (*Carica papaya*; Caricaceae), which is called pawpaw in some English dialects)
- Pecan (*Carya illinoensis* or *illinoensis*; Juglandaceae)
- Prickly pear (*Opuntia* spp.; Cactaceae) used as both a fruit and vegetable depending on part of plant.
- Pigeon plum (*Coccoloba diversifolia*; Polygonaceae)
- Red mulberry (*Morus rubra*; Moraceae)
- Salal berry (*Gaultheria shallon*; Ericaceae)
- Salmonberry (*Rubus spectabilis*; Rosaceae)

Saskatoonberry (*Amelanchier alnifolia*, Rosaceae)
Saw Palmetto (*Serenoa repens*; Arecaceae)
Southern Crabapple (*Malus angustifolia*; Rosaceae)
Texas Persimmon (*Diospyros texana*; Ebenaceae)
Thimbleberry (*Rubus parviflorus*; Rosaceae)
Toyon (*Heteromeles arbutifolia*; Rosaceae)

FRUITS NATIVE TO OCEANIA OR OF OCEANIAN ORIGIN:

I

Oceania is a region centered on the islands of the tropical Pacific Ocean. Conceptions of what constitutes Oceania range from the coral atolls and volcanic islands of the South Pacific (ethnologically divided into the subregions of Melanesia, Micronesia, and Polynesia) to the entire insular region between Asia and the Americas, including Australasia and the Malay Archipelago. The term is sometimes used more specifically to denote a continent comprising Australia and proximate islands, or biogeographically as a synonym for either the Australasian ecozone (Wallacea and Australasia) or the Pacific ecozone (Melanesia, Polynesia, and Micronesia apart either from New Zealand or from mainland New Guinea).]

Atherton Raspberry (*Rubus probus*; Rosaceae)
Black Apple (*Planchonella australis*; Sapotaceae)
Blue tongue (*Melastoma affine*; Melastomataceae)
Bolwarra (*Eupomatia laurina*; Eupomatiaceae)
Broad-leaf Bramble (*Rubus moluccanus*; Rosaceae)
Burdekin Plum (*Pleiogynium timorense*; Anacardiaceae)
Bush tomato (Certain *Solanum* species; Solanaceae)
Cedar Bay cherry (*Eugenia carissoides*; Myrtaceae)
Cherry ballart (*Exocarpus cupressiformis*; Santalaceae)
Cluster fig (*Ficus racemosa*; Moraceae)
Cocky apple (*Planchonia careya*)
Common apple-berry (*Billardiera scandens*; Pittosporaceae)
Conkerberry (*Carissa lanceolata*; Apocynaceae)
Davidson's plum (*Davidsonia* spp.; Cunoniaceae) *Davidsonia jerseyana* *Davidsonia johnsonii*
Davidsonia pruriens
Desert banana (*Marsdenia australis*)
Desert fig (*Ficus platypoda*; Moraceae)

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Desert lime (*Citrus glauca*; Rutaceae)
Dodder laurel (*Cassytha melantha*)
Doubah (*Marsdenia australis*; Apocynaceae)
Emu Apple (*Owenia acidula*; Meliaceae)
Emu berry (*Grewia retusifolia*)
Fibrous Satinash (*Syzygium fibrosum*; Myrtaceae)
Finger Lime (*Citrus australasica*; Rutaceae)
Illawarra Plum (*Podocarpus elatus*; Podocarpaceae)
Kakadu lime (*Citrus gracilis*; Rutaceae)
Kakadu plum (*Terminalia ferdinandiana*; Combretaceae)
Karkalla (*Carpobrotus rossii*; Aizoaceae)
Kutjera (*Solanum centrale*; Solanaceae)
Lady apple (*Syzygium suborbiculare*; Myrtaceae)
Lemon aspen (*Acronychia acidula*; Rutaceae)
Lillypilly (*Acmena* spp., *Syzygium* spp.) Used raw and in jam
Little gooseberry tree (*Buchanania arborescens*; Anacardiaceae)
Midyim (*Austromyrtus dulcis*; Myrtaceae)
Morinda citrifolia
Mountain pepper (*Tasmania* spp.; Winteraceae)
Muntries (*Kunzea pomifera*; Myrtaceae)
Native currant (*Acrotriche depressa*; Ericaceae)
Native gooseberry (*Physalis minima*; Solanaceae)
Native raspberry (*Rubus parviflorus*)
Nonda plum (*Parinari nonda*)
Pigface (*Carpobrotus glaucescens*; Aizoaceae)
Pink-flowered Native Raspberry (*Rubus parvifolius*; Rosaceae)
Purple apple-berry (*Billardiera longiflora*; Pittosporaceae)
Quandong (*Santalum acuminatum*; Santalaceae)
Queensland Ebony (*Diospyros humilis*)
Riberry (*Syzygium luehmannii*; Myrtaceae)
Rose-leaf Bramble (*Rubus rosifolius*; Rosaceae)
Rose myrtle (*Archirhodomyrtus beckleri*; Myrtaceae)

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- Sandpaper Fig (*Ficus coronata*; Moraceae)
- Small-leaf tamarind (*Diploglottis campbellii*; Sapindaceae)
- Snow berry (*Gaultheria hispida*; Ericaceae)
- Sweet apple-berry (*Billarderia cymosa*; Pittosporaceae)
- Tanjong (*Mimusops elengi*; Sapindaceae)
- White aspen (*Acronychia oblongifolia*; Rutaceae)
- Wild grape (*Ampelocissus acetosa*)
- Wild orange (*Capparis mitchellii*; Capparaceae)
- Wild peach (*Terminalia carpentariae*)
- Wild plum (munydjudj) (*Buchanania obovata*)
- Wild plum (*Santalum lanceolatum*)
- Wongi (*Manilkara kaukii*; Sapotaceae)
- Yellow plum (*Ximenia americana*; Olacaceae)
- Zig Zag Vine (*Melodurum leichhardtii*; Annonaceae)

History and Development of the Citrus Industry

HERBERT JOHN WEBBER

Revised by Walter Reuther and Harry W. Lawton

The various species of the genus *Citrus* are all believed to be native to the subtropical and tropical regions of Asia and the Malay Archipelago, and to have spread from there to other sections of the world. They have been cultivated from remote ages, and prototype forms of the most important species are not definitely known.

ORIGIN OF CITRUS

Comparatively little change has been required to develop our best present-day varieties from fruits of the most primitive types. It is true that the Washington navel and Valencia oranges are larger and superior in quality to most sweet orange seedlings, which doubtless represent a more primitive type. Nevertheless, in the absence of improved varieties, the fruits of these seedlings are quite acceptable. It is likely, therefore, that the citrus fruits which first attracted the attention of primitive peoples were already highly developed through the processes of natural evolution. They were thus chosen as fruits worthy of cultivation, and presumably the crude selection of the best individuals for propagation had been going on for many centuries before any type came to be cultivated in European countries.

The history of the spread of citrus reads like a romance. Even in very early times the beautiful appearance of both tree and fruit attracted the attention of travelers and received mention in their written narratives. The spread of the genus, however, from one part of the world to another was very slow.

Curiously, the first member of the group to become known to European civilization was the citron, mentioned about 310 B.C. by Theophrastus. For several hundred years this was the only citrus fruit known. Then came in order, but possibly centuries apart, the sour orange, the lemon, and the sweet orange. As far as preserved literature indicates, this last species was not known in Europe until approximately 1400 A.D., about seventeen centuries later than the citron. However, on the basis of careful examination of a Pompeian tile mosaic, Tolkowsky (1938) presented strong evidence that the orange tree—possibly of the sweet variety—was grown in Italy prior to the destruction of Pompeii in 79 A.D. He suggested that while the orange tree was cultivated at that period, it neither blossomed nor, consequently, bore fruit. A tile floor mosaic found in a Roman villa near Tusculum (modern Frascati) indicates that soon thereafter lemons and limes were also known in Italy. Eventually, Tolkowsky believes Italian gardeners succeeded in obtaining fruits from their citrus trees. From a vaulted ceiling mosaic in Rome, designed about 330 A.D. for Constantine the Great, Tolkowsky adduced "unassailable proof of the fact that in fourth century Italy oranges and lemons were actually grown."

It is now known that the sweet orange had been grown for many centuries in China and had apparently reached an advanced stage of cultivation before it became known to Europeans. Little information is available relative to the ancient Chinese literature, but there is indication that it may contain many references to sweet and mandarin oranges, and to various other citrus fruits. Han Yen-chih, in his *Chü lu*, written in 1178 A.D. and translated into English by Hagerty (*Monograph on the Oranges of Wên-chou, Chekiang*, 1923), named and described some

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twenty-seven varieties of sweet, sour, and mandarin oranges. He also described citrons, kumquats, and the trifoliate orange and discussed nursery methods, grove management, and diseases.

On the basis of statements in this work, the oldest existing book on the orange, it is safe to assume that oranges have been mentioned and discussed in Chinese literature since the time of Ch'u Yuan, who in his first poem, called "Li Sao" or "Falling into Trouble," mentioned many plants, trees, and fruits of that period (314 B.C.). This was approximately contemporaneous with the first mention of citrus fruits in European literature by Theophrastus (*ca.* 372-287 B.C.).

Doubtless many much older references to oranges may be found in ancient Chinese manuscripts and documents. The earliest reference to any citrus fruit to which attention has thus far been directed is contained in the book "Yu Kung" or "Tribute of Yu" (The Emperor Ta Yu, who reigned from 2205 to 2197 B.C.), where the statement was made, "The baskets were filled with woven ornamental silks. The bundle contained small oranges and pummeloes."

Purported evidence also has been found indicating that the citron was known in Egypt long before the references to it by Theophrastus, though it is not considered to be a native of that country. Sirag-el-Din stated (1931, p. 61):

This species has been known in Egypt since the time of the Pharoes, as a model in the Louvre Museum, which was taken from a Pharo-tomb of the twelfth century B.C. proves. There is also a previous proof to that in the form of a picture found in Karnak temple, which goes back to the fifteenth century B.C. It is thought that it was brought to Egypt by Tohotmas III during his wars with Asia. Another very important proof is the word *Gitri* in the Coptic language, which was taken from the hieroglyphic language and means sour fruit. [See also V. Loret, *La flore pharaonique* (Paris, 1887), p. 47.]

Tolkowsky (1938) finds such evidence of the antiquity of the citron in Egypt unconvincing and asserts that it relies on doubtful identifications. He notes that even the French archeologist Victor Loret was forced to admit that the wall-paintings at Karnak were not very clear. Andrews (1961) agrees that evidence for early establishment of the citron in Egypt is very weak.

Still more remote is the evidence cited by Killermann (1916) of the finding of seeds in the excavation of the Sumerian ruins of old Nippur in southern Babylonia which V. Frimmel was able to identify as citron seeds. As these ruins date back to about 4000 B.C., Killermann suggested that the citron was known and possibly used in Mesopotamia in that very ancient period.

However, Tolkowsky (1938) pointed out that the period to which these seeds belong cannot be precisely dated. Furthermore, he emphasized that their presence in Nippur does not necessarily indicate that the tree from which they came was cultivated in Babylonia at the time. If the citron tree had grown there on a limited scale in ancient times, Tolkowsky believed it would have been a common tree during Alexander the Great's conquest in the late fourth century B.C. Since Greek botanists accompanying Alexander reported the citron was grown only in Persia and Media, Tolkowsky disavows as inconclusive present evidence of the great antiquity of citrus fruits in Mesopotamia, Palestine, and Egypt, which is still further west.

Tolkowsky is of the opinion that the first attempts to grow the citron tree in Mesopotamia were the work of Alexander's botanical experts. The citron tree was then introduced throughout the Near East by Greek and later Jewish settlers, and was well acclimatized around the eastern Mediterranean by the beginning of the Christian era.

The early introduction of the citron into Mesopotamia and even possibly Palestine has been defended by Isaac (1959). He argues that Tolkowsky has misinterpreted Theophrastus, who wrote that the citron grew only in Media and Persia, and states that the Greeks actually

considered the Persian kingdom to embrace the entire Fertile Crescent. Isaac theorizes that the citron may have spread from southern Arabia and existed in the coastal plains of the Levant coast in the period of the early kings of Judah and Israel. If this was not the case, he suggests, then the Jews may have become acquainted with the citron during their exile in Mesopotamia in the sixth century B.C. On this point, however, he is forced to rely on the Nippur archaeological findings and other not totally proven evidence. Consequently, although Isaac's theories are sound they lean in the direction of his scholarly convictions. It should be noted that Andrews (1961) also believes citrus was in Mesopotamia at a very early date. A definitive proof of the cultivation of citron in Mesopotamia earlier than the time of Alexander's conquest must await the work of future archaeologists and scholars.

The earliest reference to citrus fruits in India appears in the *Vajasaneyi samhita*, a collection of devotional texts assigned to a period prior to 800 B.C., where the lemon and citron are given the name *jambila* (Tolkowsky, 1938, p. 23). Despite the extent of Sanskrit literature, there appears to be little mention of citrus fruits in India prior to the Christian era (Hayes, 1945). Names for oranges appear for the first time in the oldest existing Sanskrit medical work, the *Charaka-Samhita*, a treatise that has been dated about 100 A.D. This and other evidence led Tolkowsky to the view that the orange probably became established in southern Hindustan shortly before the Christian era.

CITRUS IN ANCIENT AND MEDIEVAL HISTORY

The Citron

First Citrus Fruit to Reach Europe.—The citron (*Citrus medica* L.) was the first citrus fruit to come to the notice of Europeans and was for many years the only one known. It first attracted attention in Media, where it was then supposed to be indigenous. Apparently it soon spread into Persia, where it came to the attention of the Hebrews and the Greeks. Although it is not now considered to be indigenous to Media, the steps by which it was first brought there from its native habitat in India or Indo-China are not known.

Establishment of the citron in Persia seems to have occurred not later than the first half of the first millenium [*sic*] B.C. When Alexander's army passed through the Greek settlements of Persia, his botanists found the citron or "Persian apple" extensively cultivated. In addition, the Greek settlers recalled that the citron tree had been commonly grown there in the time of Medes, who ruled Persia from the ninth to the middle of the sixth century B.C.

Possible Reference to Citrus Fruits in the Bible.—It would be reasonable to suppose that the Hebrews, who had easy intercourse with the Assyrians and the Persians, soon learned of this rare and beautiful plant and introduced it into Palestine. It is therefore astonishing that the Bible, in which figs, grapes, olives, and other important plants are frequently mentioned, contains no direct reference to any citrus fruit.

The suggestion has been made (Gallesio, 1811) that Moses referred to the citron with the word *hadar*, as used in the verse, "You shall take, on the first day, fruits of the tree *hadar*, of palm branches, boughs of the thickest trees, and willows that cross the length of rapid waters and rejoice before the Lord your God" (Lev. 23:40). As the Jews, at their annual Feast of Tabernacles, were, and are still, accustomed to present themselves in the synagogue carrying in their hands myrtle, willow, and palm boughs to which citrons (Persian apples) are attached (), it would seem logical to interpret *hadar* as citron.

This interpretation was thought by Gallesio to be further confirmed by the finding of Samaritan coins bearing on the one side the lulab of the Jews and on the reverse side a citron ().

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However, Tolkowsky (1938, p. 53) in connection with an illustration of one of these coins, stated: "The very earliest documentary evidence of the citron in Jewish sources is found in the representation of this fruit on coins struck by Simon the Maccabee in the fourth year of the 'Redemption of Zion', that is in 136 B.C."

Tolkowsky further pointed out that *hadar* literally means the fruit of the *dar* tree, that is, of the holy tree of India, the *Cedrus deodara*. He suggested that the fruit or cone of this tree was originally used in the Jewish ceremony, apparently adopted through Babylonian influence. Tolkowsky theorized the citron was substituted for the cedar cone in the Jewish ceremony by Simon the Maccabee, high priest and ruler, in 136 B.C., evidently because the cedar cone, through the influence of the Greeks, had become invested with bacchanalian significance. If one accepts Tolkowsky, it thus appears that no citrus fruit was even indirectly mentioned in the Bible.

Here again, however, Isaac (1959) challenges Tolkowsky and much more effectively. Isaac points out that internal evidence from the text of Leviticus argues against Tolkowsky's theory that the citron was a late substitute for the cedar cone in Jewish ritual, and asserts that nowhere else in the Old Testament, which abounds in botanical references, is the *dar* tree mentioned. Andrews (1961) also finds Tolkowsky's argument indefensible, since the Jews were ultraconservative in religious ritual. Andrews considers the idea of a shift from the cedar cone to the citron to be so radical that it cannot be supported without strong evidence.

Furthermore, Isaac notes that the first coins depicting the citron have been reassigned by more modern scholarship to the period of the Jewish First Revolt of 66-77 A.D. (See Goodenough, 1953, p. 276.) Since the coins are at least two hundred years later than Tolkowsky, Gallesio, and other scholars have previously assumed and were struck at a time when the citron is known to have been well established in Palestine, they obviously have nothing to do with celebrating a change in Jewish ritual.

Isaac finds Tolkowsky's view of an orderly sequence of plant distribution from Persia through Mesopotamia and finally to Palestine to be naive. Since cultivated plants such as the citron are "dependent upon human beings for their distribution," he suggests that the citron could well have bypassed Mesopotamia and reached Palestine at an early date. Andrews (1961), on the other hand, believes that the actual source of *hadar* is probably the Assyrian *adaru* (citron), attesting to direct borrowing from Mesopotamia.

Thus we are left with the creditable, carefully reasoned (but as yet unproven) positions of Isaac (1959) and Andrews (1961) that the *hadar* of the Bible was the citron and that it was known to the Jews far earlier than Tolkowsky postulates. Both scholars find no acceptable evidence that the Greeks played a role of any importance in the spread of the citron tree, and agree that the Jews were the transmitters of citron culture to their numerous colonies along the Mediterranean. By the second century A.D. the citron was widely cultivated around the eastern Mediterranean, since its price was comparable with that of the fig (Tolkowsky, 1938, p. 62).

References to Citron in Early European Literature.—The citron was known early to the Greeks and the Romans. Theophrastus, who wrote after the conquests of Alexander had greatly extended the knowledge of the Greeks concerning the region of Media and Persia, gave a very truthful and exact description of the citron:

Thus one sees in Media and Persia among many other productions the tree called *Persian* or *Median-apple*....Its fruit is not edible but it has an exquisite odor, as also have the leaves which are used as a protection from moths in clothing. A decoction of the pulp of this fruit is thought to be an antidote to poison, and will also sweeten the breath....The citron bears fruit continuously; while some fruit is falling with ripeness other

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fruit is but just starting....Fruit is given only by the flowers which have in the middle a sort of straight spindle; those which do not have this fall off, producing nothing (Gallesio, 1811, p. 199).

It will be noticed that the last statement in this quotation foreshadows the recognition of sex in plants, but it was nearly two thousand years later before Camerarius, in 1691, published the first experimental proof of the function of pollen and its necessity in seed formation.

Vergil (70-19 B.C.) was the first of the Latin writers to describe the citron; like Theophrastus he called it the Median apple and described uses similar to those given by the earlier author.

Dioscorides, a native of Cilicia who wrote a treatise on *Materia Medica* between 60 and 79 A.D., spoke of the citron as if it had become well established in the district where he lived. He referred to it as the Median and Persian apple or *Cedromela*, and said that the Latins named it *Citria* (Gunther, 1959).

Pliny, in his *Natural History*, published about 77 A.D., gave several names to the citron (*malus medica*, *malus assyria*, and *citrus*) and described its use as a medicine, poison, antidote, perfume, and protection from moths. He spoke of it as the only plant boasted of in Media and told of the vain attempts to transport it thence to Italy. However, it has been suggested that the citron tree was grown for ornamental purposes in Italy at the time of Pliny, although such trees may have produced fruit only occasionally (Tolkowsky, 1938). When Pliny wrote, therefore, it would seem that the citron was known to the Romans primarily as a foreign production. All writers of this period spoke of it as an exotic fruit, and the available evidence indicates that not until much later did it successfully mature in Italy. Gallesio (1811, p. 207) quoted evidence which indicates that its failure in Greece, Italy, and France in this early period was due to the extremely cold winters. The climate of the Mediterranean region, he believed, had become milder a century or two later, when the successful culture of the citron was finally established. Florentinus, a Greek writer of the third century, spoke of the citron as a tree cultivated not only in warm districts but also in colder sections, where it was covered on the approach of winter (Gallesio, 1811, p. 219).

Citron Introduced into Italy.—Many early writers, including Clausius, Bauhinus, and Ferrari, attributed the naturalization of the citron in Italy to Palladius, who described the cultivation of citron in his Sardinian and Neapolitan possessions. According to Gallesio (1811, p. 218), however, Palladius (*De re rustica* iv. 273) wrote in such a manner as to indicate that the citron was already being grown not only in Sardinia and Naples but also in the north of Italy, where it could not live without artificial shelter. Historians are not agreed on the time in which Palladius wrote, but the evidence indicates some period in the fourth century, and, as he spoke of the citron as well known, it must have been introduced considerably before his time. Gallesio concluded (1811, p. 220):

We must think it probable, then, that this plant, already in Asia Minor and Palestine at the time of Dioscorides and Josephus, passed into Italy about the third century and that in the time of Palladius it was grown not only in parts of Italy where the climate would allow it to grow in the open air, but also in districts less warm, where the luxury and magnificence of Roman grandees built country houses, embellished by art at great expense.

Tolkowsky (1938, p. 90) gave evidence clearly indicating a much earlier introduction of the citron into Italy. He stated: "The sculptural panel from the tomb of the Haterii near Rome as well as the wall paintings of Pompeii confirm the statements of Pliny and Petronius to the effect that by the middle of the first century A.D. the citron tree was already naturalized in certain parts of Italy, and that it was no longer only just vegetating there as in the time of Augustus, but was producing flowers and fruits."

Andrews (1961) is in agreement that archaeological and literary evidence support the net impression that the citron was introduced in Italy about the time of Augustus and by the middle of the first century A.D. was producing fruits in some of the warmer parts of Italy.

Influence of the Barbaric Invasions.—The barbaric invasions at the close of the fourth century interrupted citron culture in districts where artificial protection was required for its maintenance, for the invaders effaced all traces of luxury by destroying the magnificent homes of the rich Romans. However, in Sicily, Sardinia, and a large part of the Kingdom of Naples, where the climate was sufficiently mild to permit its growth as a naturalized plant, the citron survived the invasion.

It was from these countries that the Ligurians took the citron, when in the ninth and tenth centuries they began to contend with the Venetians for the commerce of the East. By 1003 the citron was much cultivated at Salerno, and in that year a prince of the country sent fruits (*poma cedrina*) as a gift to some Norman lords who had delivered him from the Saracens. Galesio (1811, p. 222) asserted that "it is well known that Liguria has for many centuries provided the Jews of Italy, France, and Germany with citrons."

The culture of the citron was not extended into the nearby sections of Mentone and Hyères in France until several centuries later, and not until the fifteenth century was the citron grown in orangeries in the colder parts of Europe.

The Sour Orange and the Lemon

Roman Acquaintance with the Sour Orange and Lemon.—Galesio and other modern scholars have concluded that the sour orange (*Citrus aurantium* L.) and the lemon (*C. limon* [L.] Burm. f.) were unknown to the Romans. This prevalent theory was vigorously rebuffed by Tolkowsky, who asserts that the Romans were familiar with both the lemon and orange, although his evidence appears somewhat weak when he seeks to establish that they were also acquainted with the sweet orange.

From the middle of the first century A.D. to the middle of the second, Roman trade was most active. Gourmets in Rome paid fantastic sums for exotic delicacies, and it seems probable that oranges and lemons in the freshest state possible occasionally arrived in shipments to Rome. A mosaic tile floor found in a Roman villa at Carthage, probably of the second century A.D., shows recognizable branches of citron and fruit-bearing lemon trees. (See Tolkowsky, 1938, p. 100.)

Evidence that the orange tree was known in Italy before Pompeii was destroyed (about 70 A.D.) is found in a remarkably faithful representation of an orange in a Pompeian mosaic, according to Tolkowsky. The Roman artist tried to depict the orange as if it had just broken off the tree together with the stem to which leaves and a flower bud are still attached. The unnatural position of the stem in relation to the fruit indicated to Tolkowsky that the artist was unfamiliar with fruit-bearing trees. Since the leaf-stalk in the picture was not winged, Tolkowsky theorized that the orange trees grown in Roman gardens were of the sweet variety, and probably not as yet fruit-bearing.

By the fourth century A.D., Tolkowsky is convinced Italian gardeners had overcome the difficulties of obtaining oranges from trees grown in that country. That both oranges and lemons were actually grown and bore fruit appears indicated by one of the earliest Christian mosaics, a vaulted ceiling in the mausoleum built by the emperor Constantine the Great (274-337 A.D.) to accommodate the remains of his favorite child, Lady Constantia, who died about 330 A.D. Citrons, lemons, and oranges are conspicuously depicted in the mosaic, all of them attached to freshly cut branches, covered with green leaves.

TREE BIEN - TU BISHEVAT PROGRAMMING

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The Lombard invasion of 568 A.D. wrested most of Italy from the Byzantine empire. The luxurious gardens of the rich were destroyed and with them presumably the delicate citrons, lemon, and orange trees. Tolkowsky believes that not only the citron but some orange trees as well continued to exist in Sicily, Sardinia, and the region of Naples, which remained in Byzantine possession and where because of a more favorable climate the trees had become naturalized.

Some students of citrus history still feel Tolkowsky's case for the early introduction of the orange into Europe remains tenuous, since mosaics and paintings could have been made by artists who had seen the orange in travels abroad. However, it is interesting that Isaac (1959), an ardent critic of some of Tolkowsky's views, credits him with providing sufficient evidence for us to "conclude that the orange and lemon were known in the early Christian centuries." And certainly it is logical that native tropical plants such as the orange and lemon, which require careful cultivation, might be introduced many times at various periods of history to subtropical regions only to disappear as a result of destructive freezes, disease, and even political upheaval.

Rise of Mohammedanism Influenced Citrus.—The barbaric invasions (350-400 A.D.) brought to an end the expansion of the Roman Empire, and there was no further extension of Roman commerce. The next advance in the diffusion of *Citrus* species came through the rise of Mohammedanism and the expansion of the Arab Empire (570-900 A.D.). The Roman Empire gradually disintegrated, and the advancing Arab Empire spread through northern Africa and into Spain, entirely surrounding the Mediterranean Sea except for parts of the French and Italian coasts. Placed in a country strategically situated between the three great divisions of the Eastern Hemisphere, the Arabs also extended their conquests into Asia and Africa far beyond the territory influenced by the Roman Empire.

With wealth and power at their command, they made great advances in art, science, and agriculture. They discovered the process of distillation, introduced into Europe the cotton plant and the sugar cane, and gave us our first knowledge of many medicinal plants, perfumes, and aromatics such as musk, nutmegs, mace, and cloves.

Sour Orange Spread by the Arabs.—That the Arabs were acquainted with the sour orange is shown by the words of one of their writers, Massoudi. He was quoted by Galesio (1811, p. 249) as stating that this fruit was brought from India after the year 300 of the Hegira (922 A.D.), was first sown in Oman (part of Arabia), and was carried thence to Iraq (part of old Persia), Syria, Palestine, and Egypt.

Galesio and others have relied on this statement as evidence that the Arabs brought the first orange trees from India to western Asia, northern Africa, and southern Europe. Yet Tolkowsky (1938, p. 124) pointed out that Galesio used an erroneous translation of Massoudi. Tolkowsky states: "What Mas'ûdi really wrote is...that Qâher had planted his garden 'with orange trees brought from Basrah and Oman, of such kinds as have (or had) been imported from the lands of India.'" Apparently the high value attached by the Caliph Qâhar to these trees rested on the fact that they were new varieties, not previously known in Iraq. Tolkowsky cites other Arab writers in support of his view that the *naranj* (sour orange) was already well established in Iraq by the time of Massoudi.

While the earlier theories that orange and lemon trees were introduced by the Arabs from India appear to be erroneous, this in no way detracts from the enormous contribution made by the Moslems in expanding citriculture throughout the countries under their sway.

Numerous references are found in Arabic literature to citrus fruits and their uses. The Damascene (Abd-ulfeda) in his *Antidotary* had a recipe for making oil from oranges and their

seeds (*oleum de citrangula et oleum citrangulorum seminibus*), and Avicenna, a famous Arab herbalist who died in 1037 A.D. gave a recipe of his own invention for making "syrup of *alkadere* in which he put juice of the *bigarade*" (sour orange) (Gallesio, 1811, p. 247).

Thus it is certain that the sour orange was known to the Arabs and they were instrumental in expanding its culture some time during the tenth century A.D. into Persia, Iraq, Syria, Palestine, and Egypt, and apparently later into northern Africa, Sicily, Sardinia, and Spain.

At the time of the discovery of the route around the Cape of Good Hope to India (1498), the Portuguese found many citrons and sour oranges on the east coast of Africa, but they found these trees only in cultivated gardens. It seems certain, therefore, that the Arabs, who had penetrated Egypt, Syria, and Barbary in the first years of their conquests, had taken the citron and the sour orange with them.

Apparently the first description of the sour orange was that given by Albertus Magnus (1193-1280) under the name *Arangus*. He stated that the fruit is short and round, the tree larger and more cold resistant than the citron, the leaves appearing to be divided into two, the largest leaf toward the end standing above the smaller one. According to Killermann (1916, p. 205), this appears to be not only the first description of the sour orange (*Citrus aurantium*) but also the first use of the term *Arangus* (orange), a name which later came to be applied most commonly to the sweet orange.

Arabs Extended Lemon Culture.—Although much is known with reference to the spread of the lemon into various parts of the world, the exact place and the mode of its origin are still in doubt. That it must have originated somewhere in the countries of southeastern Asia seems certain. Laufer (1934, p. 145) pointed out that "the earliest references to the lemon in Chinese records is made by Fan Ch'eng-ta...in his *Kwei hai yü heng chi*...(preface dated A.D. 1175)," who described the *li-mung* fruit as being "the size of a large plum; again, it resembles a small orange, and is exceedingly sour to the taste." Laufer also informed us that "the earliest important description of the lemon [in Chinese] is contained in the *Ling wai tai ta*...written by Chou K'ü-fei...in A.D. 1178." This Chinese author described the fruit *li-mung* as given above and indicated how it was used by the people of Canton. It was also stated that "some people say that it has come to us from the southern barbarians." In view of the doubt that still exists concerning the native origin of the lemon, this tradition that it had been received from the "southern barbarians," coupled with the name *li-mung*, which Laufer stated is foreign to the Chinese language, is important evidence indicating that it was an introduced fruit not native in China. Laufer concluded that the lemon was introduced into what is now Kwangtung Province in China probably in the early part of the twelfth century.

Laufer also stated (1934, p. 158): "It is said that the so-called Nabatean Agriculture, written in A.D. 903 by Ibn Wahshiyah...contains an allusion to the lemon...If this be true, it would be the earliest reference to the fruit in the literatures of the world." He directed attention, however, to a probable error in the translation, which Seidel regarded justly as a transcription of the language of Khasia, a district of India famous for citrus cultivation, so that it is not certain that the lemon is intended.

The authenticity of Ibn Wahshiyah's reference to the lemon was accepted by Tolkowsky. He pointed out that the Arab agronomist called the lemon *hasiâ* and added that *limûn* was the Persian name of the fruit. Since *limûn* is also the term generally applied by the Arabs, and since there is no trace of the word *hasiâ* in their writings, Tolkowsky believed the latter name to be of purely Nabataean origin, thereby pointing to an old established culture of the lemon in Iraq.

That the lemon was grown in Egypt before 900 A.D., Tolkowsky considered evident from

the contents of certain so-called *Scalae*—glossaries of Coptic, Greek, and Arabic synonyms—found in Egypt and dating back to the seventh, eighth, and ninth centuries A.D. These glossaries contain the equation: *kortimos=el-limûn*.

Tanaka (1929, pp. 342-43) said of the lemon: "The writer's critical study clearly shows its early introduction into China during the *Sung* dynasty (960-1279)." He also noted the first reference to the invention of lemonade by Mongolians as early as 1299.

The most enlightening paper on the nativity of the lemon is that of Shiu Iu-nin (1933), who, although not making positive claims, advanced strong evidence indicating that the lemon is native in southeastern China and was well known and cultivated before the *Sung* dynasty. He stated: "But in the Lingnan section...of (43) these words are found: 'In the fourth year of K'ai Pao...two bottles of lemon juice were allowed to be presented to the Emperor.' The fourth year of K'ai Pao is 971 A.D., which is only eleven years after Emperor *Sung T'ai-chu*...ascended the throne" (Shiu, p. 281). Shiu pointed out that the conditions of such an offering to the emperor indicate clearly that the fruit must have been well known and widely grown and used long before that time and thus certainly before the *Sung* dynasty.

Shiu (p. 284) also mentioned the statement quoted above from Laufer of the tradition that the lemon had been received from the "southern barbarians," taken from *Chou K'ü-fei* (1174-1178 A.D.). Shiu, however, explained that what was known as the "barbarous south" in that period was southern China, as the culture was then mainly developed in central and northern China. He mentioned other fruits typical of *Kwangtung*, such as the *Lychee* and *Lungan*, which were also then spoken of as fruits of the "barbarous south."

Glidden (1937), in an exhaustive study of the evidence based on the derivation of native names used in the different countries and the historic evidence available, concluded: "From all the available evidence the lemon seems to be a native of the eastern Himalaya region, as both the geographical distribution and the various names of the fruit testify." Thus it may be stated that the weight of evidence now available favors southern China and probably Upper Burma as the native home of the lemon.

The lemon came to attention in Europe a little later than the sour orange, but apparently followed the same general route on its journey there. *Ibn-al-Awâm* (1864) in his treatise on agriculture, written in Spain some time in the latter half of the twelfth century, described rather fully the methods of citrus propagation and culture and referred to the citron, the orange (sour), the lemon, and the pummelo or shaddock as if they were well-known fruits. All of these fruits, furthermore, were discussed in statements that he quoted from *Abu'l Khayr*, who wrote some time in the first half of the twelfth century. Thus we may conclude with reasonable certainty that by about 1150 A.D. the citron, the sour orange, the lemon, and the shaddock had been introduced by the Arabs into Spain and the countries of northern Africa.

The lemon was not mentioned by the Damascene or by *Avicenna*, but was described in all the works of Arabian writers of the twelfth century, especially by *Ibn al-Baitar* (1197-1248 A.D.) (*Gallesio*, 1811, p. 250; *Laufer*, 1934, p. 158), who had an article on it in his dictionary of simple remedies. It is certain that the culture of the lemon, as well as the sour orange, was furthered by the Arabs in Persia and Palestine, and, by the beginning of the twelfth century, the lemon was being commonly grown in those countries. Evidently it was also taken to the countries of northern Africa and into Spain, as was the sour orange.

It may also be assumed that the *Mazoe* lemon, found in recent years by English settlers apparently growing wild along streams in Southern Rhodesia, was introduced by the Arabs. *Vasco da Gama* (1898) arrived at Mombasa on April 7, 1498, and in the account of his voyage

described the place as "a city of great trade with many ships. The King sent to the explorers a large boat laden with fowls, sheep, sugar canes, citrons, lemons, and large sweet oranges, the best that had ever been seen." Thus it would appear that the lemon had been introduced into this section by the Arabs, and probably also the Mazoe type, which later became feral. The Mazoe lemon is identical with the Florida rough lemon, which was introduced into Florida by the Spanish voyagers slightly later, and there also became feral. It is likewise identical with the *jamberi* lemon of India.

Influence of Crusades in Extending Citrus Culture.—Following the activity of the Arabs in spreading citrus culture, the next great advance in extending these fruits into Europe came through the Crusades, the great religious movement which began at the close of the eleventh century. The Crusades opened to the peoples of Europe the entrance to Syria and Palestine, which had been closed by the expansion of the Arab Empire, and reawakened among them the spirit of commerce and a taste for arts and luxury. The Crusaders were not common soldiers but were men of the highest class and rank who joined the movement in a spirit of religious fervor to win the universe for Christianity. They entered Asia Minor as conquerors and thence spread as traders into all parts of Asia. Naturally they were attracted by the desirable products of art and agriculture in the new lands and coveted them for their homes, to which they expected to return. It is not surprising, therefore, to find that in this period Europe was enriched with many valuable products, among them the apricot, the sour orange, and the lemon.

Sour Orange, Lemon, and Lime Introduced by Crusaders.—The lemon, the lime, and the sour orange were mentioned by European historians only after the period of the Crusades. Hence, it seems certain that these fruits must have been brought to Liguria and to other parts of Italy and France by the Crusaders. In his *History of Jerusalem*, Jacques de Vitry, a bishop and historian of the thirteenth century who had been in Palestine with the Crusaders, described the interesting citrus fruits found there (Gallesio, 1811, p. 256). The Adam's Apple (shaddock), the lemon, the citron, and the sour orange are among the trees which he mentioned and regarded as foreign to Europe.

Sylvaticus of Mantua (Italy), who wrote about the middle of the thirteenth century (Gallesio, 1811, p. 266), described the citron, the sour orange, the lemon, and a fruit commonly called *lima* (probably what we now know as the lime). At this time the culture of these four fruits in Liguria had evidently made considerable progress, for he stated that they were very well known.

It is true that the citron, the orange, and the lemon had already been grown in many parts of Italy, but it is likely that the contraction of the area over which they had been grown, caused by the barbaric invasions of several centuries before, had left citrus culture limited to the warm islands of the Mediterranean, and to Sicily and Sardinia. If this was the situation, then, owing to the difficulty of communication and the general illiteracy of the age, it is not surprising that citrus may have been forgotten by the peoples of southern Europe.

The Sweet Orange

First European Reference to Sweet Orange.—Although Tolkowsky theorized that the sweet orange (*Citrus sinensis* [L.] Osbeck) grew in Italy during the early Christian era, traces of its culture vanishing during the barbaric invasions, there is no written evidence of the actual culture of sweet oranges in southern Europe until the fifteenth century.

Some historians of citriculture have maintained that no sweet oranges were grown in Europe until the Portuguese brought the first trees from India or the Far East after they discovered the direct sea-route around the Cape of Good Hope. Tolkowsky, however, has asserted that the

sweet orange tree must have already been established in the Mediterranean regions of Europe prior to Vasco da Gama's voyage of discovery of 1497 A.D. He cites as one direct documentary proof a letter written on June 29, 1483 by the king of France, Louis XI, to Francois de Genas, governor of the province of Languedoc (Tolkowsky, p. 238). Louis XI requests that the governor send him "citrons and sweet oranges, muscatel pears and parsnips, and it is for the holy man who eats neither meat nor fish and you will be doing me a very great pleasure." Since the holy man referred to is Saint Francis of Paula, who had just arrived at the court of Louis XI, Tolkowsky considered it probable that the pious monk had already become accustomed to eating sweet oranges in his native country of Calabria.

By the beginning of the sixteenth century, there was abundant evidence showing that the sweet orange had become well established and had assumed commercial importance in southern Europe. It does not seem to have been widely cultivated until toward the middle of the fifteenth century.

Portugal Orange Not the First Importation.—The path by which the sweet orange first reached Europe is difficult to trace. Many early writers believed that voyagers brought it to Portugal shortly after Vasco de Gama rounded Cape Horn and reached India in 1498. Valmont be Bomare (1764), for example, stated in his *Dictionary of Natural History* that the first imported tree, from which came all the sweet orange trees of Europe, was at that time still growing at Lisbon in the garden of the Count St. Laurent (Gallesio, 1811, p. 297). Apparently the general application of the name Portugal orange to the sweet orange came from the belief in its origin from this tree. Gallesio (1811, p. 298), however, pointed out that this name was not known in Europe until about the middle of the seventeenth century and that previous to that time the fruit had been known under the simple name of *orange douce* (sweet orange). He also pointed out that the Portuguese did not reach China until 1518 and that João de Castro, who is credited with having brought the tree to Portugal, was born in 1500 and could not have returned from his first voyage until about 1520.

Vasco da Gama, in relating the story of his voyage (1498), as written by a Florentine who was on his vessel, said that in India there were many orange trees, but all with sweet fruit. If the sweet orange were at that time unknown to da Gama, it would seem astonishing that he failed to describe it as different from the known sorts.

None of the travelers of this epoch showed surprise at sight of this fruit, as they did on seeing many others, from which it may be deduced that they were already familiar with the sweet orange and that it was no longer a novelty.

Sweet Orange Widely Grown in Early Sixteenth Century.—Many writers at the beginning of the sixteenth century mentioned the sweet orange, and all of them spoke of it as an old tree of unknown origin.

Matioli, famous for his work in botany, in his translation of Dioscorides printed in 1540, regarded the sweet orange as an ancient tree. Augustino Gallo, in his work on agriculture published in 1569, spoke of the sweet orange as a plant whose cultivation dated from time immemorial and told of an old cultivator at Salo, ninety years of age, who could not remember the planting of the trees existing in his time.

Navagero, in his *Spanish Voyage*, published in 1525, described the prodigious trees in the kitchen garden of the King at Sevilla, all of which were sweet oranges. Possibly most important of all, as proving the wide distribution of this species at the beginning of the sixteenth century, is the statement of the learned monk, Leandro Alberti, who traveled in Italy in 1523. He stated that he saw immense plantations of orange, lemon, and citron trees in Sicily, Calabria, upon the

borders of the river Salo in Liguria, and in many other places. He expressly stated that a great number of varieties were cultivated and that most of them had sweet fruit. (See Gallesio, 1811, pp. 302-03.)

Gallesio (1811, p. 322) also described two documents, found in the archives of the city of Savona, which he considered important evidence as showing the presence of the sweet orange in Europe at the end of the fifteenth century. One, under date of May 27, 1471, is an account of an expedition to deliver a gift of fruits from the city of Savona to an ambassador at Milan. From the wording it would appear that the fruits must have been sweet oranges, though they were designated merely as *citruli*. The second document, dated February 12, 1472, is a bill of sale of 15,000 *citranguli*, received by the notary Pierre Corsaro. Gallesio concluded from the conditions and wording of this bill that the *citranguli* were undoubtedly sweet oranges.

It is clearly impossible that this extensive culture of the sweet orange in Liguria at the beginning of the sixteenth century could have come from the Portuguese importation, since that did not take place earlier than the beginning of that century (perhaps about 1520).

In explaining why there are few references to sweet oranges in European literature prior to 1500 A.D., Tolkowsky noted that most oranges—sweet or sour—were used as condiments for fish and meat and rarely eaten as fresh fruit. The sweet oranges cultivated in Europe prior to the Portuguese importation were probably of inferior fragrance and taste. Once the Portuguese began importing new varieties from Asia, however, the demand for sweet oranges quickly exceeded that for sour fruit. Culture of the new type of sweet oranges soon became an important factor in the economic life of Portugal and rapidly spread into other Mediterranean countries.

Sweet Orange Arrived over Genoese Trade Route.—Gallesio concluded from his study of historic evidence that the sweet orange probably reached Europe first through the commercial trade route established and maintained by the Genoese. The Crusaders had stimulated in Europe a desire for the luxuries of the East. The religious movement, long continued, led to the revival of trade and finally to the establishment of two great trade routes, one from Genoa and the other from Venice, which were operated on an extensive scale and under great difficulty through several centuries. Hosts of highly intelligent men seeking honor and wealth joined the traders and, disguised as Arabs or by other means, penetrated Arabia, Palestine, and India.

The maintenance of these trade routes stimulated the Arabians and those having connection with India and the East to search for and procure the novel articles of commerce sought by the European traders.

It can scarcely be doubted, therefore, that the sweet orange which is mentioned in literature of the fifteenth century reached Europe sometime in the early part of that century, probably over the Genoese trade route.

Portuguese Made Important Introduction.—Although the sweet orange had been introduced into Europe at least a century before the Portuguese reached China, it seems certain that the Portuguese contributed much to the spread and popularization of orange growing by introducing a superior variety. This new variety, which later came to be known as the Portugal orange, evidently stimulated the industry much as the introduction of the Washington navel stimulated orange culture in California. The mother tree of the variety was evidently the imported tree from China described by Valmont de Bomare (1764) as "still growing in the Garden of the Count St. Laurent" at Lisbon.

This also was evidently the variety (*Aurantium olysiponense*) referred to by Ferrari (1646, p. 425) in the statement: "Just recently there has been sent to Rome to the garden of Pios and

Barberinos from Lisbon a beautiful tree with golden fruit. Some say the tree has come originally from China, hence, it is sometimes called Chinese or Sinensian tree." Ferrari's illustration of the fruit of this tree indicated a fairly good, smooth, thin-skinned, spherical type (). It was further stated:

The shape of its leaves and flowers is the same as other citrus trees. It surpasses others only in this, that a crushed leaf smells more alluring. The fruit is decidedly round in shape with a skin, if you look at it carefully, that is granular and most glowingly and delightfully yellow. The pulp extends to the very outer rind, and has a sweet and most pleasingly spicy taste. The pulp and juice are so golden in color one would think gold had been melted away into its juice. This fruit although it has a very slight acidity is a sweet and fragrant morsel for anyone's palate. (Hawkinson, 1936).

Ferrari described other sweet oranges but singled out this Portugal orange as something new and good. This was in 1646, about a century after its importation into Portugal, indicating how slowly such valuable plants were disseminated.

These statements of Ferrari, together with our knowledge of the wide diffusion of the Portugal orange under that name, indicate clearly that the Portuguese did introduce a sweet orange that had a profound influence on the industry.

The Lime

Apparently the first mention of the lime in literature was made by Abd-Allatif in the thirteenth century. Gallesio (1811, p. 33) stated that his "balm lemon of smooth skin the size of a pigeon's egg" was apparently identical with the species of lime of Naples. Evidently, therefore, the lime also was known to the Arabs, who probably played a major role in spreading its culture through India to Persia, Palestine, Egypt, and Europe. The first mention of the lime, under that name, according to T. W. Brown (1924, p. 74), was apparently by Sir Thomas Herbert (*Travels*, 1677), who spoke of finding "oranges, lemons, and limes" on the island Mohelia (Mohéli of the Comoro group, off Mozambique) during a voyage begun in 1626. However, as has been stated previously, Sylvaticus in the middle of the thirteenth century spoke of a fruit vulgarly called *lima* which apparently was what we now know as the lime (Gallesio, 1811, p. 268). Sir George Watt (1889-1893) stated that the Arabic word *limoon* through the Persian is the Hindi word *lime* or *limbu*, probably adopted by the Sanskrit people for this fruit and used with little change in most languages.

According to T. W. Brown (1924), the first reference to the lime in Egypt was that made by Thevenot, who in his description of the Mataria garden in 1657 "alludes to '*des petits limons*' and these could hardly have been anything else but limes." However, Tolkowsky has noted a reference in one of the stories of the *Arabian Nights* to "Egyptian limes and Sultania oranges and citrons." These ancient tales were collected in their present form about 1450 A.D.

The Mandarin Orange

The mandarin orange (*Citrus reticulata* Blanco), which is a native of China and south-eastern Asia, was not taken to Europe during ancient and medieval times but was known and extensively planted in China and Japan at a very early date. As has already been stated, several clearly distinct varieties were described in 1178 A.D. in the *Chü lu* (Han Yen-chih, 1923). The variety Chen kan or Ju kan (Milk orange of Wên-chou) described by Han, according to the studies of Tanaka (1932, p. 7)

became famous in Japan, not only from the excellence of the original text, but from the admiration of Li Shih-Chen, the author of the *Pen ts'ao kang mu*, or *Standard Chinese herbal*. There is, however, a diversity of opinions about the identity of the Ju kan with the orange grown in Japan. The author of *Wakan Sansai Dzue* (A.D. 1713) identifies

it as the Japanese Kunembo (true *Citrus nobilis* Lour. [now *C. reticulata* Blanco]), while the authors of *Zôtei Nankai Hôfu* (1867) and *Yamato Honzo* (A.D. 1761) make it identical with the Kishu Mikan or the Kinokuni (*C. kinokuni* Hort.).

According to Tanaka, the first reference to the orange of Wên-chou in Japanese literature "is perhaps a citation in *Isei Teikin Orai*, one of the oldest books of family letter writing, composed by Kokwan (1278-1346 A.D.)." It is thus evident that varieties of the mandarin orange reached Japan about the time that the orange and the lemon reached Europe. They were not introduced into Europe and America until modern times. The first mandarin tree was brought to England from China in 1805, and the mandarin spread from England first to Malta, and then to Sicily and continental Italy (Tolkowsky, 1938, p. 216).

The Pummelo and the Grapefruit

The pummelo or shaddock (*Citrus grandis* [L.] Osbeck) in its journey to Europe apparently followed about the same path as the sweet and sour oranges. The intermediate steps in its passage, however, are less perfectly known, perhaps because no particular use was made of its fruits. The Adam's Apple, a form of the shaddock, was mentioned by an anonymous pilgrim as growing in Palestine in the year 1187 (Tolkowsky, 1938, p. 139); Jacques de Vitry, about the middle of the thirteenth century, also mentioned it among the fruits of Palestine. Ibn-al-Awâm (1864), writing in Spain in the latter half of the twelfth century, described what is interpreted as being the Adam's Apple under the names *zamboa* and *bustanbûn*, quoting from Abu'l Khayr (first half of the twelfth century). From the statements of Abu'l Khayr and al-Awâm it would seem that the Adam's Apple and perhaps other forms of the pummelo or shaddock had already arrived in Spain by the middle of the twelfth century, having been brought there by the Arabs. Since Ferrari (1646) described and illustrated several varieties of the pummelo, it must have reached Europe fairly early.

Alphonse de Candolle (1886, p. 177) stated:

The number of varieties in the Malay Archipelago indicates an ancient cultivation. Its original country is not yet known because the trees which appear indigenous may be the result of naturalization following frequent cultivation. Roxburgh (1832, vol. 3, p. 393) says that the species was brought to Calcutta from Java.

In the Friendly Islands and the Fijis, the very widespread existence of the pummelo or shaddock in the wild indicates that it may be indigenous there. A consideration of the evidence available seems to indicate that it may safely be considered as indigenous in the Malayan and Indian archipelagos and to have spread from there to China and India, and thence to Persia, Palestine and Europe.

Plukenet (1696, p. 239), in his *Almagestum botanicum*, mentioned the shaddock, which indicates that it had been introduced into the West Indies prior to that time. It was also described in the same year by Sloane (1696) as occurring in Jamaica. Later Sloane (1707, vol. 1, p. 41) stated: "The Seed of this [the shaddock] was first brought to Barbados by one Captain Shaddock, Commander of an East India ship, who touch'd at that Island in His passage to England, and left its Seed here." The date of the importation was not given, but as the shaddock was recorded as being cultivated in both Barbados and Jamaica in 1696 the importation probably occurred some decades prior to that date.

The grapefruit, which probably originated as a mutation or sport from the shaddock, was first described under the name "forbidden fruit" by Griffith Hughes in 1750 from Barbados.

Establishment of Orangeries.—In the early growing of oranges and other citrus fruits, which were highly prized, frost injury caused much difficulty. Then came the first efforts of

civilized man to grow tender, exotic plants under special shelters, a development that finally led to the establishment of hothouse or greenhouse culture. Early accounts contain many references to different methods of protection which were used to preserve citrons and oranges from cold injury.

As early as the latter half of the first century B.C., Seneca wrote in his ninetieth epistle that panes of mica had come into use—not only for windows, but as a means of protecting the more delicate plants grown in Roman gardens against the cold (Tolkowsky, 1938, p. 91). The poet Martial (about 81-96 A.D.) taunts a friend in an epigram for being kinder to his flowers and young trees than to the writer, since he keeps the former under mica to protect them from the wind and cold air and yet permit the warm rays of the sun to reach them. It is doubtful whether the desire to protect tender citrus trees was the stimulating influence in the first use of greenhouses, but such structures later became commonly known as "orangeries."

Apparently by the fourteenth century, fanciers were using specially heated buildings to provide an artificial climate. These special houses, known by ancient writers as *stanzone per i cidri* (see) were erected primarily for the culture of citrons and oranges. They came to be used in all parts of Europe, and, although used for many exotic plants, were designated "orangeries." Thus originated greenhouses and greenhouse culture.

INTRODUCTION OF CITRUS INTO OTHER COUNTRIES

The Americas

Closing of Trade Routes by the Turks and Discoveries in Navigation Extended Citrus to America.—It remains to inquire how citrus fruits reached the Western Hemisphere, where natural wild groves of sour and sweet oranges, lemons, and limes were found in the various sections when they finally came to be settled, and yet where no *Citrus* species is supposed to be indigenous.

Here again an upheaval of human relations that interrupted existing conditions led to the further advance of the *Citrus* tribe. In 1453, Constantinople fell before the Turks, and throughout the next century Turkish pressure upon Europe was continuous and severe. The great trade routes to India from Venice and Genoa were almost completely closed. All over Europe, traders were speculating on new routes to India and the East.

Sailing ships had been much improved and the science of navigation had been much extended and perfected. It was at this time that Columbus conceived the great idea of reaching India by sailing westward. As we know, he did not reach India, but on an October day in 1492 he landed on the shores of the New World.

Six years later Vasco da Gama, a Portuguese navigator, rounded the southernmost point of Africa and finally reached India. There followed a period of extraordinary activity in the discovery and exploitation of the world's natural resources. Products of the Old World were taken to America and those of America brought back to enrich Europe. The Spanish and Portuguese were leaders in these explorations and were the first to establish colonies in America. Trade relations with America were considered so important in Spain that a powerful governing board for American trade, the Casa de Contratación, was organized in 1505. For many years it directed activities in outfitting expeditions and provided for the exchange of valuable seeds and plants (Puente y Olea, 1900).

No Citrus Species Native in America.—That citrus fruits were not known in America at the time of the discovery is clearly indicated by the fact that the accounts and narratives of the early explorers contain no reference to these valuable plants, although they do describe many new

fruits and plants, and the beautiful gardens of Montezuma. That no *Citrus* species is indigenous to America is a fact now recognized by authorities. By the middle of the sixteenth century, however, numerous statements in the literature of the period make mention of the presence of several species in widely different localities.

Columbus Introduced Citrus into America, November 22, 1493.—It probably cannot be assumed that Columbus on his first expedition took citrus seeds to America, there to be planted or scattered, as his first voyage was primarily one of discovery, and inasmuch as both the fort and the settlement that he established at La Navidad were destroyed after he left. On his second voyage, however, he went prepared to establish settlements, taking the seeds, plants, and domestic animals that were considered necessary and important. It was this voyage (1493) that resulted in the first permanent settlement in the New World, that on the island of Haiti.

At this period, citrus fruits, particularly the sweet orange, were greatly prized throughout the Mediterranean countries, and, as we have seen, efforts were being made to extend their culture by the use of orangeries (greenhouses). It is scarcely conceivable that an expedition at this time would set out from Spain to a subtropical country with colonization in view without taking a stock of seeds or plants of a fruit as much prized as the orange.

Puente y Olea (1900, p. 375) wrote:

The first plants from the Old World were planted on the island of Hispaniola [Haiti] immediately after its discovery and it is known that Christopher Columbus on his second voyage, for which he had been provided with supplies of every sort and which he made in the company of 17 vessels and about 2,000 men, brought with him seeds of various kinds, and also useful animals for propagation on this island. It is likewise known that by order of Queen Isabella a certain number of farmers embarked in his ships and according to Angleria (Peter Martyr) artisans of many kinds, who shall build there a city.

Columbus on this expedition did establish a settlement at Isabella in Haiti and the colonists developed successful gardens, as is shown by later testimony. It can scarcely be doubted that, among their other cultivations, trees of the sweet orange, the sour orange, the lemon, the citron, and probably the lime, the types with which the Spanish and Portuguese were at that time familiar, were included.

Bartolomé de Las Casas in his *Historia de las Indias*, the manuscript of which was written in the period between 1520 and 1559 (Las Casas, 1875-1876), gave a definite account of the taking of citrus seeds to America by Columbus on his second expedition, which sailed from the Bay of Cadiz, Spain, on September 25, 1493.

According to the statement of Las Casas (vol. 1, chap. 83, p. 3), Columbus, with his fleet of seventeen vessels, proceeded southwest to the Grand Canary Island and thence on October 5, 1493, to the island of Gomera, also one of the Canary group, where a stop was made. Las Casas stated that "during this time, with great haste he [Columbus] provided himself with some cattle, which he and those who came there with him bought.... They bought hens and also grains, and seeds of *oranges*, *lemons*, and *citrons*, melons, and all kinds of vegetables; and this was the origin of everything that is there (that is in Hispaniola) today of the things of Castile." According to this account of Las Casas, Columbus at Gomera awaited favorable winds and finally set sail on October 13, arriving at Hispaniola (Haiti) on November 22, 1493. Then followed the establishment of the new colony of Isabella, where orchards and gardens were subsequently planted.

The statements of Las Casas provide positive evidence that orange, lemon, and citron seeds were taken to America from the island of Gomera. It seems peculiar that, in outfitting the expedition, supplies of this sort were not procured in Spain, where, as previously described, all

these fruits were then cultivated and highly prized. It is probable, however, that the season's citrus crop in Spain was not sufficiently matured to be used for seed when Columbus left on September 25, and that he definitely planned to secure stocks of such seeds in the Canary Islands, where the season of ripening is earlier.

That oranges were grown in the Canary Islands at that time (1493) is indicated in Louis de Cadamosto's account of his voyage to Guinea, written in 1463, in which he spoke of oranges as being well known in the Canaries (Gallesio, 1811, p. 227).

Orange Reached Continental America, July 12, 1518.—Perhaps the first mention of citrus in continental America (*tierra firme*) is in an old manuscript, written in 1568 by Bernal Díaz del Castillo, which is to be found in the official archives of Guatemala. In Maudslay's English translation of the work, entitled *The True History of the Conquest of New Spain* (1908, vol. 1, p. 62), the statement is made that in the original manuscript the following passage had been blotted out:

I sowed the seeds of some oranges near to another Idol house, and it happened thus:—There were so many mosquitoes near the river that ten of us soldiers went up to sleep in a lofty Idol house, and close by that house I sowed the seeds which I had brought from Cuba, for there was a rumor that we were coming back to settle. They came up very well, for it seems that the papas (priests) when they saw that they were plants differing from those they knew, protected them and watered them and kept them free from weeds and all the oranges in that province are the descendents of these plants. I know well that these old tales have nothing to do with any history, so I must leave off telling them.

Maudslay also stated that the Alonzo Remon edition added to this passage the following:

And I have called this to mind because these were the first oranges planted in New Spain. After the fall of Mexico, when the towns subject to Coatzacoalcos had been pacified, this was looked upon as the best province, being the best suited in all New Spain, both on account of the mines it possessed as well as for its good harbour, for it was a land both rich in gold and in pasture for cattle. For this reason it was settled by the principal conquistadores of Mexico, of whom I was one. So I went back to look for my orange trees and transplanted them, and they turned out very well.

This statement, translated from the original manuscript, where it was blotted out as data "irrelevant to history," is of great interest to the citrus industry. Certainly Díaz would not have thought of making such a statement had there not been some foundation for it in fact. At the end of the paragraph he stated that it had "nothing to do with any history," and this is clearly the reason it was blotted out. Maudslay, the translator, pointed out the frequent statements in the manuscript which indicate the author's indecision concerning what should be considered important historic data and his timidity concerning his own ability to write history.

In Díaz' manuscript, this quotation is near the end of Book II, which deals with his early voyages to Central America and Mexico in connection with the expedition of Juan de Grijalva. According to the notes of the translator (Maudslay), Grijalva's expedition left Cuba on April 8, 1518, and returned to Cuba on November 15, 1518. It reached the town of Tonalá by the Río de Tonalá (San Antón) in Vera Cruz on July 12, 1518, and remained there from July 12 to July 20. We thus have definite evidence that orange seeds were planted in continental America between July 12 and July 20, 1518.

Since we know that the orange must have appeared in continental America at about this time, we are probably justified in accepting Díaz' statement as being fairly definite evidence of its first introduction into the country.

It should be remembered, however, that the coast of Darien (Panama) was reconnoitered by Rodrigo de Bastidas as early as 1501, and that permanent settlements were made in 1509 by the

Spaniards at Antigua, Nombre de Dios, and Uraba under the rival leaderships of Alonso de Ojeda and Diego de Nicuesa. The Casa de Contratación, organized in Spain in 1505 to promote the exchange of products and supplies between the Old World and the New World, was already in operation at the time of the 1509 voyages of Ojeda and Nicuesa, and it is probable that citrus seeds and possibly plants were taken by these expeditions and planted where settlements were made. It is not improbable, therefore, that earlier references to citrus plantings in continental America than those now known may ultimately be found.

The Spread of Citrus in the Americas.—The naturalist Oviedo y Valdéz (1547, libro viii, cap. 1), who was in Santo Domingo, Haiti, from 1514 to 1525, wrote as follows:

Orange trees from Castile were brought to this island of Hispaniola [Haiti], and they have multiplied so abundantly that now they are past counting; the fruit is very good, both the sweet and the sour. They grow in this city of Santo Domingo and all over the islands wherever Christians have their estates and gardens. And what is true here is equally true in the other islands, and also on the main land wherever there are settlements of Spaniards.... There are many lemon trees and limes, and many citrons, and as I have already said great quantities of each; and the quality is uniformly good—Andalusia itself has no superior (1851-1855 ed.).

Slightly later, Gómara (1554, p. 457) also referred to oranges as having become abundant in Central America. He wrote: "Fruits of acid and juice such as oranges and sugar cane have multiplied abundantly."

In the first century after the discovery (about 1550), Acosta (1590, libro iv, cap. 31) also found citrus trees growing in abundance in the West Indies. In the quaint words of the Grimston translation of *Historia natural y moral de las Indias* made in 1604 he stated:

As for those trees that have most abundantly fructified, be orange trees, limons, citrons, and others of that sort. In some parts there are at this day, as it were, whole woods and forests of orange trees; and which seeming strange unto me, I asked who had planted the fields with so many orange trees? they made mee answer, that it did come by chaunce, for that oranges being fallen to the ground, and rotten, their seeds did spring, and of those which the water had carried away into diverse partes, these woods grew so thicke, which seemed to me a very good reason. I have saide that this fruite hath generally increased most at the Indies, for that I have not beene in any place but I finde orange trees, for that all their sayle [soil] is hote and moist, which this tree most desires. There growes not any uppon the Sierra or mountains, but they carry them from the vallies or sea coast. The conserve of oranges which they do make at the Ilands is the best I have seene anie where.

It is also interesting to note from this statement that a conserve, probably similar to marmalade, was in use at this early date.

It was at about the same period that the principal citrus fruits were introduced into Brazil by the Portuguese. Navarro de Andrade (1933) quoted the following statement from the notes of Rudolpho Garcia on page 117 of the *Historia gerai do Brazil*, which was taken from a document of 1540: "On the island of Cananea and on the mainland (*tierra firme*) there have been propagated and grown many oranges, lemons and citrons and many other trees."

Fra Camillo Torrend, S.J., of the Colegio Antonio Vieira, Bahia, Brazil, stated that the Jesuits arrived in Bahia in 1549, the first place in which they established themselves. The grounds surrounding their residences were soon transformed into beautiful orchards, which included many citrus trees. In a letter dated 1583, Fernão Cardim wrote: "The orchard of the college is planted with many spine trees (*arvores de espinho*), i.e. oranges, lemons, etc."

Similar statements with reference to the early dissemination of citrus in America, according to Gallesio (1811, p. 347), were made by Pisonis concerning Brazil and by Garcilaso de la Vega concerning Peru. Garcilaso (1609) was quoted as stating: "Before the Spanish conquered Peru it is certain one saw there neither...oranges, citrons, sour or sweet,...which grow in Spain. But

one can say in truth that all these fruits and many others grow there today in abundance."

In the first half of the seventeenth century, the accounts of the Spanish and Portuguese voyagers contained many references to the spread of citrus in the New World. Quotations from some of these were given by Puente y Olea (1900) in his description of the work of the Casa de Contratación. One of the most important references given is a quotation with reference to Peru from Bernabé Cobo, author of *Historia del nuevo mundo*, who wrote in 1653. Cobo stated:

There are in this country all the varieties of oranges which there are in Spain; some with a thin skin, others called *cageles*, with a thick; some sweet, others sour; but all in brief large and heavy and filled with juice....Sweet and sour limes and lemons of exceptional fragrance grow to good size and are also very juicy. The large lemons, called the Royal are not so abundant as the small. The first oranges in this city of Lima were planted by one of its first inhabitants, a man named Baltasar Gago, in his own garden a half league from the city, and there the first orange trees are still to be seen alive. When I first came to Lima there were no sweet lemons either in the city or elsewhere in the realm; but now in this district we have had them for twenty years; both the large lemons called the Royal and the smaller lemons with a heavy fragrance (*Ceuties*) and every day they are becoming more abundant.

From the statements cited above—and many other similar statements could be given—it is clear that oranges, lemons, limes, and citrons had been distributed widely in the Americas by the middle of the sixteenth century and had become very abundant and even feral in some places.

Africa

Orange, Lemon, and Pummelo Reached Southern Africa, June 11, 1654.—The paths traveled by the various species of *Citrus* in their early march toward commercialization have been indicated in preceding sections. By the close of the fifteenth century the different species had reached almost all the tropical and subtropical sections of the Eastern Hemisphere except southern Africa. Here exact evidence of the date of their introduction and first fruiting was given in the daily journal of events kept by Van Riebeeck, the first governor of the Dutch colony at Capetown (see Leibbrandt, 1897; and Webber, 1925, p. 10). The first sweet orange trees were brought from the island of St. Helena by the ship "Tulp," which arrived at Capetown on June 11, 1654, and were planted in the governor's private garden. On July 25, 1661, the first fruits produced by the trees from St. Helena ripened and were plucked and tested by the governor and found "to be good." Meanwhile other trees had been received from India, and at this time (July, 1661) it was stated that there were 1,162 young orange, lemon, and pummelo (shaddock) trees growing in the governor's garden. (See also Webber, 1943.)

The island of St. Helena was commonly used by the early voyagers to India as a stopping place for supplies and water, and evidently the orange, and perhaps other citrus trees, had been taken there from India and planted, as an intermediate point in their transfer to Europe.

Australia

Orange Introduced into Australia in 1788.—Citrus was first planted in New South Wales by the colonists of the First Fleet under Captain Arthur Phillip, who sailed for Australia in 1787 with instructions to introduce plants and seeds at his discretion (Bowman, 1955). At Rio de Janeiro, Brazil, where the expedition stopped for one month, the colonists purchased orange, lime, and lemon trees. On arrival at Port Jackson on January 26, 1788, the first work performed was the planting of the seeds and plants obtained in the voyage from England. According to Bowman (1955), oranges, limes and lemons were flourishing at the end of the first year of settlement.

Shortly after 1800, an orangery was begun at Seven Hills, which was to become the most famous grove of its day. By 1828, exports of oranges and lemons were being made from New

South Wales to Van Diemen's Land (Bowman, 1955). An 1828 catalogue of the Botanic Gardens at Sydney lists twenty-one varieties of oranges and mandarins as being grown, the mandarins indicating that trade had been established with China at an early date. The most interesting item on this list, however, is the Washington navel or Bahia orange, which had such a profound effect in stimulating the development of the citrus industry in California, first fruiting in that state in 1878. Coit (1915, p. 14) reports that this Brazilian variety "was grown commercially and was marketed under the name of Bahia, or Navel orange, as early as 1860."

INTRODUCTION OF CITRUS INTO THE UNITED STATES

The Spread of Citrus into Florida and South Carolina

Introduced into Florida About 1565.—The exact date of the introduction of citrus fruits into Florida is unknown. It is certain, however, that they were brought in by the early Spanish explorers and colonists some time between 1513, when Ponce de León first landed in Florida, and 1565, when St. Augustine, the first colony in Florida, was established.

The first reference to the occurrence of oranges in Florida appears in a statement by Pedro Menéndez to the Audiencia of Santo Domingo, dated at St. Augustine, April 2, 1579. He stated: "There are beginning to be many of the fruits of Spain, such as figs, pomegranates, oranges, grapes in great quantity; there are many mulberries from the mulberry trees produced in this same soil, etc."

From Menéndez' comments, it would seem that oranges were being produced in abundance in St. Augustine in 1579, thirteen years after the arrival of the first settlers there. We are justified, therefore, in assuming that sour oranges, sweet oranges, and probably lemons, limes, and citrons were introduced in 1565, when the settlement was first established at St. Augustine.

First Plantings in South Carolina Made Before 1577.—It is well known that oranges in small quantities have been grown for many years in South Carolina and Georgia, particularly on certain islands adjacent to the coast. It is therefore interesting to know that Bartolomé Martínez in a letter to the King dated at Havana, February 17, 1577, stated: "And what may be truthfully told to your Majesty is that in Santa Elena [Parris Island, South Carolina] I planted with my own hands grape vines, pomegranate trees, *orange* and fig trees; wheat, barley, onions, and garlic." Martínez had lived in Santa Elena until 1576. His garden therefore was planted before 1577, the date of his statement.

It is clear from this evidence that citrus fruits were introduced into several sections of the southeastern United States in the latter part of the sixteenth century.

Wild Orange Groves Developed in Florida.—The early settlers in Florida some two centuries later found wild citrus groves in various parts of the state, some of them many acres in extent, which are supposed to have developed from seeds dropped by the Indians, to whom fruits had been given. They were usually found on hammock lands near lakes or rivers where conditions were particularly favorable for their growth and in places where the Indians commonly maintained villages. According to Harris (1875):

The most extensive groves are on Orange Lake, in the northern part of Marion County....There are several hundred acres of the finest wild orange grove around this lake that can be found anywhere....The next largest groves are on Lakes Griffin and Harris in Sumpter County. There are also fine wild groves on Lakes Weir, Bryant, Panasoffkee, Jessup, George, and Apopka, and on the Ocklawaha, Withlacoochee, St. Johns, Indian, and Halifax Rivers, and also in many other parts...there are wild orange trees in groves of from a few trees to several acres.

Adams (1875) stated: "The natural trees grow from 12 to 15 feet in height—not very large, interspersed with oak, hickory, bay, et cetera."

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These wild groves were mainly of the sour and the bittersweet orange, but some of them along the Indian River were of sweet orange, and in places in the southern part of the state the Rough lemon and the lime were also found growing wild.

The English Governor Grant in a proclamation dated at St. Augustine, October 7, 1763, stated: "Oranges, lemons, limes and other fruits grow spontaneously over the country" (Fowler, 1875). Evidently, therefore, wild groves or wild trees were well known at that time.

Bartram (1791) in his travels in Florida, during 1774, saw and described numerous wild orange groves. In traveling down the St. Johns River in a small boat alone he sought high lands every night on which to camp and almost invariably found these locations to be wild orange groves interspersed with magnolia, oak, hickory, and bay trees. These locations also frequently gave indications, by the presence of shell mounds, roadways, or otherwise, that they had been used as Indian campgrounds. It would seem certain from such evidence that the Indians had recognized the value of oranges and in all likelihood had purposely scattered around their villages the seeds of fruits obtained from the white settlements.

Bartram also mentioned the thriving town of New Smyrna "established by Mr. Turnbull on the Mosquito river" near the coast. He wrote:

I was there about ten years ago [this would thus be about 1764] when the surveyor ran the lines or precincts of the colony, where there was neither habitation nor cleared field. It was then a famous orange grove, the upper or south promontory of a ridge, nearly half a mile wide, and stretching north about forty miles...All this ridge was then one entire orange grove, with live oaks, magnolias, palms, red bays and others.

This grove was largely cleared by Turnbull and the land planted with indigo.

When the senior author first visited New Smyrna in 1893, nothing remained of the early settlement but historic ruins. Following the failure of Turnbull's enterprise, the entire site grew up to great live oaks, magnolias, and palmettos, which in 1893 presented the appearance of a primeval forest. Here and there in the forest, however, one could trace the old drainage ditches, and find remains of the indigo vats constructed by Turnbull, mute evidence to his early enterprise. By 1893, a railway had been built through the forest, the modern village of New Smyrna had developed, and here and there the second forest had been cleared and fine orange groves established. Even as late as 1960, a few wild orange trees remained in the undeveloped sections of land cleared a second time. Bartram (1791) expresses regret that several of the fine wild orange groves on the St. Johns River were being cleared to establish indigo plantations.

Spread of Cultivation in Florida.—About 1809, a Spanish nobleman, Don Phillippe [*sic*], migrated to Florida and settled near what is now Safety Harbor in Pinellas County. He is said to have brought seed of grapefruit and other plants and to have set out a small grove of grapefruit trees, which is supposed to have been the first planted in the state (Hume, 1926, p. 95). Whence his seed of the grapefruit came, or the exact date of the planting, cannot now be determined. It does not seem that the seed could have come from Spain or Europe, for the grapefruit was not known there until much later. A citrus fruit grown in Jamaica in 1814 was known as the grapefruit, and perhaps Don Phillippe obtained his seed from that source.

A. L. Duncan (1892), a pioneer grower of the same county, who named and introduced the Duncan grapefruit and no doubt carefully considered its origin, in 1892 stated that "Phillippe fifty years ago planted seed [of grapefruit] which came from Cuba." As the Duncan grapefruit was a seedling from one of Phillippe's trees, it is probable that this statement about the origin of the seed and the date of planting of the Phillippe trees is approximately correct.

Don Phillippe gave seed to his neighbors freely, and many of the old seedling grapefruit trees in Florida are supposed to have come from this source. One of the grapefruit trees planted by

him was still living in 1925, according to Hume (1926), and in January, 1932, the senior author examined a very old grapefruit tree on the original Phillippe place which, so far as he could learn, was one of the original trees planted.

Two grapefruit trees in a neighbor's grove which were seedlings from the Phillippe trees became famous, one for its great size and the other as being the original seedling of the Duncan variety ().

Measured by the senior author and Dr. H. S. Fawcett in 1932, the trunk of the former tree one foot above the ground had a circumference of 95 inches and three feet above the ground a circumference of 66.5 inches. The height and spread of the top were approximately 45 feet and 40 feet respectively. In its full vigor the top doubtless much exceeded these measurements. Hume (1926) stated that this tree had a branch spread of over 60 feet.

Cession of Florida to the United States in 1821 Stimulated Industry.— The development of the commercial citrus industry in Florida may be said to have started with Spain's cession of the territory to the United States in 1821. Preceding this time, although trees had been grown by the Spanish settlers at St. Augustine, Picolata, and elsewhere, and although many wild groves had developed, there had been no commercial industry. Considerable progress, however, had been made by 1835, when a severe freeze greatly interrupted the development. According to D. J. Browne (1857, p. 63):

The number of trees owned by different individuals prior to 1835 varied from ten to fifteen hundred. Perhaps no person in Florida had more than the latter number in full bearing condition at the time of the great frost, which occurred on the 9th of February, of that year. There were many trees then to be found in St. Augustine which exceeded forty feet in height, with trunks from twenty to twenty-seven inches in diameter [63 to 85 inches in circumference], and which probably were more than a century old....Previous to 1835 St. Augustine produced annually from two million to two million five hundred thousand oranges which were equal in bulk to about fifteen thousand barrels. They were shipped to Charleston, Baltimore, New York, Boston, etc., and usually brought from one dollar to three dollars per hundred.

Colonel F. L. Dancy (1875), a well-known pioneer orange grower, who was in Florida at the time of the great freeze of 1835, stated: "Trees a hundred years old were killed to the ground....In the spring, however, the trees grew up from the roots, and in two years bore fruit once more."

Famous Early Orange Groves.—After the cession of Florida to the United States, Zephaniah Kingsley, sugar planter, slaver, author, patriot, and alleged pirate, occupied Fort George Island at the mouth of the St. Johns River and in 1824 planted a three- or four-acre orange grove, which later became known as the Mays grove at Orange Mills. At about the same time he also planted the Rembert grove on Drayton Island. The trees were all sweet orange seedlings. D. J. Browne (1857, p. 63) stated: "The late Mr. Kingsley left upwards of six thousand bearing trees in 1843, all of which are on the St. John's river. During the 1890's, these were known as the oldest groves in Florida, the Mays grove being particularly famous. Hubbard (1919) stated:

There were three types of oranges in the original [Mays] grove, a round, full-colored orange not quite so fine flavor as Homosassa; a lighter-colored orange slightly flattened and not quite so sweet—an Azorean type; and a very sweet oblong orange known as the "Early Oblong" or "Sweet Seville."...it would seem that most of the sweet seedling orange trees of Florida were propagated from seed from the Mays and Rembert groves.

Another grove famous in the early history of Florida was the D. D. Dummitt grove on Merritt Island, which according to Bass (1926), was, started about 1830. If we may judge from the statements of old residents and from the fact that the oldest trees in the grove were on sour

orange stocks budded from three to four feet high, Captain Dummitt first top-worked wild sour orange trees that were growing on the place (). All the oldest tree in the grove clearly showed the bud union. The senior author testified that the stocks were sour orange, for he carefully examined sprouts from the stocks of several trees. This was probably the first instance of the working over of a wild grove; the general practice of using such groves in this way did not start until about 1865 or 1870. The sweet orange to which the Dummitt trees were budded was taken from a grove near New Smyrna, and was doubtless a wild sweet orange tree. Bass stated that this was the beginning of the old "Indian River variety," which later became famous.

Bass reported that about fifty of the original trees were living in 1926, but when the senior writer visited the grove in 1932 the number had been greatly reduced. In 1967, only six of the original trees were still alive.

The Speer grove at Sanford, planted in 1842; the Dancy grove at Orange Mills, planted in 1859; and the Hart grove at East Palatka, planted in 1859, were famous forerunners of the large plantings that followed in later years.

The early groves were situated along rivers, for the only means of transportation was by boat, and the methods of handling and shipping were crude. The advent of railways in the early 1860's provided a means of quick transportation to the principal northern cities, and from that time on the development of the industry was rapid.

The early plantings were of seedlings propagated from certain choice trees, but soon (beginning about 1870) the best seedlings were named as varieties and propagated by budding or grafting. For a number of years such native varieties were almost the only ones in use, but as the industry developed many foreign varieties were brought into the state. Imported varieties began to be offered as early as 1875 by such nurserymen as A. J. Beach and Sons of Palatka, but native varieties, selected and named in the state, have continued to dominate in Florida plantings.

Top-Working Wild Groves.—The top working of wild groves, which has been such an important factor in the development of the Florida industry, was started with the Dummitt grove in 1830 and was generally taken up between 1865 and 1870. This practice was found so satisfactory and profitable that by 1892, when the senior author's study of the industry in Florida began, so far as could be learned there remained in the state only one unbudded wild grove, a small one, situated on the St. Johns River. It is to be regretted that one of the old groves was not maintained as a national monument, but this phase in the refinement of our national life developed too late. A few of the top-worked wild groves still remain, though most of them have been either severely injured or wiped out by cold ().

Grapefruit Industry Originated in Florida.—One of the outstanding aspects of the citrus industry in Florida has been the development of grapefruit growing on a commercial scale. Elsewhere this fruit was considered to have no special value; it was grown only as a curiosity and allowed to rot on the ground. Gradually the residents of Florida began to recognize that the fruit was refreshing and wholesome, and this knowledge was slowly passed on to tourists from the North. The first fruit shipments were made to Philadelphia and New York some time between 1880 and 1885. These are said to have netted the growers only about fifty cents per barrel, but soon the demand for the grapefruit became established and better prices were obtained. This was the beginning of the commercial grapefruit industry, an industry which now has extended to all suitable citrus sections of the world. (See also Chapter 4, .)

California and Florida Industries Compared.—Although citrus growing on a commercial scale began to be developed at about the same time in both Florida and California, the industry in Florida, prior to the great freeze of 1894-95 (), had made by far the more rapid progress

(Webber, 1896). The Florida crop of 1894-95, almost entirely destroyed by the record temperature drop of that winter, was estimated at over 6 million boxes, whereas the crop of California for the same year was only 1.6 million boxes. Fourteen years passed before Florida again reached a production equaling the 1894-95 estimates. Meanwhile California had advanced to an average production of approximately 15 million boxes per year by 1908-09.

Despite additional severe freezes in 1889, 1905, and 1917, the Florida citrus industry moved further south and developed rapidly. By the 1924-25 season, Florida's total production had advanced to slightly over 20 million boxes as compared to California's 24 million boxes. More recent trends are indicated in . Some of the year-to-year fluctuations in production were caused by the severe freezes of December, 1934; January, 1940; December, 1957; February, 1958; and December, 1962.

The Spread of Citrus into Arizona

It is interesting to note that the early historical records indicate that citrus fruits reached what is now the state of Arizona before settlements had been made in California, and that Arizona is thus an older citrus-growing section than California. Father Eusebio Kino's manuscript describing the exploration and establishment of the early missions in Lower California, Sonora, and Arizona, which was translated by Professor Herbert E. Bolton (Kino, 1919) of the University of California, supplies definite evidence of the introduction of oranges into Arizona in the early days of the eighteenth century.

The first mission established by Kino in Lower California in 1683 failed and was abandoned, but those established somewhat later in northern Sonora (Mexico) and in southern Arizona flourished and developed an extensive and prosperous agriculture. In summarizing the conditions and the cultivations at the missions during the period from 1707 to 1710, Kino stated:

There are many Castilian fruit trees such as fig trees, quinces, *oranges*, pomegranates, peaches, apricots, pear-trees, apples, mulberries, pecans, prickly pears, etc., with all sorts of garden stuff (Kino, 1919, vol. 2, p. 265).

It seems certain from this statement that at the missions in Sonora and southern Arizona oranges were being successfully grown in the early days of the eighteenth century, and the date of Kino's report, 1707, may be taken as approximately the date of the introduction of oranges into Arizona. It is quite certain that no citrus trees reached Alta California prior to the establishment of the first mission in 1769.

Citrus growing in Arizona, however, for approximately two centuries was limited to scattered plantings of only a few trees in yards here and there for home use. It was not until the beginning of the twentieth century that small commercial groves began to appear. In 1965, there were an estimated 40,000 acres of citrus plantings in the state.

The Spread of Citrus into California

Establishment of Missions Extended Citrus Culture.—If definite records exist indicating when the first citrus seeds or trees were brought to California and planted, they have not yet been brought to attention.

In 1767, the Jesuits were expelled from the missions in Baja or Lower California, and their possessions were placed in charge of the Franciscans. Owing to a dispute between the Franciscans and the Dominicans, a division of the property was made, and the Franciscans elected to develop the missions in Alta California. In 1769, under the leadership of Fra Junípero Serra, they entered what is now California and founded the first of their missions at San Diego. Twenty-one missions were ultimately established in the coastal section of the state, forming a

chain extending northward as far as San Rafael.

The missions necessarily were forced to produce their own foodstuffs, and all but three of them maintained gardens and orchards. It is known that the Franciscans in beginning their settlement in Alta California got their supplies of seeds, plants, and domestic animals almost wholly from the missions in Baja California. Hence, what was included in their cultivations depended at first upon the products in cultivation and available in the earlier settlements.

Venegas (1757), writing in Mexico in 1739, mentioned the difficulty experienced in the successful cultivation of crops at the missions in Lower California owing to the lack of experienced gardeners. "The latter requirement was supplied in the person of Ugarte," a trained gardener, so Venegas reported, "who brought to the peninsula almost every kind of fruit tree growing in New Spain." Venegas also quoted Clavigero as having stated that the orange was among the fruits grown in the mission gardens at that time.

Clavigero's manuscript (1852, p. 8), which was not published until 1789, contained the following statement with reference to foreign plants cultivated in Baja California:

Not all of the plants and fruit trees taken to California from various parts of Mexico have grown. In the few places where water is sufficient and the soil suitable for their respective cultivations, the following have prevailed: the olive, lemon, orange, peach, pomegranate, fig, apple, guava, yellow sapota, watermelon, muskmelon, pumpkin (also squash), date palms, wheat, corn, rice, and various kinds of vegetables.

It seems clear from these statements that both oranges and lemons were cultivated in the mission gardens of Lower California prior to 1739, the year Venegas' manuscript was written. By the time the Franciscan expedition which established the first California mission at San Diego in 1769 departed from the missions of Lower California, oranges and lemons must have been fruiting there, and it is very probable that orange and lemon seeds or plants were taken along, with grapes, olives, and other important products, for propagation in the prospective new settlements.

Oranges Introduced into California in 1769.—Apparently, therefore, the date of the introduction of citrus fruits into California may properly and safely be considered as 1769, the date of the establishment of the first mission at San Diego.

The first definite mention of the actual presence of citrus fruits in California was that made by Vancouver (1798, vol. 2, p. 494), who, on his famous voyage of discovery, visited Mission San Buenaventura () on November 20, 1793. He stated:

...yet the garden of Buena Ventura far exceeded anything of that description I had before met with in these regions, both in respect of the quality, quantity, and variety of its excellent productions, not only indigenous to the country but appertaining to the temperate as well as torrid zone; not one species having yet been seen or planted that had not flourished, and yielded its fruit in abundance and of excellent quality. These have principally consisted of apples, pears, plumbs, figs, *oranges*, grapes, peaches, and pomegranates, together with the plantain, banana, cocoa nut, sugar cane, indigo, and a great variety of...kitchen herbs, plants and roots...Here also grew great quantities of the Indian fig, or prickly pear; but whether cultivated for its fruit only or for the cochineal I was not able to make myself thoroughly acquainted.

Doubtless at this time orange trees of considerable age could have been seen at several of the missions in southern California.

As late as the 1870's, Taliesin Evans, a newspaper reporter, found evidence of the orange trees that had once flourished at Mission San Diego, Mission San Buenaventura, and Mission San Luis Rey (Evans, 1874). Evans, one of the earliest chroniclers of California citrus history, noted that the only living orange trees from the mission period were to be found at San Gabriel and at Old San Bernardino, where Mission San Gabriel established a rancho in 1819.

Unfortunately, Evans does not elaborate on the trees at Old San Bernardino, and he is our only known source for their existence.

That other citrus species were also taken to California from the missions in Lower California is proven by a statement in Alfred Robinson's *Life in California* (1846, p. 44). Robinson, who visited San Gabriel Mission in 1829, stated: "There are several extensive gardens attached to this mission, where may be found oranges, citrons, apples, pears, pomegranates, figs, and grapes in abundance."

First Orange Grove Planted.—The first orange grove of any size to be set out in California was planted in the garden of San Gabriel Mission. However, the early records of the California missions rarely mentioned fruits or products and the exact date that the orchard was established is unknown. In 1884, William Spalding, a newspaper reporter, interviewed Father Joaquin Bot, the priest at the mission. Spalding (1885, p. 7) quoted Father Bot as fixing the planting of the first orange orchard at about the year 1804. Spalding attributed to Father Bot a statement that the distinction of planting this first orange grove in California belonged to Father Tomás Sánchez.

However, there never was a Father Tomás Sánchez at any of the California missions, and it seems probable that Spalding was careless in his transcription of the interview. Records of the San Gabriel Mission (Englehardt, 1927) show that the only Father Sánchez stationed at the mission about the time the grove was planted was Father Francisco Miguel Sánchez, whose death occurred in July, 1803. Since Father Sánchez was in charge of Mission San Gabriel, he probably personally directed the planting of the first grove and at least a year or more earlier than reported by Spalding.

According to Spalding, Father Bot believed that the trees were propagated from seeds brought from San Rafael in Lower California. Spalding (1885, p. 7) added:

Col. J. J. Warner our "oldest inhabitant," settled in Los Angeles County in 1831. At the time of his coming the orange trees in the Mission garden were twenty-five or thirty years old, and had long been in bearing. This agrees with Father Bot's calculation as to the time of their planting.

In 1885, when the trees were approximately eighty-two or more years old, Spalding (1885, p. 9) had this to say regarding them:

The original orchard of Father Tomás [sic] Sánchez, of blessed memory, still remains in the Mission garden at San Gabriel. It is a decrepit old patriarch still lingering to witness the glory of its tribe. The inclosure comprises about six acres, and it is probable that 400 trees constituted the original plantation. Of this number less than thirty survive. I wish that I could say that these trees, now more than 80 years old, remain in a fair state of preservation, but they do not. Few of the trunks are sound. Some of them appear half or two-thirds dead, and only a narrow margin of live bark and wood to keep vigor in the top....One of the old trunks that I measured showed a girth of 42 inches near the ground.

Some of the trees in this old orchard lived on for many years, but the last of them died of age and lack of care in the early years of the twentieth century.

Early California Orange Groves.—While there are accounts of fruit trees such as pears, peaches, nectarines, apples, and pomegranates being cultivated on lands around Los Angeles, citrus orchards apparently did not become established outside the missions until after secularization in 1833. The mission fathers seem to have prized citrus highly. In 1877, Jose del Carmen Lugo (1950) of the San Bernardino rancho recalled that owners of fields could not obtain seeds of oranges and lemons from the missions, because the padres "refused to allow these fruits to be raised elsewhere than at their missions."

In 1834, Jean Louis Vignes, a Frenchman, procured from Mission San Gabriel thirty-five
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large seedling sweet orange trees which he transplanted to his place on Aliso Street in Los Angeles, and this number was gradually increased until he was the possessor of a sizable grove. This was the second orange orchard to be planted in California (Spalding, 1885, p. 7).

According to Lelong (1902, p. 17), in the same year, 1834, a small planting was also made in Los Angeles by Manuel Requena. By this time the planting of a few citrus trees in gardens and courts for home use had become a common practice, but no groves had been planted to provide fruit for sale.

Next came the famous planting of William Wolfskill, a Kentucky trapper of German descent who came overland to Los Angeles in 1831. His first trees, seedling sweet oranges, were obtained from Mission San Gabriel and were set out in 1841 on a small tract on the site occupied later by the old Arcade passenger station of the Southern Pacific Railway. Spalding (1885, p. 8) said that the orchard of William Wolfskill was no doubt the first to be planted in California with an eye to profit. Since fruit from the Vignes grove was grown for home use and distribution among friends, Wolfskill's biographer, Iris Higbee Wilson, considers her subject to have been the founder of California's citrus industry (Wilson, 1965, p. 13).

Wolfskill's neighbors ridiculed him and his idea of growing oranges for sale, but with German tenacity and patience he maintained his trees and gradually extended his plantings. It was a hard struggle in the early years, but contrary to expectation the project paid, and the grove was gradually increased in size to twenty-eight acres and finally to approximately seventy acres. In later life Wolfskill reaped a rich reward. The last crop to be disposed of in his lifetime, from about twenty-eight acres of his grove, sold on the trees for \$25,000.

At about the same time, in the early 1840's, the planting was begun of a grove that later became famous as the Don Benito Wilson grove, situated several miles north of Mission San Gabriel and at one time a part of the mission property.

While citrus culture was very slowly extending, the great advances being made in the development of the United States were paving the way for the introduction of the orange into commerce.

After the secularization of the missions in the 1830's, the early fruit industry began to decline, and when General Frémont visited California in 1846 he wrote that "little remains of the orchards that were kept in high cultivation at the Missions." Some of the early settlers who had foresight enough secured certain of the mission orchards and maintained them and were thus enabled later to reap a rich reward.

Influence of Americanization and "Gold Rush."—After the planting of the Mission San Gabriel grove, the next great stimulus to the citrus industry came with the ceding of California to the United States. This transaction followed the Mexican War (1846) and the conquest of California by the United States, and was ratified by treaty in 1848. Almost immediately came the discovery of gold in the new territory, followed by the great "gold rush" of 1849, which swelled the population of California to undreamed of proportions and created a nearby lucrative market for all the fruit the existing groves could be made to produce. This was the real birth of the commercial citrus industry in California. The fruit could be shipped by ocean freight to San Francisco and thence by water up the Sacramento, American, and Feather rivers to points near the mines. San Francisco became the great market for the industry and remained so for a period of three decades.

Apparently, however, there was no great haste to take advantage of this opportunity. It required too long to produce a bearing grove and the persons who were living in California were not commercially minded. The people coming in by the thousands were seeking wealth through

the metal gold and not through the golden fruits. The reaction to the new conditions was therefore slow, but by providing potential market the stimulation that was needed to expand the industry was created.

In 1852, Don Benito Wilson purchased the small orchard that thereafter was known as the "Don Benito Wilson grove" and began to extend the plantings. In 1853, Mathew Keller began the planting of an orchard opposite the Wolfskill grove with seedlings grown from fruit obtained from Central America and Hawaii.

In 1857, a small orchard was planted by L. Van Luven at Old San Bernardino with seedlings grown by himself and with other seedlings from Los Angeles. In 1869, L. F. Cram set out a small grove of some two hundred seedling trees near Highland (Brown and Boyd, 1922, vol. 1, p. 73). These last two orchards were important as marking the extension of experimental culture into the interior valleys, unless one accepts the curiously meager testimony of Evans (1874) that orange trees were grown at Old San Bernardino in the mission period.

The Cram orchard remained for many years a show place, but gradually the trees became badly infested with scaly bark and were largely dug out in 1928. One of the oldest trees in this planting remained until after World War II, but gradually deteriorated thereafter and was finally removed in 1961. As far as can be learned, it was the oldest and largest citrus tree in California when removed. Careful measurements of this tree made by the senior author in December, 1926, gave the following dimensions: height, 33 feet 5 inches; circumference, one foot above the ground, 59 1/2 inches; spread of branches, 30 feet (). When felled in 1961, the tree measured 39 feet in height. The stump remaining in 1965 measured 25 inches in diameter two inches above ground level.

In 1865, Myron H. Crafts set out a small orchard of some two hundred trees at Crafton. By that time it may be said that the citrus industry in the interior valleys had become reasonably well established.

Four years later, F. A. Kimball planted a small orchard of orange, lemon, and lime trees at National City in San Diego County, apparently the first grove planting in that section of the state. According to Kimball (1897), there were at that time a few isolated trees near San Diego and in the San Luis Rey Valley.

In 1867, according to the United States Department of Agriculture, there were in California 17,000 orange trees and 3,700 lemon trees, of which 15,000 orange trees and 2,300 lemon trees were in the Los Angeles region.

Introduction of the Washington Navel Orange Stimulated Citrus Planting.—Riverside, a community that became famous in the early history of citrus culture because of the Washington navel orange, was founded by Judge J. W. North in 1870, and the first citrus seed and trees were planted in 1871. The development of orange, lemon, and lime groves in the Riverside colony was very rapid between 1871 and 1880, and the names of Dr. K. D. Shugart, A. J. Twogood, J. C. Waite, Sam McCoy, Josiah Cover, G. W. Garcelon, S. L. Wright, and Judge E. G. Brown stand out as important pioneer growers.

Here the Washington navel orange was introduced in 1873 and first fruited in 1878. (See Chapter 4, .) In a few years the variety had become so famous that citrus culture in California was greatly stimulated.

A census of the citrus industry of Riverside in 1880 showed that there were growing in the community 17,038 orange trees, 3,199 lime trees, and 2,480 lemon trees. It was thought at the time that the lime was likely to be more successful as a commercial fruit than the lemon, and limes were planted in all the developing citrus sections of the state. At this period Riverside

contained the largest citrus plantings in the state other than those immediately around Los Angeles.

The citrus trees planted during this period were largely seedlings grown from seeds taken from local trees, mainly from the orchard of Mission San Gabriel, or from special fruits shipped in from Mexico, Hawaii, and Tahiti. Considerable activity was manifested, however, in obtaining good varieties. Thomas A. Garey, who established a nursery at Los Angeles in 1865 and who was one of the most outstanding of the pioneer nurserymen of California, introduced a large number of varieties during the period from 1868 to 1875. He is said to have received shipments of varieties and seed from Mexico, Central America, Australia, southern Europe, and Florida, and through such famous nurserymen as Elwanger and Barry, of Rochester, New York, and Thomas Rivers, of Sawbridgeworth, England. His most outstanding orange importations were the Mediterranean Sweet and the Paperrind St. Michael, both of which were extensively planted in the early orchards. He also named and introduced the Eureka lemon, which was from an exceptionally good seedling grown by C. R. Workman, a pioneer orange grower of Los Angeles (Garey, 1882).

Extension of Citrus into Northern California.—Meanwhile citrus growing had been developing in the northern part of the state also. In 1856, Judge Joseph Lewis purchased three sweet orange seedlings from Jesse Morrill in Sacramento, and these were planted in the vicinity of Oroville in Butte County (Webber, 1927*a*, 1927*b*, 1928). One of these trees was planted at the west end of the famous suspension bridge at Bidwell's Bar and is still living and bearing large crops annually (). It has come to be known as the "Mother Orange Tree" and is now apparently the oldest and largest living orange tree in California. In 1965, this tree was moved in good condition to a new site overlooking the Oroville Dam. Measurements made by an official committee on November 27, 1926, gave the size of the tree as follows: height, 33 feet 6 inches; spread of top, 31 feet 5 inches; circumference of trunk one foot from the ground, 66 inches (Webber, 1927*a*, 1927*b*). The success of these trees soon led to the planting of other trees in the vicinity.

The visiting committee of the State Agricultural Society in 1858 (*Transactions*, p. 167) stated that they had found "oranges" and "citrons" in the ornamental garden of the venerable pioneer General John A. Sutter, on the bank of the Feather River; also orange trees at Marysville that had endured the winters for two years. In the *Transactions* of the Society for 1872, the variety committee reported that they had found bearing orange and lemon trees in the garden of Judge Sexton at Oroville; a twelve-year-old orange tree in the garden of Mr. Glaucauf, likewise at Oroville, which had produced a crop of 400 fine oranges during the year; and a tree at Bidwell's Bar which had borne 1,500 fruits that year (the Mother Orange Tree when sixteen years old).

The extent of citrus growing in northern California in the late 1870's is shown by the following statement by Hoag (1879):

Marysville, Sacramento, and many other cities and towns from San Diego to Red Bluff have large numbers of orange trees now in bearing. Contrary to general expectation the orange ripens from two weeks to one and one-half months earlier in nearly every locality north of San Francisco than in Los Angeles.

In 1862, H. M. White planted two orange trees in Frasier Valley east of Porterville, Tulare County, which later formed the nucleus of a forty-acre orchard. The first orchard in this section was the A. R. Henry orchard at Porterville, which was set out in 1883.

It thus appears that by 1870 many individual trees and small orchards had been planted in all the principal citrus-growing regions of California, and the commercial industry, presently one of

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the most important horticultural industries of the state, could be considered as well established. Before this time stress had been placed mainly on the production of fruits for home use only. Fresh fruits were scarce and expensive; even a large share of the oranges consumed in the state were being imported. In 1866, San Francisco, at that time much the largest city in California, imported some 3 million oranges from Mexico and the islands of the Pacific, whereas only 250,000 were received from the vicinity of Los Angeles.

The rapid extension of fruit production in the late 1860's and the coming into bearing of many young orchards soon resulted in low prices, with no relief in sight. In 1862, there were about 25,000 orange trees in the state, but by 1882 bearing trees had increased to over half a million (Butterfield, 1963). Fruit industries languished and well-nigh perished.

Completion of Transcontinental Railways.—The third great impetus to the extension of the citrus industry in California came in the late 1870's and early 1880's with the completion of three transcontinental railways: the Southern Pacific Valley Line in 1876, making connections with the Central Pacific and Union Pacific to the East; the southern line of the Southern Pacific to New Orleans in 1881; and the Santa Fe in 1885. These railways provided competing carriers for eastern shipments and had an immediate effect on the industry.

The first carload of fruit to be shipped east from California was from the famous Wolfskill orchard in Los Angeles and was sent to St. Louis in 1877. It is said to have arrived in good condition, though it was a month in transit. The freight charge on this car of three hundred boxes is said to have been \$500.

In 1881, the Southern Pacific, owing to the approach of competing lines, cut the rate on carload lots from Los Angeles to Chicago from \$650 to \$350, with similar reductions to intermediate points. The first carload shipment from any point in the state other than Los Angeles was probably that made from San Bernardino by G. W. Garcelon and A. J. Twogood of Riverside in 1882. This was a mixed car of oranges and lemons sent to Denver.

According to Spalding (1922), the first special train loaded exclusively with oranges "left Los Angeles February 14, 1866, via the Southern Pacific and Union Pacific railways, consigned to some eastern point."

By the following year, ventilated boxcars were carrying oranges across the continent to New York. The refrigerated boxcar made its appearance in 1889. A. T. Hatch, a pioneer in refrigeration, reported that merchants at first viewed the fruit dubiously and commented that it would "all fall to pieces and decay as soon as it was taken from the refrigerators." In 1892, five carloads of fruit were shipped by the California Fruit Transportation Co. to New York and transferred to steamers for a fourteen-day voyage to Liverpool and London. Great crowds attended the fruit sale in London, and out of the first shipment some samples were sent to Queen Victoria, who "pronounced them palatable." (See Calif. State Board Hort., 1892, p. 330-31.)

Railroad transportation to eastern markets played a significant role in stimulating expansion of the California citrus industry. In 1908-09, over 15 million boxes of citrus were shipped east by rail. In the 1924-25 season, California produced about 24 million boxes of citrus. Subsequent trends in the growth of California's citrus industry are indicated in . It will be noted that there was a decline in production after World War II, primarily resulting from urban encroachment on citrus orchard land in the Los Angeles basin.

The Spread of Citrus into Texas and Other States

The Gulf States.—In the other continental sections of the United States, where citrus fruits are now being grown commercially, the industry is of relatively recent origin. Individual trees

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have for many years been grown in gardens in various sections of the states adjoining the Gulf of Mexico and even as far north as Charleston, South Carolina, but it is only within the last sixty years that important commercial plantings have appeared in any of these regions.

In the 1880's, small commercial plantings were made in Louisiana, mainly in the Delta region below New Orleans. In certain sections of the Gulf States, small plantings of the hardy satsuma orange were made as early as 1890, but these were largely killed by the freezes of 1894-95 and 1899. Planting was gradually resumed, and the industry became rather widespread, particularly in the southern sections of Alabama and Louisiana and along the Gulf Coast section of Texas in the vicinity of Houston and Beaumont. Then came the freeze of 1916-17, which destroyed thousands of acres of citrus groves in Alabama, Texas, and other Gulf States.

In 1910, the United States census report gave for Texas a total of 833,406 citrus trees, which were mainly satsumas in the Houston and Beaumont districts, and in 1915 Webber (1929) reported the existence of a flourishing industry in those sections, even though an intensive fight for the control of citrus canker was in progress. The freeze of 1916-17 destroyed most of these groves and by 1920 the census report showed only 123,951 citrus trees in the state. Meanwhile, the industry had moved farther southward, and the trees reported were mainly in a new section, the lower Rio Grande Valley.

Commercial plantings in the lower Rio Grande Valley of Texas were begun about 1910. These expanded very rapidly so that there existed a total of about 116,000 bearing acres in 1948 that produced over 28 million boxes of citrus in the 1947-48 season. A series of devastating freezes in January, 1949, in December, 1950, and in January, 1951 eliminated about three-fourths of the total acreage and reduced production in the 1951-52 season to about one-half million boxes. By the 1960-61 season, production had recovered to more than 10 million boxes, but other very severe freezes in January, 1962 and January, 1963 reduced production in the 1962-63 season to a few per cent of the 1960-61 level (see). In spite of these discouraging setbacks, the industry was again being replanted in 1965 on a modest scale and a 3 million box crop was estimated.

The plantings of satsuma in the other Gulf States, mainly Alabama, Louisiana, and northern Florida, totalled [*sic*] about 12,000 acres in the early 1940's, but a series of severe freezes in the two decades following World War II all but eliminated these plantings. The only commercial citrus remaining (about 2,000 acres) is in the delta area south of New Orleans in Louisiana, most of which was non-bearing in 1965, having been replanted after the freezes of 1961 and 1962.

Hawaii and Puerto Rico.—The orange was introduced into Hawaii in 1792 by Captain George Vancouver, and other kinds of citrus have been cultivated in the fiftieth state for more than a century. Production of citrus for export reached a peak during the period from 1840 to 1870, and since that time citrus plantings have declined because of the development of the more remunerative sugar, coffee, and livestock industries (Pope, 1934).

Many of the early citrus varieties planted in California in the 1850's were imported from Hawaii. For several decades in the nineteenth century, oranges were a leading export product from the Kona District on the island of Hawaii. Citrus is still grown in a number of localities of Hawaii for domestic consumption, but total production in 1961 amounted to only 19,400 boxes. Over 90 per cent of the 14 million pounds of fresh citrus consumed in Hawaii in 1961 was shipped from the mainland. Some excellent citrus studies have been published by the Hawaii Agricultural Experiment Station, situated at Honolulu.

Citrus was introduced into Puerto Rico by Spanish explorers and settlers very early in its history. Prior to World War II, Puerto Rico produced considerable quantities of grapefruit for

export to the United States. Grapefruit exports reached a peak of 672,000 boxes annually in the 1927-31 period, and total citrus production was in excess of 2 million boxes.

Puerto Rico now produces citrus primarily for domestic use. Total production of the self-governing commonwealth in 1961-62 consisted of about 1 million boxes of oranges and less than 400,000 boxes of grapefruit (see chap. 2, table 2-1, pp. 42-43 [text version, Revised Ed.]).

ORIGINS OF CITRUS RESEARCH AND TECHNOLOGY

Prior to the nineteenth century, horticultural techniques and methods of disease control in citrus culture were left largely to the orchardist, whose knowledge had been handed down from a remote past. The orchardist might apply surprisingly sophisticated techniques in propagation () or frost protection (crude smudging was practiced for hundreds of years in parts of Europe) and yet in ensuring good crops still rely chiefly on magic and superstition (Coit, 1915; Fawcett, 1936).

Even an educated citrus grower of the seventeenth century, acting on information from Ferrari (1646), might have solved his tree disease problems by "burying a dead dog near the roots." Nor would a later grower have been likely to learn anything useful from the early recognition and depiction of citrus pests () in Volckamer's *Nürnbergische Hesperides* (1708-14). In 1719, a puzzled Leeuwenhoek first observed two embryos in orange seeds, but it wasn't until 1878 in Germany that Strasburger industriously followed up this clue to formulate the theory of polyembryony.

The systematic study of citrus occurred earliest in the field of botany. Ferrari (1646), Jonstons (1662), and Volckamer (1708-14) paved the way by illustrating and describing many citrus varieties in their works. Then, following Linnaeus' development of a classification system, scientific botanical research was swept along by the collecting fervor of the eighteenth and early nineteenth century botanical explorers. The first comprehensive account of the orange subfamily was published by Augustin P. de Candolle in 1824.

Other areas of scientific citrus research and horticultural experimentation did not receive their impetus until the mid-nineteenth century, however, and prior to that time only chance discoveries were made and disconnected investigations pursued. Notable advances in such fields as citrus pathology had to await the death-blow that was given the theory of spontaneous generation by Tyndall and Cohn in 1830 and the growth of a commercial citrus industry of economic importance (Fawcett, 1936, 1941).

The active period in plant-disease investigations began about 1880 after Burrill (1878) proved for the first time that bacteria could be a cause of plant diseases. The accidental discovery of the Bordeaux mixture in France by Millardet in 1882 touched off activity in spraying for plant diseases and what one botanist referred to as the "squirt-gun period" of plant pathology. In Italy, G. Izenga as early as 1864, Penzig in 1882, and Savastano beginning about 1884 were publishing descriptions of citrus diseases and fungi (Fawcett, 1936, 1941).

But it was inevitable that crop-oriented research would gather momentum in the United States, where in Florida and California two gigantic commercial industries began developing in the 1870's and 1880's, stimulated by the advent of the transcontinental railroads. A pioneer period of citrus research blossomed—an era characterized by the enthusiastic cross-pollination of ideas among research scientists of the universities and U.S. Department of Agriculture, members of horticultural societies and state boards of agriculture, enterprising nurserymen, and a learned breed of growers, who often pioneered experiments in their own orchards.

Although the Florida industry was older, experimentation had its headstart in California, where as early as 1858 the State Agricultural Society revealed an interest in citrus problems

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(Anonymous, 1858). Sometime around 1869, cottony-cushion scale was imported to California on Australian acacia trees and within a decade was spreading through orchards and threatening to doom the young industry. Two years after the establishment of the California State Board of Horticulture in 1883, the first American quarantines were being invoked at sea ports by W. J. Klee, state fruit inspector. As the disease spread, D. W. Coquillet, an entomologist, set up one of the first citrus field laboratories on the Joseph Wolfskill ranch in 1886, where he privately conducted the first experiments with hydrocyanic gas fumigation (Wilson, 1965). Klee carried out similar experiments for the state, and more successful endeavors in fumigation were conducted in 1887 by F. W. Morse of the University of California (Woodworth, 1915).

The dramatic breakthrough of control on cottony-cushion scale came in 1889 when Albert Koebele of the U.S. Department of Agriculture returned from Australia with the *Vedalia* or ladybird beetle, a parasite of the scale. Released in great numbers in California, the ladybird beetle was so successful in eradicating the pest as to provide one of the most spectacular demonstrations of biological control in agricultural history (Rasmussen, 1960). The achievement focused attention of California and Florida growers on the benefits of agricultural research.

California's citrus problems were magnified by its distance from the eastern markets, and it was there that the first totally cooperative citrus exchange, the Pachappa Orange Grower's Association, was established in 1892. The growth of such cooperatives as the California Fruit Growers Exchange and the Florida Citrus Exchange in the late nineteenth century made possible orderly marketing, and the co-ops served as focal points for growers in lobbying for their needs, thereby further stimulating research on pressing cultural and shipping problems.

Meanwhile in Florida, growers began working cooperatively after the organization of the Florida State Horticultural Society in 1888. In 1889, the Florida Agricultural Experiment Station at the University of Florida was established with J. Kost as the first director. By the 1890s, Dr. P. H. Rolfs of the experiment station and Dr. H. G. Hubbard of the U.S. Bureau of Entomology were studying scale insects in Florida orchards (Rolfs, 1935).

Fresh from its triumph in California, the U.S. Department of Agriculture turned its attention to the problems of Florida citrus growers. One of the most significant events in the industry's history was its establishment of the Subtropical Laboratory at Eustis, Florida, in 1892. Here two young researchers, H. J. Webber and W. T. Swingle, for the first time studied and described such diseases as blight, dieback, foot rot, scab, melanose, psorosis, and others, making some progress in methods of control. They performed pioneer work in citrus breeding and originated and named the first varieties of the important new hybrids known as tangelos and citranges. They also first called attention to the possibility of controlling the white fly and certain scale insects by the use of parasitic fungi (Webber, 1937).

The great Florida freeze of 1894-95 set that industry back many years () and resulted in the recall of Swingle and Webber to Washington, D.C., and the abandonment of their laboratory. It also brought about increased interest in frost protection and one of the pioneer studies in this field was conducted in 1895 by the Riverside Horticultural Club and the U.S. Weather Bureau. Numerous smudging devices were tested and the burning of coal in wire baskets was settled upon. Although Charles Froude had introduced the first oil heater in the 1890's, it was not until after 1900 when oil became cheaper as a fuel that it was universally employed (Coit, 1915).

By the start of the twentieth century, numerous scientists were pursuing investigations connected with citrus in the Mediterranean countries, South Africa, Japan, India, Australia—wherever citrus was grown commercially. The economic importance of the crop

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was indicated by the development of unique institutions oriented toward citrus research such as the Florida State Citrus Experiment Station, Lake Alfred, founded in 1919; the Research Institute for Citrus and Subtropical Fruits, Nelspruit, South Africa, established in 1927; and the University of California's Citrus Experiment Station, now the Citrus Research Center and Agricultural Experiment Station.

The Citrus Experiment Station was established in 1907 by the Regents of the University of California. The institution consisted initially of a pathological laboratory in Whittier and an agricultural experiment station on the slopes of Mount Rubidoux in Riverside (). Dr. Ralph E. Smith served as head of both facilities. In 1913, Dr. H. J. Webber became the first man to hold the title of director and began shaping the policies and selecting the staff that were to give the Citrus Experiment Station worldwide influence in citrus research. Purchase of the present Riverside site made possible an enlarged citrus experiment station that combined both the Whittier and Mount Rubidoux staffs. The first and main building was completed in 1918. The broadening of its scope through the years led to the institution being renamed the Citrus Research Center and Agricultural Experiment Station in 1961 (). After more than a half century of distinguished service in the advancement of science and citrus technology, it continues to be the most prolific single center of research concerned with citrus problems.

RECENT DEVELOPMENTS

The writers have endeavored in the preceding sections to place the spread of the culture of citrus fruits in broad historical perspective, emphasizing the always interesting and sometimes romantic relation of citrus to the forward march of civilization. In this final section, it appears appropriate to comment briefly on some of the more recent trends and the apparent forces behind them.

Modern production trends in the principal citrus areas of the United States are indicated in . The fluctuating but upward trend shown is fairly typical of several other leading citrus-growing countries. Projections made in 1967 suggest that Florida's production alone—barring adverse weather—could exceed 225 million boxes, and total U.S. production could exceed 350 million boxes by 1970-1971.

Beginning around the turn of this century, citrus culture entered a period of relatively rapid expansion in many parts of the world in response to an increasing market demand in the more advanced countries. Some of the major driving forces behind this market expansion were increases in population, rising standards of living, and the improvement of worldwide communications resulting from the very rapid extension of railroad, automobile, air, and steamship transport systems. Improved market quality due to the development of refrigerated ships, railroad cars, and trucks contributed strongly to a rise in per capita consumption in many countries. Better citrus varieties and improvement in cultural, handling, and shipping methods also contributed greatly to reducing fruit costs and enhancing fruit appearance. The discovery of Vitamin C and its importance in the human diet did much to change consumer attitudes toward citrus. In the United States at least, widespread advertising, emphasizing the nutritional value of the high Vitamin C content of citrus, gradually changed the popular image of citrus from a luxury to a basic health food.

The most spectacular and far-reaching technological change in recent citrus history is the development of frozen and hot-pack citrus juice concentrates, which began to be marketed in quantity about 1948. These new products have had a worldwide impact on per capita consumption, although to date the Florida orange industry has experienced by far the greatest transformation as a result.

The data summarized in show that immediately prior to World War II only about 20 per cent of the Florida orange crop was processed, but that by 1963 almost 80 per cent was processed. During the 1935-40 period, California processed about 12 per cent and Texas about 1 per cent of their orange production. By the 1960-65 period, these states were processing about 28 and 32 per cent of the crops, respectively.

Thus, the recent history of the United States orange industry provides an excellent example of the vital, indeed almost revolutionary, impact that research can have on an agricultural industry. Currently, processing research in the citrus industry is proceeding at an accelerating tempo. Without doubt, other new products—both natural and synthetic—will have a strong influence in molding the trends in world citrus plantings in the 1970's and 1980's. Similarly, improved varieties and new production, harvesting, and handling technologies will have various impacts on the future industry.

FOOTNOTES

1. As given in this chapter, the early history of the introduction and spread of the different *Citrus* species into European countries has been derived largely from Georges Galesio, *Traité du Citrus* (Paris, 1811), and S. Tolkowsky, *Hesperides. A History of the Culture and Use of Citrus Fruits* (London, 1938). Free use has been made of *The Florida Agriculturist's* translation of Galesio, entitled *Orange Culture. A Treatise on the Citrus Family, by Georges Galesio* (Jacksonville, Florida, 1876). References to authors cited by Galesio and Tolkowsky may be obtained from their works. Because of frequent reference to both authors, citation of the dates of their works is sometimes omitted after a series of references.
2. James Legge, *The Chinese Classics* (London: Trübner...), Vol. III, Pt. I (1865), "The Shoo King," Pt. III, Bk. I, "The Tribute of Yu," chap. 6:44, pp. 111-112.
3. *Libre de vegetabilibus* vi, tr. I, cap. xi, pp. 54-55. Ausgabe von Jessen, pp. 362-63.
4. The reference under "43" is to Sung Lueh Ssu..., *T'ai peng hoan yu chin...*, 161:3. (Geography of the Chinese Empire, published in the Sung dynasty.)
5. Given as twelve bottles in another place (Shiu, 1933, p. 277).
6. Citrus historians have long been uncertain how much credence can be given Sloane's tale of the introduction of the shaddock to the West Indies. Swingle (1943, p. 418) was unable to document the existence of "the elusive Captain Shaddock...whose name up to now has not been found in records of either government or private shipping." Tolkowsky (1938, p. 266) also failed to uncover a record of the man for whom the fruit was supposedly named. Immediately prior to publication of this volume, the junior authors succeeded in a search for the missing captain. A brief reference to a Captain Chaddock (sic) making a trip from the Somers Islands (Bermudas) to Trinidad in 1642 was found in a letter from Richard Norwood to the Governor and Company of Adventurers to the Somers Islands in W. Noël Sainsbury (ed.), *Calendar of State Papers, Colonial Series, 1574-1660*, I, 323 (London, 1860). This clue led to a Captain Thomas Chaddock (the spelling varies) who served as Governor of the Somers Islands from

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1637 to 1641. Further research will be needed to substantiate the Sloane legend.

7. Letter directed to Vice-Chancellor Ascanio on November 1, 1943 (*Decadas*, I, 24).

8. Díaz left Spain for the New World in 1514, going first to Nombre de Dios (Panama) and thence to Cuba. He was with Cortéz throughout the conquest of Mexico. His manuscript was written in 1568, and the Alonzo Remon edition was published in Madrid in 1632.

9. Quoted from the English Translated Edition of Edward Grimston, 1604, edited with notes and introduction by Clements R. Markham (Hokluyt Society, London, 1880), Vol. 1, p. 265.

10. In letter to Dr. H. S. Fawcett, dated July 13, 1937.

11. "Narrativa epistolar," in *Revista trimestra do Instituto Hist. e Geogr. Brasileiro*, LXV (1902), 16.

12. Cobo (1890-1895), II, 398. Quoted from a free translation made in 1934 by Professor George W. Hendry of the College of Agriculture, University of California at Berkeley, California.

13. Pedro Menéndez, marqués, a la Audiencia de Santo Domingo, San Agustín, 2 abril de 1579. Translated in Jeanette Thurber Connor, *Colonial Records of Spanish Florida*, II, 227.

14. Bartolomé Martínez al Rey, La Habana, 17 febrero de 1577. Translated in Jeanette Thurber Connor, *Colonial Records of Spanish Florida*, I, 245.

15. Rev. Maynard Geiger, O.F.M., the leading Franciscan authority on the California missions, in a letter to the editor, dated August 7, 1965, states: "I have no recollection of the mention of citrus fruits prior to the Vancouver reference of 1798."

16. Former California Governor J. G. Downey (1874) dated planting of this grove after the Wolfskill planting.

17. From data compiled by Albert S. White and printed in the *Riverside Press and Horticulturist* (see Brown and Boyd, 1922, Vol. 1, p. 512).