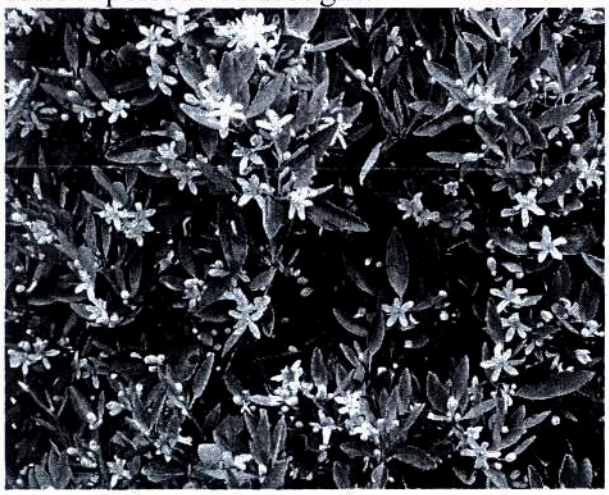
FACTORS AFFECTING BLOOM, FRUIT PRODUCTION AND QUALITY

In subtropical regions during the winter months, the temperature normally falls below 70 °F for several months. This causes growth to cease and trees to become dormant for about 3 months. This dormancy, among other things, induces flowering when warmer temperatures in the early spring cause resumption of vegetative growth. In a tropical climate, there is no period of cold temperature to induce dormancy. However, with periods of less than ample soil moisture, flushes of bloom and vegetative growth normally follow periods of drought.



It is well known that vegetative growth is competitive with fruit growth for available nutrients such as sugars and minerals. Flushes of heavy vegetative growth will reduce the solids available to developing fruit, while a period of dormancy will increase solids. This competition for nutrients between vegetative growth and fruit development is one of the reasons reducing solids concentration often found in oranges produced in the tropics as compared with those produced in subtropical regions.

Fruit production and quality is influenced by many factors including climatic conditions and production practices. Within fairly broad parameters of adequate soil and reasonably good cultural and crop protection practices, climate is the most important component of the climate-soil-culture complex causing differences in fruit quality among commercial citrus production areas.

CLIMATE

There is considerable diversity among citrus cultivars in their response to climate, especially as regards to market quality of the fruit. For example, 'Navel' develops its best eating and eye-appeal qualities in a Mediterranean type climate with cool, wet winters and hot, dry summer. In wet, tropical regions, it tends to be large, with poorly colored rinds, and low total soluble solids and acid in the juice. However, 'Valencia' is adapted to a broad range of climates, producing excellent to acceptable fruit quality in most of the important citrus regions. Unlike 'Navel', most grapefruit cultivars develop optimum internal quality in warm climates with little winter chilling.

Cultural practices cannot completely overcome these differences. For example, there is no known cultural practice that allows California (with Mediterranean climate) to produce low-acid, thin-peel Florida world top quality grapefruit.

Worldwide, climate has a significant effect on citrus yield, growth, fruit quality, and economic returns. In growing regions where the average temperatures remain high all year, chlorophyll levels remain high for oranges and tangerines and the fruit peel stays green, while the peel color of oranges and mandarins is more intense and of greater eye-appeal at maturity in the cold-winter subtropical climates.

In lowland tropical areas, due to the high respiration rate at warm temperatures, the fruit mature fast, do not have sufficient time to accumulate high soluble solids levels and acidity declines so rapidly that the soluble solids/acid ratio increases sharply and the fruit quickly become insipid and dry. Total soluble solids (TSS) in the fruit accumulate most slowly in cool coastal areas. Maximum levels of TSS are usually attained in the mid-tropics and in humid subtropical regions with warm winters. Total acid (TA) levels are generally greatest in semiarid or arid subtropical and coastal regions and decline more slowly than in other regions. This decrease in TA is primarily a function of temperature (heat unit accumulation) and the rapid respiration of organic acids at those temperatures.

GROWTH REGULATORS

Application of plant growth regulators can provide significant economic advantages to citrus growers when used in appropriate situations. Depending on cultivar and timing, plant growth regulators may improve fruit set, increase fruit size by reducing cropload, extend the harvest season by delaying rind aging, and reduce preharvest fruit drop.

Gibberellic acid (GA) is recommended for citrus hybrids that are weakly parthenocarpic and without sufficient cross-pollination to improve fruit set. Applied from full bloom to two-third petal fall, GA can effectively set and produce an excellent crop of seedless Robinson, Nova, Orlando, Minneola, or other self-incompatible mandarin hybrids. Application of GA to citrus fruit approaching maturity enhances peel firmness and delay peel senescence.

Application of GA in the fall often increases juice extraction from sweet oranges. It is likely that GA enhances juice extraction efficiency because increased peel firmness provides better mechanical support for fruit within extraction cups.

Applied in winter during floral induction to cultivars that routinely flower heavily but set poor crops such as Navel, Ambersweet, and Ortanique, GA reduces flowering and often results in increased fruit set. A combination of GA and 2,4-D has been used in many fresh fruit growing regions to enhance peel strength and extend the harvest seasons for grapefruit and oranges.

Naphthaline acetic acid (NAA) is used to reduce the number of fruit with excessive set. The advantage of NAA thinning in heavily cropping trees is increased fruit size. The greatest response has been shown when the average fruit diameter is around half an inch, which typically occurs 6 to 8 weeks postbloom. Thinning of Murcott and Sunburst tangerine with NAA was found to increase fruit size, mean fruit weight, and percent packout through improved fruit appearance.

CULTIVAR/ROOTSTOCK

The most important determinant of fruit production and quality under the control of the grower is the selected cultivar. Under comparable conditions, 'Hamlin' orange always has poorer juice color and lower soluble solids than 'Midsweet' or 'Valencia' orange. On the other hand, 'Hamlin' produces higher, more consistent yields per acre than any other sweet orange cultivar. 'Valencia' is worldwide known to produce premium quality fruit. Its internal quality is excellent. The fruit has high sugars, superior flavor, and deep orange juice color at maturity.

Beside the cultivar, many horticultural characteristics are influenced by the rootstock including tree vigor and

size, fruit yield, fruit size, maturity date, and fruit quality. One of the best known examples is the small fruit size of 'Valencia' budded on Cleopatra mandarin rootstock. Cleopatra mandarin is well suited for use with tangerines, Temple, and tangerine hybrids. Cleo is not widely used for grapefruit and 'Valencia'. Sweet orange and grapefruit cultivars on Cleo generally produce small fruit and are not precocious. Low yield results from poor fruit set and size and fruit splitting. Scions on Cleo are most productive on heavier soils.

Larger fruit with thicker, rougher peel, and lower concentrations of soluble solids and acids in the juice are generally associated with cultivars budded on fast-growing vigorous rootstocks such as rough lemon, Volkamer lemon, *Citrus macrophylla*, and Rangpur lime. However, these rootstocks impart high vigor to the scion and induce high yield. Tangerine fruit from trees grown on vigorous rootstocks tends to be puffy, hold poorly on the tree, and have high incidence of granulation.

Cultivars budded on slower-growing rootstocks, generally do not produce vigorous vegetative growth, but tend to produce small to medium size fruit with smooth peel texture and good quality fruit with high soluble solids and acid contents in the juice. This latter group of rootstocks includes trifoliate orange and some of its hybrids (citranges and citrumelos). Sweet oranges budded on Carrizo have been among the most profitable combinations over the long term in Florida. Planted on the right soils, trees on Swingle are very productive at high-density plantings.

IRRIGATION AND NUTRITION

Although citrus trees develop largely in response to their genetic endowment and the climate, good production practices can have favorable influences on fruit production and quality. Cultural practices that attempt to cope with climatic or weather problems include irrigation and nutrition. Irrigation is of particular importance during the spring, which coincides with the critical stages of leaf expansion, bloom, fruit set, and fruit enlargement.

Irrigation increases fruit size and weight, juice content and soluble solids-acid ratio. Soluble solids per acre may increase due to yield increase. However soluble solids per box and acid contents are reduced. Through its tendency to stimulate vegetative growth, irrigation in the dry fall and winter may reduce soluble solids in the fruit. Decline in total acid levels can also be aggravated by excessive irrigation.

Citrus trees require a good water management system and a balanced nutrition program formulated to provide specific needs for maintenance and for expected yield and fruit quality performance. Adequately watered and nourished trees grow stronger, have better tolerance to pests and stresses, yield more consistently, and produce good quality fruit. On the other hand, excessive or deficient levels of watering or fertilization will result in low fruit yield and oversize fruit with poor quality and diluted soluble solids content.

The most important nutrients influencing fruit quality are nitrogen, phosphorus, and potassium. However, when any other nutrient is deficient or in excess, fruit yield and quality are negatively altered. Nitrogen (N) increases juice content, TSS per box and per acre, and acid content. However, excessive N can induce excess vigor and promote a vegetative rather than a flowering tree and can result in lower yields with lower TSS per acre. In contrast, low N levels promote extensive flowering but fruit set and yields are poor.

Phosphorus reduces acid content, which increases soluble solids-acid ratio. Potassium (K) increases fruit production, fruit size, green fruit and peel thickness. Foliar spray of potassium nitrate or monopotassium phosphate in the spring often increases fruit size of tangerine and grapefruit, and fruit size and total pound solids of 'Valencia' orange. Foliar application (6 to 8 weeks before bloom) of low biuret urea can increase flowering and fruit set.

SUNLIGHT AND PRUNING

Even though citrus trees can tolerate shade and still flower and fruit, maximum flowering occurs when leaves are fully exposed to the sun. Therefore, pruning including topping and hedging to avoid crowding is extremely important for optimum flowering. The amount of fruit that is set has a very significant effect on fruit quality. There is a positive correlation between the number of fruit per tree and fruit quality. When the number of fruit per tree is low, the peel texture, shape of fruit, and often fruit color are poor. Quality of individual fruit varies significantly, even on the same tree. Inside heavily shaded fruit have less total soluble solid than outside exposed fruit. Insufficient light contributes to reduced total soluble solid concentration of inside fruit nourished by heavily shaded leaves.

Pruning is also an important factor affecting fruit production and quality. Crowded conditions result in poor light accessibility and reduction in fruit yield, size, and external quality. Therefore, good management dictates the need to prune before the occurrence of these undesirable effects.

It is well established that shoots with fruit do not flower the following year. A heavy fruit crop tends to deplete carbohydrates and results in a small crop and increased vegetative growth the following year. Pruning after a heavy crop additionally stimulates vegetative growth and reduces fruit yield the following year. Pruning after a light crop and before an expected heavy crop can increase fruit size and help reduce alternate bearing. Pruning or topping and hedging usually increase fruit size and packout of fresh-market fruit by reducing cropload, thus increasing net cash returns to growers.

PESTS AND DISEASES

The improvement in fruit quality that a grower can achieve through choice of rootstocks, irrigation/nutrition management, and other grove practices may easily be overwhelmed by pests, diseases, and other injuries. Excessive leaf loss will noticeably reduce flowering the following spring and fruit production. The primary causes of leaf loss are freeze and hurricane injury, salt and water stress problems including drought stress and flooding injuries, mites, greasy spot, herbicides and pesticide phytotoxicities. Excessive leaf loss in the fall and in early winter is the worst thing that can happen to citrus trees. It will reduce flowering, fruit set, and fruit yield.