POSTHARVEST RESPONSE OF LEMON FRUIT TO HOT WATER IMMERSION, QUARANTINE COLD OR METHYL BROMIDE FUMIGATION TREATMENTS DEPENDS ON PREHARVEST GROWING TEMPERATURE

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For several years we have treated lemons and grapefruit grown in different production areas (San Joaquin Valley, Coastal and Desert) and harvested at different seasons (summer, autumn, winter, spring) of the year with heat, cold, or methyl bromide (MB) fumigation insect quarantine treatments. Fruit often markedly varied in their susceptibility or tolerance to injury that is often caused by these postharvest stress treatments.

In those tests fruit response variability may have been because: (1) the fruit were grown in different geographic growing areas and consequently were harvested at different times of the year; (2) there were cultural variations (fertilization, irrigation, rootstocks, pesticide applications, etc.) between the geographic areas; and (3) there were large temperature differences between the production areas and among times of the year when the fruit are harvested. There is a need to determine what causes this variable injury response in order that postharvest insecticidal quarantine treatments may be fairly evaluated for commercial use.

In our present tests, to determine whether temperature is a factor, Eureka and Lisbon lemon trees obtained from a commercial nursery were grown outdoors at Fresno in 5-gallon containers, all on drip irrigation, using uniform fertilizer, preharvest insect control treatments and pruning procedures. Plants were exposed to the same climatic factors, e.g., temperature, light exposure, rain, etc. Therefore, all trees had a uniform background. In September approximately 50-60 trees were moved from their hot outdoor summer environment and placed in three greenhouses, 15-20 trees per greenhouse. Initially all three greenhouses were maintained at the same temperature, to continue exposure to the hot summer conditions. In late October the weather had cooled enough so that it was possible to cool the greenhouses to simulate some representative coastal and valley temperatures during the times when fruit are harvested. At that time one greenhouse (the "cool" greenhouse, roughly simulating some coastal and valley winter conditions) was set to 5-10°C night and a day maximum of 200. A second greenhouse (the "warm" greenhouse, simulating summer coastal conditions and desert winter

conditions) was set at 18-22° night and up to 30-33° days. The third greenhouse (the "hot" greenhouse, simulating late summer and early autumn desert conditions) was set at 25-30° night minimums and 35-40° day maximums.

Representative fruit were harvested after 1, 2 or 4 weeks exposure in these cool, warm, or hot greenhouses. After harvest, fruit were held at 20° overnight (approximately 18 hours) then samples were handled in the following manner: (1) not treated; (2) immersed in hot water (HWI) (55°C/5 min., a dose previously found to usually injure lemons); (3) given a fruit fly quarantine cold treatment (CT) (1±0.5°/3 weeks); or (4) fumigated with MB (60 gm MB/m^3/2 hr at 21°, a dose that exceeds fruit fly quarantine requirements but that had more chance of injuring fruit and therefore providing more information of value than would the quarantine dose which usually does not injure fruit). The lemons from all treatments were then stored 4 weeks at 10° to roughly simulate shipping and marketing conditions. Injury caused by the treatments developed during that 4-week period. Fruit were inspected for any peel injury symptoms that could have been caused by the postharvest stress treatments.

HWI caused more peel injury to fruit from the cool greenhouse (82%) than from the hot greenhouse (32% injury) The incidence and severity of injuries increased with time fruit were held in the cooler greenhouse. CT caused more peel injury in fruit from the hot (94%) greenhouse than from the warm (48%) or cool (16%) greenhouses. Variation to MB injury was not as dramatic, but was least in fruit from the cool and warm greenhouses (2-3%) and most from the hot greenhouse (14%). MB injury increased only slightly with time fruit were held in greenhouses at different temperatures.

These and other tests show clearly that preharvest environment definitely affects fruit postharvest response to stress (cold, heat and fumigation) treatments. Fruit preconditioned on the tree at cool temperatures (coastal and valley conditions) are, after harvest, tolerant to cold treatments and susceptible to injury by heat treatment. Fruit conditioned on trees at hot temperatures (summer-early autumn desert conditions) are tolerant to heat treatment and susceptible to cold treatment injury.