COMMODITY INDEPENDENT BEAT TREATMENT PARAMETERS FOR DISINFESTAITON FROM *ANASTREPHA FRUIT* FLIES

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Quarantine treatments of fresh commodities normally require that the commodity be treated in such a manner to kill infesting pests while maintaining commodity quality. Methodology for estimating treatment efficacy with respect to pest mortality is usually well defined in quarantine treatment and there is some variability in the required level *of* efficacy. For example, in some systems approaches to quarantine security, such as methyl bromide fumigation *of* Mexican citrus against *Anastrepha ludens,* treatments are used that have less than probit 9 (95% confidence of 99.9968%) mortality while in others, such as hot water treatment *of* mangoes against *Anastrepha spp.* were demonstrated to meet the probit 9 standard. We feel that the requirement for documenting commodity quality should be an integral part of quarantine development research and that responsible researchers should document the commodity quality as part *of* the treatment development. An approach that defines treatment parameters with respect to commodity tolerance can be integrated with dose-mortality response *of* the pest to devise treatments that optimize commodity quality pest mortality efficacy.

Heat treatments can be viewed as consisting *of* a heating phase, *of* the period *of* time for the commodity to reach a set temperature, and a holding phase during which the commodity is held at the set temperature. There is a trade-off between treatment temperature and holding time with lower temperatures requiring longer holding times. Recently approved treatments for grapefruit, navel and Valencia oranges, and tangerines require heating the fruit a to set center temperature of approximately 45°C. This target internal temperature was mostly based on fruit tolerance tests of the commodity. Total treatment time was estimated from a number *of* dose-response models such as probit, logit, and cloglog and weighting techniques. The treatment times were then confirmed by killing the necessary number *of* pests to achieve 95% confidence that the mortality was at least 99.9968%.

When we examined heating profiles of the 3 species of citrus fruit (Figure 1) during exposure to hot forced air, it was clear that the heating times were variable among the fruit species and that smaller fruit heated more rapidly. As presented in Table 1, when the heating period (time from start *of* treatment until a target center temperature was reached) for each fruit species was subtracted from the total treatment time, the holding time was relatively constant for all 3 species. In the case *of A. ludens,* we found that a holding time corresponding to about 100 minutes after the fruit center reached 45°C resulted in at least 99.9968% mortality.

Based on this analysis, we propose that commodity independent heat treatment parameters be estimated by delineating heating time and holding time. The method for reaching the temperature set point (for *Anastrepha spp.* we propose that this be 45°C) we propose to be based on commodity tolerance and the type *of* treatment equipment used. Although the discussion here focuses on use of hot forced air as the treatment medium, we also recommend

that this approach be applied to hot water and vapor heat treatments. The capacity of the equipment to heat the commodity load evenly will be a major factor in time required to reach the set point. The holding time may be slightly variable among commodities because in larger fruit (such as grapefruit) there may be some pest mortality if a relatively long period is required for the fruit to heat from 43 to 45°C. The major feature of this approach is that the holding period is related to mortality and is independent of the heating phase. The estimated holding time of 100 minutes at 45°C is a conservative treatment and for *A. ludens* and a good estimate for other *Anastrepha spp.* since *A. ludens, A. obliqua, A. serpentina,* and *A. suspensa* appear to have very similar heat tolerances

Figure 1. Heating profiles for 3 citrus species treated with hot forced air at 46°C (grapefruit and oranges) or 45°C(tangerines).

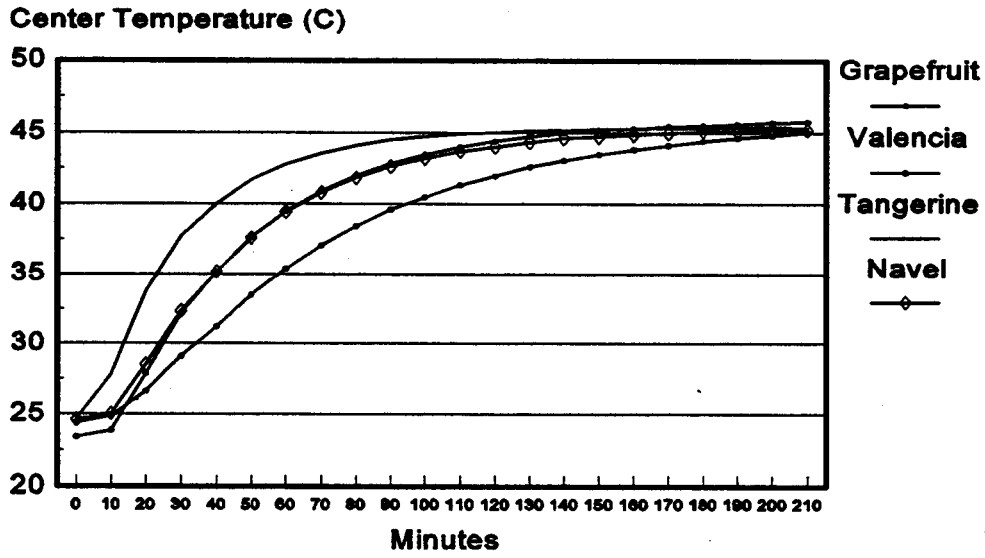

Table 1. Treatment times for 3 citrus species at non-damaging temperature-time treatment combinations that achieved probit 9 mortality levels.

Fruit	Air Temperature	Total Treatment Time	Heating Phase	Holding Phase	Tolerance Temp. time
Grapefruit	46°C	300	200	100	>48°C (unknown)
Orange	46°C	250	150	100	47°C 180 min
Tangerine	45°C	210	110	100	46°C 180 min.