

High and Low Budding of Citrus

malformation of bud union of citrus trees on Sampson tangelo, and Cleopatra mandarin stock seems related to budding height

W. P. Bitters, R. G. Platt, John A. Brusca, and N. W. Dukeshire

Malformed bud unions on young citrus trees—particularly lemons—budded upon Cleopatra mandarin and Sampson tangelo rootstocks vary in relation to the height of the budding. The reasons for the variations in bud union reaction with height of budding are not known but approximately 8" seems to be the critical height.

Cleopatra mandarin and Sampson tangelo produce extremely slow growing seedlings as compared to sweet orange. The Cleopatra seedlings are erect, sparsely branched and of slender caliper, while seedlings of the Sampson are stunted and much branched although of acceptable caliper. Lopping the seedling promotes a vigorous sucker-like growth more readily budded.

Because of the slow seedling growth, many nurserymen have difficulty in producing budded trees with these two stocks on a time schedule comparable to other common rootstocks, although both stocks push a strong bud once they are budded.

To offset this slow rate of growth, the budding is often done closer to the ground than would ordinarily be practiced on the more vigorous stocks. Trees on both Cleopatra mandarin and Sampson tangelo rootstocks may be somewhat slower in taking off in an orchard although eventually they make standard sized trees, or even larger trees than those on other rootstocks.

Initially, it was thought that because the young trees were budded to vigorous Lisbon lemons or nucellar Eurekas and pushed a strong bud, the bud union would smooth out in a year or two as the trees grew older. Such has not been the case and the malformation of the bud union area appears to become greater with time.

In old established rootstock trials the bud unions of navel oranges, Valencia oranges, Eureka lemons, Lisbon lemons, Marsh grapefruit, and other miscellaneous tops budded upon Cleopatra mandarin and Sampson tangelo have a

smooth union similar to that of similar scions budded on sweet orange or rough lemon. The mandarin stock is slightly ridged or fluted instead of being symmetrical and is of darker or grayer color than sweet or sour root. The Sampson tangelo stock makes a smooth union with all scion varieties, is usually slightly larger than the scion, somewhat in the fashion of certain grapefruit stocks, tends to flare slightly and is perfectly symmetrical.

These trees were intentionally budded high and planted high to observe the nature of the bud union. Most of the bud unions are 8"-10" above ground to facilitate calipering at half the distance between the bud union and the ground line to provide a cross-sectional area index for stock-size comparisons. Budding high not only has lessened the incidence of gum disease, but also has prevented malformation of typical unions by flaring of the crown roots.

Continued on next page

Bud unions of a 35 year old Lisbon on sweet orange stock budded low left and budded high right within the same orchard. Note the outbreak of shellbark on the lemon trunk of the low budded tree.



BUDDING

Continued from preceding page

A comparison of these old rootstock trees in the experimental orchard with the young trees observed in commercial orchards suggests that the greatest single difference between the two groups is the height above ground at which they are budded.

Further observations indicate that while the bud union malformation is greatest with lemons it may occur with other scions to a lesser degree and with other rootstocks, but to a lesser degree on sweet orange and sour orange. It is consistent and obvious that the higher the trees are budded—once a critical height is reached—the smoother the bud union and that the lower the trees are budded, the more malformed the bud union.

The malformation consists of the scion overgrowing the stock and in advanced stages translocation may be seriously interrupted by a compression effect. With some stocks, such as the Sampson tangelo, the overgrowth is not symmetrical since some points about the union appear to be stimulated to overgrow more than others. A knotty, gnarled, asymmetrical union results, with some of the overhang extended as much as 2" beyond the stock diameter. The swelling in advanced stages will extend 2"-4" above the actual bud union, lessening as it ascends the scion. When bark samples—for analytical purposes—were removed from the stock and scion of the trees budded high and low on Sampson tangelo stocks, stem pitting was found on the lemon trunk of the low budded trees but was not in evidence on the high budded trees.

In advanced stages the bark of the scion in the overgrowth area will rupture on trees only four or five years old, similar to the initial cracking and scaling effected by shellbark. These low bud unions with their ruptured bark will probably be more susceptible to gummosis than normal healthy unions.

This type of swelling was very noticeable on three- and four-year-old Allen nucellar Eureka budded on Sampson and Cleopatra as well as on the Frost nucellar Eureka budded on Cleopatra, U.C.L.A. nucellar Eureka on Sampson, Prior Lisbon on Cleopatra, Cook nucellar Eureka on Sampson, and other combinations of similar age. An examination of the bud unions of such trees and the assigning of a numerical value of 0 to a normal union and 3 to a severe overgrowth with intermediate grades, and measuring the height of the bud union from the ground indicates that approximately 8" is the critical height of budding for lemons with these two particular stocks. This assumes that the seedlings were lined out at an approximate uni-



Above—Typical bud unions of 30 year old Valencia orange trees on Sampson tangelo left and Cleopatra mandarin right. Note the slight overgrowth and flaring of the tangelo root and the slight ridging or fluting on the mandarin stock.

Below—Bud union of nucellar Eureka lemon on Sampson tangelo stock budded low left and budded high right within the same orchard.





Above—Bud unions of nucellar Eureka lemons on Cleopatra mandarin stock budded low left and budded high right within the same orchard.

Below—Tops of nucellar Eureka lemon on Sampson tangelo stock budded low left and budded high right within the same orchard. At seven years of age note that there is no difference in top appearance.



form depth in the nursery and also that they were planted out into the field at the same soil level height at which they were removed from the nursery.

A few trees budded below 8" had appreciably smooth unions and occasionally one budded over 8" had a noticeable swelling, but in general trees budded above 8" have relatively smooth unions. No obvious exceptions were observed above a 10"-12" height of budding. An adequate number of trees on stocks other than Cleopatra and Sampson have not been examined to determine a critical height, but the effect has been observed. Similar overgrowth with lemons has been observed on San Jacinto tangelo, Mency tangor, Orlando tangelo, Clement tangelo, Minneola tangelo, Seminole tangelo, Thornton tangelo, Marlow tangelo, and others. The overgrowth appears to be worse on stocks of tangerine and tangerine hybrids than on others observed. A similar type of bud union effect—with the stock overgrowing the scion—has been observed when English walnuts are budded low on black walnut stock; a smooth union is obtained when they are budded high.

On lemon trees budded on Cleopatra and Sampson up to eight years of age, in spite of the severe overgrowth on some combinations, there has been no visible effect on the top. Nevertheless, it appears likely that low budding will have adverse effects on the top. Observations made on some high-low buds of 35-year-old Lisbon lemons budded on sweet orange stock revealed that the high bud trees—approximately 30"—have a smooth union and are healthy, vigorous, productive trees. The low bud Lisbon trees are stunted, open, small leaves, slightly chlorotic, with small tree ripe fruits, deadwood, and lacking in general vigor and healthy new growth. Many of these trees have shellbark on the trunk, but there is little or no evidence of shellbark on the high buds. The undesirable effects of the low budding on the scion may thus be evident somewhere after eight and before 35 years of age.

It has long been recognized with lemons, that high budding has tended to delay and minimize the appearance and rate of spread of shellbark. A similar reaction is obtained when orange trees are top-worked to lemons and a sandwich, or interstock, is obtained. The reason for this is not known. Nucellar lines of lemons also postpone the occurrence of shellbark.

In stocks that tend to overgrow the scion there is also a similar type of effect with height of budding. The girth of the stock is reduced as the height of budding is increased. Such stocks include trifoliolate orange, Morton citrange, and Troyer citrange but this does not imply

Concluded on page 15

marked holes. This method reduced the planting time by 50%. However, a close follow-up irrigation—by furrow or sprinkler—is necessary to settle the plants.

A good crew is important in the use of the labor transport and once a crew has been trained the men should be kept to work together.

Bernarr J. Hall is Farm Advisor, San Diego County, University of California.

Robert G. Curley is Extension Agricultural Engineer, University of California, Davis.

John H. MacGillivray is Professor of Vegetable Crops, University of California, Davis.

Growers Tom Imaizumi, Valley Center, and Fred M. Yasukochi, San Luis Rey, constructed the equipment and cooperated in the study reported here.

BUDDING

Continued from page 7

that a perfectly smooth union would ultimately be obtained.

The critical height of budding with the various combinations of scions and stocks is unknown but—apparently—8" should be considered a bare minimum with lemons and probably a greater height would be safer and more advantageous.

W. P. Bitters is Associate Horticulturist, University of California, Riverside.

R. G. Platt is Specialist in Subtropical Horticulture, University of California, Riverside.

John A. Brusca is Principal Laboratory Technician in Horticulture, University of California, Riverside.

N. W. Dukeshire is Principal Laboratory Technician in Horticulture, University of California, Riverside.

The above progress report is based on Research Project No. 193C.

MARKETING

Continued from page 2

of supply could not be controlled by the state lemon products marketing order which had been introduced to regulate the flow and price of lemons used in processing. A situation developed wherein the lemon products marketing order was terminated as of September 30, 1957.

The effects of these developments were not limited to the lemon products, but spilled over into the fresh lemon market which has always been the mainstay of profitable earnings for California lemon growers. Canned lemon juice and frozen concentrated lemonade compete with fresh lemons. Studies indicate that, although the demand for fresh and processed lemons combined continues to increase, the growth is absorbed by the demand for lemon juice products while

the demand for fresh lemons is gradually decreasing.

However, California has the advantage of being able to ship fresh lemons of high quality throughout the year. A profitable outlook for the California lemon industry depends on the maintenance and expansion of the fresh lemon market. In this respect, the orange and lemon situations are the same; both are tied to the fresh-use markets.

Sidney Hoos is Professor of Agricultural Economics, University of California, Berkeley.

RAPID PACK

Continued from page 3

thus make it easier for the packer to pick up the front row. Front fruit is held in place by a thin strip of wood kept as low as possible, but high enough to prevent fruit from rolling over the edge.

The rollboard must be sufficiently deep so that fruit is free of the baffle and has time to settle into a single layer before reaching the edge.

The carton is seated on a board placed tight in front of, but below, the edge of the rollboard and should be tipped toward the packer enough so that the first row of fruit in it will stay in place.

The waxed slip board system for moving a packed carton to a conveyor used at Santa Paula appears to be very practical.

How much faster a packer can work with the rapid pack system has not yet been determined but studies are being made to determine the rate of pack that may be anticipated.

Roy J. Smith is Professor of Agricultural Economics, University of California, Los Angeles.

Haruo Najima is Assistant Specialist in Agricultural Economics, University of California, Los Angeles.

SLUDGES

Continued from page 13

tions sludges neither appreciably increase nor decrease the water or air content of a soil.

The value of sludges to the grower using containers lies in the fertilizer value. An increase in the air space of an artificial growing mix is easily provided by the incorporation of peat, wood shavings, fir bark or other similar materials.

To determine the feasibility of using sewage sludges in ornamental production, material from a new process in use at Redwood City was selected for trial because—primarily—of the excellent physical conditions of the product. In the Redwood City process, sewage is digested—by standard anaerobic methods

—in large closed tanks for 60–90 days before the sludge is pumped into drying basins spread with filtering layers of peat, sand, rice hulls, or wood shavings, either pine or redwood.

After a short period of drying, the basins are rototilled which results in aeration of the sludge and the creation of aerobic biological conditions. Sludge handled in such a manner is well aggregated, light and porous rather than a moist sticky mass. Subsequent new layers of anaerobic sludge can be pumped on top of the tilled material in the basins, and again rototilled two or three weeks later. After a final short period of rototilling and aeration the sludge is ready for use. Digested sludges processed in different ways usually have less desirable physical properties and may be fine and dusty and difficult to wet.

Greenhouse Trials

Sewage sludge—primarily based on peat and wood shavings—from the Redwood City processing plant was tried on chrysanthemums, roses, carnations, and camellias.

In a greenhouse trial with chrysanthemums peat based sludge was added to fine sand in 8" raised beds at the rate of one half by volume. The mixture was not steam sterilized. An excellent crop of chrysanthemums was grown—in 120 days from the planting of rooted cuttings to flower harvest—without additional fertilization.

The same experiment was tried on greenhouse roses with the exception that the mixture was steam sterilized after the sewage sludge was added. Subsequent growth of the roses indicated that some toxic effects resulted from the steaming. Other observations indicate that steam sterilization of sewage sludge mixtures may result in a hazardous risk of crop damage.

A mixture of 25% sludge—peat or wood shavings base—by volume has proven satisfactory with carnations grown in the greenhouse on raised beds. After-steaming toxicity was held in check by leaching with heavy application of irrigation water at planting. Additional fertilizers and amendments—single superphosphate at four pounds, one and one half pounds sulfate of potash, and 10 pounds of agricultural lime—were added per 100 square feet of planted area shortly before planting. No nitrogen fertilizer was added for a period of several months.

In other trials sludge has been used successfully on canned Meyer lemons, camellias, junipers, and daphne with 25% by volume sludge—either peat or wood shavings base—mixed with fine sand. No additional fertilizer was added

Concluded on next page