

Mechanical harvesting of citrus fruits for fresh market with a trunk shaker and a hand-held petrol shaker

A. Torregrosa, C. Ortiz, B. Martin, R. Moreno, E. Moltó, P. Chueca

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Abstract

Harvesting is one of the more expensive tasks in a Spanish citrus crop because it is done manually. Spanish researchers are investigating the possibilities of mechanical harvesting of citrus cultivated under Spanish conditions. This paper compares two different strategies for mechanical harvesting: the use of a trunk shaker and the use of a hand-held petrol shaker. Tests were performed in lemon, orange and mandarin groves. Tree spacing was 6-7 m between rows and 2.5-4.5 m in the row. Trees were 2.5-3 m height and had a 0.35-0.70 m branch-free trunk. The harvesting equipment was (a) an inertial tree trunk shaker that produced displacements of 2-3 cm and frequencies of 10-25 Hz and (b) a hand-held shaker with a stroke of 6 cm and a variable frequency between 10 and 25 Hz. Fruit fell on canvases with different shock-absorbing materials. The overall trunk shaker fruit detachment capacity was 70%. Fruit detachment was influenced more by tree architecture than by fruit attachment force. Trees with a favorable branch disposition allowed fruit detachment percentages up to 90%. The hand-held shaker had higher fruit removal efficiency on shaken branches (76%) but a lower efficiency on the whole tree (63%) because of its low efficiency in transmitting vibration to thin and willowy branches. Since fruit are for the fresh market, two quality parameters were evaluated: a) fruit detachment point and b) fruit damage. The majority of the fruit was detached with calyx or with peduncle attached, which means that fruit was good for the fresh market. Fruit susceptibility to damage mainly depended on the variety.