8, 10) who based their conclusions on field studies. We also showed a consistent but small effect of photoperiod on cold hardiness of peach fruit buds at the warm temp but not at the cold. Long photoperiod was associated with more bud injury than short photoperiod (Fig. 1).

Evidence for the over-riding effect of temp on photoperiod was obtained at the lower temp where the influence of photoperiod was apparently overcome or masked by a much greater acclimation response to temp. A similar response has been noted with apple (4).

The short day signal may have already been received by our plants before they were moved in Sept. from outdoors to the greenhouse since no further growth occurred. Acclimation did proceed in all material regardless of treatment and the warm temp (20°C or higher) and long photoperiod (18 hr) in the greenhouse did not over-ride or reverse it. Evidence for this was that lower freezing temp were required to produce comparable injury among plants in each successive group moved from the greenhouse to the growth chambers. Also, evidence was obtained that acclimation occurred in all plants in the growth chambers because colder freezing temp were generally required at 30 than at 20 days and at 20 than at 10 days to produce comparable injury. Similar responses were reported for apple (4).

Peaches appeared to follow the general acclimation pattern for woody plants (11). Short days promoted cold acclimation even at warm temp but low temp promoted substantially greater cold acclimation regardless of daylength.

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Scholander Pressure Bomb Technique to Assess the Relative Leaf Water Stress of 'Orlando' Tangelo Scion as Influenced by Various Citrus Rootstocks

T. E. Crocker, W. D. Bell[2], and J. F. Bartholic[3]
University of Florida, Gainesville

Abstract. **A modified Scholander pressure bomb was sensitive enough to detect significant differences in relative leaf water stress among 'Orlando' tangelo (*Citrus reticulata* Blanco × *C. paradisi* Mact.) on several rootstocks. Leaf water potential for the rootstocks ranged from –7.9 bars for rough lemon (*Citrus jambhiri* Lush.) to –13.7 bars for those on trifoliata orange (*Poncirus trifoliata* Raf.). There was a diurnal pattern in leaf water stress. Modifications and procedures for the pressure bomb measurements are described.**

The Scholander pressure bomb (6) is a modification of Dixon's technique (1) to measure leaf water potential. Earlier work demonstrated that the pressure bomb was useful in evaluating water stress of 'Washington' navel and 'Valencia' orange trees (4). This study was to determine whether Scholander's pressure bomb technique could distinguish between the water uptake capacities of 'Orlando' tangelo on different rootstocks. 'Orlando' tangelo was a convenient test subject which exhibits the normal range of visual water stress responses among citrus species and hybrids in Florida.

A slightly modified Scholander pressure bomb (6) was constructed and used in the experiments (Fig. 1). A mature leaf, not exposed directly to the sun, was excised from a nonbearing twig with a razor blade just prior to testing. The leaf petiole was placed in the rubber disk (Fig. 2). Set screws on the brass ring were tightened to compress the rubber disk to form a gas-tight seal. The top of the cylinder was then tightened onto the chamber before N_2 was introduced into the chamber through the intake valve E (Fig. 1). The operator used a magnifying lens to observe the first appearance of free liquid at the cut ends of the xylem tissue. Then, the pressure cylinder was shut off and the pressure reading was

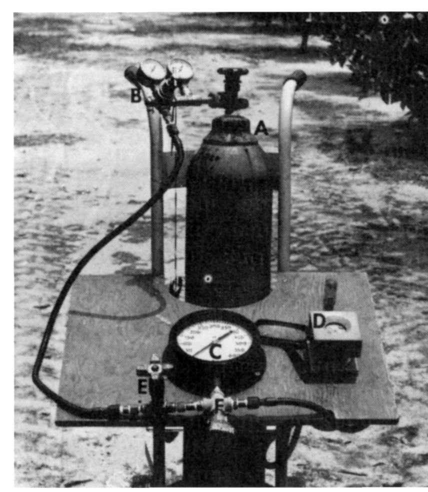

Fig. 1. Portable pressure bomb apparatus consisting of N_2 tank (A), pressure regulator (B), gauge to measure chamber pressure (C), chamber with leaf inserted (D), valve to pressurize chamber (E), and purge valve (F).

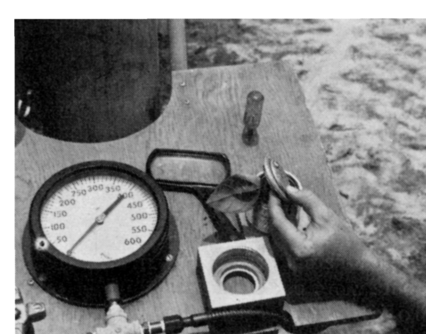

Fig. 2. Pressure bomb showing leaf inserted through cover of chamber.

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[2]Present address: Fairchild Tropical Gardens, Miami, Florida.

[3]Assistant Professor, Assistant in Fruit Crops, Associate Professor, respectively, Fruit Crops Department.

recorded. Pressure in the leaf chamber was exhausted through an outlet valve before the lid was removed to change leaves for another test.

Preliminary work in Oct., 1972 showed that differences could be observed in the pressure required to produce free liquid at ends of petiole xylem tissue among 'Orlando' tangelo leaves from trees on different rootstocks. It was determined that 4 leaves per tree was the minimum number that would yield reliable results. This number was selected because it provided an adequate representation of leaf water stress variability for the tree (2). Because of the 2–5 minutes required to sample each tree quadrant (2), the number of varieties was limited to 5 for each of the 2 locations.

Trees were located at the University of Florida Horticultural Unit (HU) and in a commercial orchard near Leesburg (LB). The former is situated on Kanapaha fine sand which has a water table that usually varies from 60 to 120 cm (2 to 4 ft). Pressure bomb readings at HU were taken during 1 hour periods between 12:00 and 2:00 PM, on May 7, 18, 19 and 23, 1973, with random samples taken from a different tree of each rootstock at each sampling date (Table 1). The orchard near Leesburg has Astatula fine sand which is underlain with clay loam at depths of 200 to 250 cm (6.6 to 8.3 ft) (3). This location is typical of commercial citrus areas in respect to soil conditions. Pressure bomb readings at LB were taken on 2 trees of each rootstock (1 tree of each rootstock during a 1 hr period) between 12:00 and 2:00 PM on April 25 and May 29 (Table 2).

Data in Tables 1 and 2 show that the pressure bomb was sensitive enough to detect significant differences between rootstocks for leaf water stress at both locations; however these differences were not visibly apparent. Results showed that leaf water stress fluctuated with date of sampling, however, the relationship between rootstocks remained relatively constant within each location.

For the HU location, 7 of the 10 possible contrasts between mean pressure bomb readings (converted to bars) indicated significant differences between rootstocks in leaf water stress. Greatest leaf water stress was observed for sour orange (*C. aurantium* L.) with a mean leaf water stress values of –12.03 bars, and lowest for Palestine sweet lime (*C. limettioides* (L.) Raf.) with a mean leaf water stress value of –7.88 bars. At the LB location 4 of 10 possible contrasts between mean pressure bomb readings (converted to bars) indicated significant differences between rootstocks in leaf water stress. Greatest leaf water stress was observed for trifoliate orange with a mean leaf water stress value of –13.67 bars, and lowest for rough lemon with a mean leaf water stress value of –7.87 bars. 'Orlando' tangelo trees at LB showed marked differences in tree size (5) and depth of rooting (3). Trees at HU were approximately the same size regardless of rootstock due to the presence of a high water table which limited root growth. The pressure bomb techniques made a greater number of significant discriminations at the HU location where readings were taken on 4different occasions as compared to 2 occasions at LB.

In a second study leaves from 'Orlando' tangelo trees at HU were tested at 2 hr intervals to observe diurnal changes in pressure readings for the same trees (Fig. 3). Leaf water stress increased until the sun reached the zenith and then decreased. Data for this curve were obtained on a day that became cloudy at noon, which would account for a faster than normal increase in water potential. The latter indicates that readings must be taken within a relatively short time to be comparable. A max period of 1 hr or less under clear sky conditions is suggested. Differences in leaf water potential for rootstocks could also be determined early in the day when very little stress was present.

The data suggest that the pressure

Table 1. Leaf water potential (bars) of 'Orlando' tangelo on different rootstocks at the Horticultural Unit, 1973.[z]

Rootstock	May 7	May 17	May 18	May 23	Mean
Palestine sweet lime	– 8.25	– 8.63	– 8.16	– 6.46	– 7.88a[y]
Rough lemon	– 8.21	– 8.12	– 9.10	– 6.58	– 8.00a
Trifoliate orange	–10.24	–10.20	–10.03	– 9.27	– 9.94b
Cleopatra[x]/ mandarin	–10.33	–12.71	–10.90	– 8.25	–10.55bc
Sour orange	–11.44	–13.31	–12.84	–10.54	–12.03c

[z]Each value is a mean of 4 readings.
[y]Mean separation by Duncan's multiple range test, 5% level.
[x]*Citrus reticulata* Blanco.

Table 2. Leaf water potential (bars) of Orlando tangelo on different rootstocks in a grove near Leesburg, 1973.[z]

Rootstock	April 25	May 29	Mean
Rough lemon	– 6.89	– 8.84	– 7.87a[y]
Palestine sweet lime	– 8.11	–10.09	– 9.10ab
Sour orange	– 7.91	–12.19	–10.05ab
Carrizo citrange[x]/	– 8.80	–13.48	–11.41bc
Trifoliate orange	–11.69	–15.65	–13.67c

[z]Each value is a mean of 2 trees with 4 readings on each tree.
[y]Mean separation by Duncan's multiple range test, 5% level.
[x]*Citrus sinensis* × *Poncirus trifoliata*.

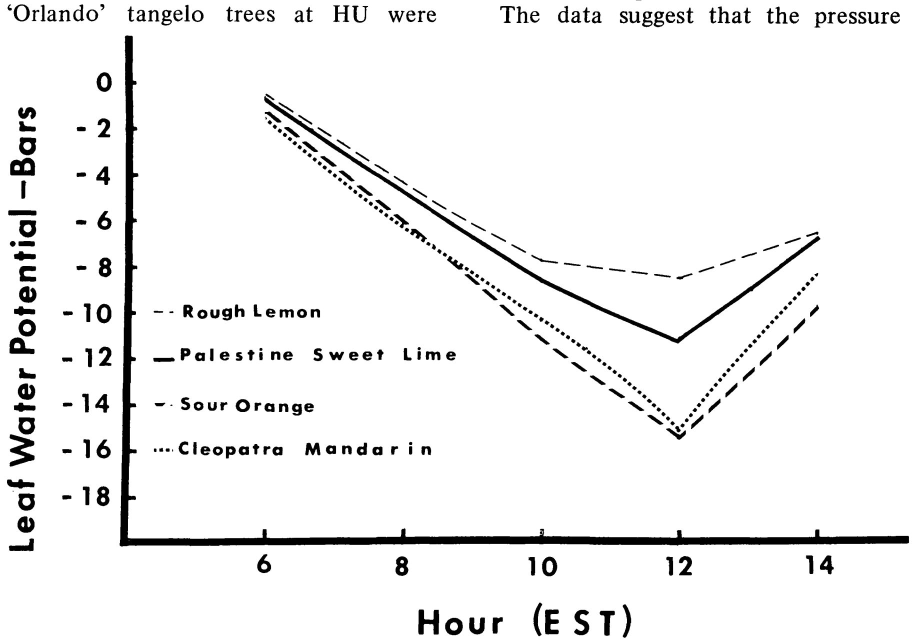

Fig. 3. Diurnal Study of leaf water potential on 'Orlando' tangelo at Horticultural Unit, July 18, 1973. Time is Eastern Standard.

bomb may be an effective means of evaluating the effect of rootstocks on scion leaf water stress. Differences in leaf water stress could be measured by this technique when it could not be detected by visual observations. Additional research is needed to establish the normal range of leaf water stress for different rootstock and scion combinations to aid in interpretation of leaf water stress values. Such information could be helpful in planning the timing of irrigation for citrus trees on certain rootstocks and in evaluating new rootstock selections. This technique does have limitations because of the time required to execute the measurements. This may limit sample size; but with experience and improved techniques the time required for these measurements can be reduced.

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Rootstocks Affect Postharvest Decay of Grapefruit[1]

Roy E. McDonald and Heinz K. Wutscher[2]
U.S. Department of Agriculture, Weslaco, Texas

Abstract. **Rootstocks affected decay of grapefruit (*Citrus paradisi* Macf. cv. Redbush) stored for 9 weeks at 10°C plus 1 week at 21°. Fruit from trees on 'Smooth Seville' (Australian sour orange) was least susceptible to decay, 3.3%. Fruit from trees on the hybrid C61-253 ('Shekwasha' × 'Chinotto') was the most susceptible, 27.7%. Postharvest decay was statistically related to rootstocks but not to standard fruit quality characteristics.**

Little research has been reported on the effect of rootstocks on susceptibility to postharvest decay of grapefruit. Rootstock research has been primarily concerned with yield, effects on physical characteristics, chemical composition of the fruit, and tolerance to *Phytophthora,* tristeza and other virus diseases. However, selection of a good rootstock should not only be based on production of large amounts of good quality fruit; but also the shelf-life of the fruit should be taken into account.

Decay of citrus fruit in market channels is extensive. This experiment was designed to determine differences in susceptibility of grapefruit to postharvest decay over a 3-year period among fruit from trees on 21 rootstock cultivars.

Preharvest. Nucellar 'Redblush' grapefruit was harvested in Jan. or Feb. from trees on 21 rootstocks (Table 1) in 4 rootstock trials in 1971, 1972 and 1973. Three replications consisting of 40-fruit samples each were used for postharvest decay studies. Two 80-fruit samples were also collected from trees on each rootstock for fruit quality analyses by standard methods. Each sample was harvested from 2 trees.

Trees were 6 to 10 years old at the beginning of the experiment and received normal grove care, including 4 to 6 flood irrigations and 3 insecticide sprays a year. No fungicides were used. Spring applications of 504 kg of ammonium nitrate (NH_4NO_3) per ha (450 lb./acre) were made. Four trial plantings were located within a 2.4 km (1½ mile) radius on the same farm at Monte Alto, Texas, on bench-levelled Willacy fine sandy loam.

Postharvest. Fruit samples used for the postharvest decay studies were carefully graded for mechanical injury, washed, waxed with a non-fungicidal water-emulsion wax, and dried the day after harvest as in a standard packinghouse operation. The fruit was packed in (4/5 bu) corrugated fiberboard citrus cartons and stored at 10°C for 8 weeks at 95% relative humidity and 1 week at 21°C. Fruit was inspected after 2, 4, 6, 8 and 9 weeks for decay from various pathogens; spoiled fruit was removed as found. Data for fruit quality characteristics, i.e. fruit circumference, rind thickness, soluble solids, total acids and percentage decay were examined for possible simple correlation with susceptibility to decay.

There were large differences in postharvest decay among fruit from trees on 21 rootstock cultivars (Table 1). Approx 80% of the decay was green mold (*Penicillium digitatum* Sacc) and the remainder was diplodia stem-end rot (*Diplodia natalensis* Pole-Evans).

Postharvest decay of fruit from trees on 'Smooth Seville' rootstock was the lowest among the 21 rootstocks in the present experiment. This high resistance to decay combined with tolerance to *Phytophthora* spp. indicate that 'Smooth Seville' should be tested

Table 1. Postharvest decay of nucellar 'Red-bush' grapefruit on 21 rootstocks after 9 weeks at 10°C plus 1 week at 21°.

Rootstocks	% decay[z]
Smooth Seville (Australian Sour orange) (*Citrus aurantium* L.?)	3.3 h
Colombian sweet lime (*C. limettoides* Tan.)	4.0 gh
Macrophylla lemon (*C. macrophylla* Wester)	5.5 fgh
Rough lemon (*C. limon* (L.) Burm. f.)	5.7 fgh
Swingle citrumelo (C.P.B. 4475)[y]	8.6 efgh
Texas sour orange (*C. aurantium* L.)	10.5 defgh
Carrizo citrange[y]	11.0 defg
Rich trifoliate orange (*Poncirus trifoliata* Raf.)	11.6 defg
Bittersweet sour orange (*C. aurantium* L.)	12.1 cdefg
Rangpur lime (*C. reticulata* var. *austera* hyb.)	14.1 bcdef
Kunenbo[y]	14.3 bcdef
Sunki mandarin (*C. reticulata* Blanco)	15.2 abcde
Texas sour orange (*C. aurantium* L.)	15.6 abcde
Abers sour orange (*C. aurantium* L.)	16.4 abcde
Taiwanica orange (*C. taiwanica* Tan. & Shim.)	16.9 abcde
Sun Chu Sha Kat mandarin (*C. reticulata* Blanco)	17.9 abcde
Cleopatra mandarin (*C. reticulata* Blanco)	19.9 abcd
C61-241 (Shekwasha × Rough lemon)[y]	21.9 abcd
C61-250 (Shekwasha × Koethen)[y]	24.8 abc
Changsha mandarin (*C. reticulata* Blanco)	25.3 ab
Morton citrange[y]	26.5 ab
C61-253 (Shekwasha × Chinotto)[y]	27.7 a

[z]Avg. of three 40-fruit samples per rootstock at 3 harvests. Means separation between rootstocks by Duncan's multiple range test, 5% level.

[y]Hybrids:
- Swingle citrumelo (C.P.B. 4475) (*Poncirus trifoliata* Ref. × *C. paradisi* Macf.)
- Carrizo citrange [(*P. trifoliata* × *C. sinensis* (L.) Osbeck)]
- Kunenbo (*C. sinensis* × *C. reticulata* Blanco)
- C61-241 [Shekwasha *(C. reticulata)* × Rough lemon (*C. limon* L. Burm. f.)]
- C61-250 Shekwasha [(*C. reticulata*) × Koethan Sweet orange (*C. sinensis*)]
- Morton citrange (*P. trifoliata* × *C. sinensis*)
- C61-253 Shekwasha [(*C. reticulata*) × Chinotto (*C. aurantium* (L.) var *myrtifolia* Ker-Gawl.)]

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[2]Research Horticulturists, U.S. Department of Agriculture, Agricultural Research Service, Southern Region, Subtropical Texas Area.