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Effect of Wounding on 'Fuerte' Avocado Ripening[1]

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Abstract. **Wounded mature 'Fuerte' fruit *(Persea americana* Mill.) ripened faster than non-wounded fruit when stored at 14°C. Significant differences were not observed in respiration or ethylene production between wounded and non-wounded fruit when stored at 20° but the former softened faster and showed greater polygalacturonase activity. Wounded and non-wounded fruit ripened at similar rates when stored after wounding for 10 days at 5° and thereafter transferred to either 14° or 20°. No "wound ethylene" could be detected immediately after wounding at any temperature and is not the earliest event occurring during ripening. Effects of wounding in metabolic processes of ripening are observed better at a moderate continuous storage temperature of 14° than at 20°.**

It is well known wounding in various fruit enhances physiological processes which lead to faster ripening and decay (3, 4, 10, 11). It has been suggested (3) the response of fruit to wounding is complex, apparently differing among cultivars and even in an individual fruit depending upon the extent of the wound or the conditions under which it was inflicted. More recently, it was reported that removal of a pulp plug from avocado fruit and covering of the wound immediately with lanolin did not affect the general pattern of respiration and ethylene production during ripening (1).

Avocado harvesting is an expensive and difficult operation, leading people to try cheaper and faster ways of harvesting fruit. Tree-shaken harvest has been attempted (7) and effects of snap-harvest of avocado upon ripening and weight loss have been studied (5). Some of the fruit are wounded in the above-mentioned operations and during packing and transportation; therefore, it was of interest to study the effects of wounding upon the ripening processes and shelf life of avocado fruit.

Mature 'Fuerte' avocado fruit were harvested when they contained 15% oil, held for one day at 14° or 20°C and 85 to 90% relative humidity, then wounded by excising 1 cm^3 of

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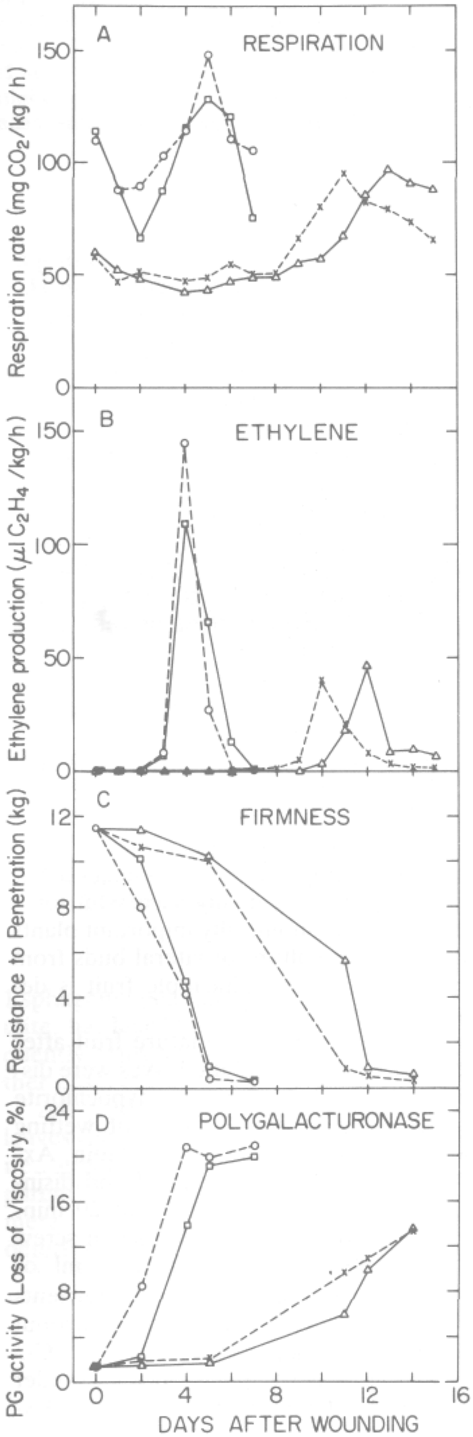

Fig. 1. The effect of wounding of avocado fruit on respiration rate (A), ethylene production (B), softening (C) and polygalacturonase activity (D), during storage at 14° and 20°C. Respiration and ethylene were measured in the same fruit; softening and polygalacturonase activity are averages of 6 determinations. Intact fruit at 20° —□—; Wounded fruit at 20° — —o— —; Intact fruit at 14° —△—; Wounded fruit at 14°— —x— —;

tissue including the peel and pulp at the widest part of the fruit.

Five fruit from each treatment were tested daily, each in a 2-liter jar for exactly 1 hr; 10 ml of gas from the head space was then sampled with a syringe for ethylene and CO_2 determination by gas chromatography (6). The limit of detection was 20 ppb ethylene/ml.

Firmness was determined without removing the peel, with a mechanized Chatillon pressure tester using a conical tip 34.6mm in diameter (12). The beginning of softening could be sensed by hand when the resistance to penetration was about 3.5 kg. Three fruit per treatment were tested at each determination, each at 2 points, then sampled for polygalacturonase (PG) activity. The latter was determined as described previously (13); 50 g fruit pulp was ground, 1 part tissue and 3 parts 1 M NaCl, in an Osterizer blender for 3 min. The filtered extract was incubated for 30 min with 1% aqueous solution of citrus pectin (Yakin, Israel) at a ratio of 1:10, at pH 5.0 and 30°C. PG activity was expressed as percent loss of viscosity using an Ostwald Viscometer (Volac No. 150). Similar studies were carried out during 3 consecutive harvest seasons, however in this communication representative data of only 1 season of studies are presented.

Wounding avocado fruit accelerated their ripening, this effect being more clearly observed at 14° then at 20°C. Respiration rates and ethylene production were similar in both wounded and non-wounded fruit at 20°. Peak respiration rate on the 5th day and that of ethylene production on the 4th day after wounding (Fig. 1A & B). Rates and levels of CO_2 and ethylene production were lower at 14° and their peaks in wounded fruit preceded those in non-wounded fruit by 2 days. The ethylene peak in sound fruit occurred on the 12th day after wounding and that of respiration on the 13th day; whereas the respective peaks were observed in wounded fruit on the 10th and 11th days (Fig. 1A & B). Awad and Young (1) recently showed that the general pattern on avocado ripening processes was not altered by wounding. No increase in ethylene evolution was observed either immediately after wounding or 2, 6, and 24 hr later at either temperature (Fig. 1B). It is in contrast to reports about "wound ethylene" produced by other fruits (8, 9). The fact that no "wound ethylene" could be observed after wounding is in line with the suggestion that ethylene may not be the initiator of natural ripening but rather a product of ripening processes (2). It seems possible that, in wounded avocado fruit, the hydrolytic enzymes are activated or released directly by the act of cell breaking (wounding) or are indirectly activated by some agents other than ethylene.

Softening was accelerated by and PG activity increased following wounding (Fig. 1C & D). A difference could be observed only on the 11th day at 14°C, but it was obvious already by the 2nd day after wounding at 20°. Final PG activity in sound and wounded fruit reached similar levels at both temperatures similar to what was reported by Awad and Young (1); however the final level of PG activity was lower at 14° (Fig. 1D). There were no differences between sound and wounded fruit in softening rates when fruit were stored at 5° for 10 days (9.5 Kg resistance to penetration) before being transferred to either 14° or 20°. However, fruit, both sound and wounded, become soft (0.5 kg) 7 days after it was transferred to 14° and after only 4 days at 20° (0.4 kg). Wounding the fruit did not cause any decay development during softening under our conditions.

It appears that when ripening processes are accelerated by storage at a temperature such as 20°C small differences cannot be observed; however, by slowing these processes at 14° the relatively small differences become more obvious as the time scale of ripening is stretched out.

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