BRUISING AND ITS CONTROL

Bruising or physical damage to the apple causes unnecessary losses to the grower. With good management, this can be almost totally controlled.

DEFINITION OF BRUISING

Bruising is an injury to the apple and is a function of the shock loading on the apple – either static (pressure) or the forward or downward speed (velocity) when the apple comes in contact with another fruit or surface, which causes it to expend its kinetic energy.

Bruising is a function of many variables.

1. Some years are more bruise-prone than others.

2. The more mature the apple the more bruise-prone it become, i.e. the softer the apple, the larger the bruise caused by the same shock loading.

3. Soil moisture can influence the severity of the damage. Apples picked after rain or with soil moisture at full capacity, will bruise far more easily than fruit picked on a falling moisture regime.

4. Apples picked in the early morning bruise more easily than those picked after they have warmed up during the day.

WHERE AND WHEN DO APPLES BRUISE

Apples can be damaged throughout the handling chain, from the tree to the time when the consumer eats it, all of which causes loss of value to the product.

(P) denotes pressure bruising.
(V) denotes velocity bruising.

At harvest or picking time

1. The picker holds two or more apples in his hand. (P)

2. The picker drops the fruit through the tree, hitting another apple on the way down. (V)

3. The picker drops the fruit into his picking bag or basket. (V)

4. The picker overfills the picking bag. (P)

5. The picker lengthens the string of the picking bag for more volume and less walking and the fruit bumps against his knees when walking. (V)

6. The picker bumps his bag against the ladder (V) or squeezes the bag between his body and the ladder. (P)

7. The picker empties his bag roughly into the bin. (V)

8. The bin sorter bruises fruit through rough handling when looking for defective fruit in the bin. (V)

9. Caution must be exercised when changing from one variety to another. Pickers tend to handle Packham's Triumph and red apple varieties faster and more roughly, and when changing to Golden Delicious, continue in this manner with disastrous results. (V)

10. A tired picker will bruise fruit more often and severely than one who is rested and fit.

<u>Transport to the Packing shed</u>

1. Defective bins cause bruising. (P)

2. Badly graded roads or holes or bumps in orchard cause bruising (P & V), especially if the picking trailers are not sprung.

3. Tractor drivers, who drive too fast, can cause severe damage when traveling over bumps. Damage can also occur with bin sway, if more than one trailer is being towed, especially to the last bin on the second last or last trailer. (V)

4. If the bin on the ground system is used, overfilled bins can cause severe bruising to apples when the second bin is placed on top of the first. The centre bearer presses down on the top of the fruit, causing bruising to occur right through the bin to the bottom. With the trailer system en route to the packing shed, the overfilled bins normally vibrate down to the top plank.

<u>The Forklift</u>

1. The forklift operator can cause severe bruising if he lowers the bin too fast. And the bin comes to a halt with a bump. (V)

2. By bumping the bin from the side or misdirecting his fork. (V)

3. Here again, defective bins can cause severe bruising to the fruit, especially if the bottom of the bin moves relative to the sides when the forklift lifts the bin or puts it down. It is thus far preferable to have bins with centre bearers that

are halved (to prevent pressure bruising on overfilled bins) and the bottom side plank is firmly connected to the bearer with a strap to prevent relative movement.

4. A bin that bulges sideways, as with a plywood bin, can cause severe bruising, especially when hit from the side by a forklift. (P & V)

Down the packing line

1. Dry dumping at too great a speed. (V)

2. Invert dumping in water when opening the lid too early, i.e. above the water before the inverted bin has been lowered into the water. (V)

3. All drops down the line must be well padded. Make sure the padding deadens the impact rather than making the fruit bounce and hit the next fruit. Curtains are also essential to each drop to slow down the forward movement of the fruit. (V)

4. Fruit must drop free from the rollers onto the drop board; otherwise fruit can be pinched while it is still on the roller between the drop board and the roller. Place the drop board just below the centre line of the shaft driving the roller. (V)

5. Sorters can bruise fruit through rough handling and by throwing fruit onto the belt above. (V)

6. The sizing machine should be well curtained and padded to prevent apples bumping against each other as they are dropped onto the belt below, especially when the sizer is moving fast (+ 250 Bars per minute). (V)

7. Overfilled packing tables can cause severe bruising (P & V). Ensure that tables only have a single layer of fruit, especially with Granny Smith and Golden Delicious.

8. The bin filler operator can cause severe bruising with incorrect control and feed into the bin, both wet and dry. Again, watch for overfilled bins. (V)

9. A rough packer who packs too fast can cause severe damage, which is very difficult to pin-point, by misplacing the apple on the edge of the cup of the pulp tray or hitting another apple in the box. Monitor all packers once or twice per week. (V)

10. Some pulp trays can be more rigid than others, especially if the moisture content in the pulp is incorrect. Pulp trays put into cold stores without their plastic wrap will absorb some moisture and soften. (P)

11. If the strapping machine is incorrectly set, this can cause bruising throughout the carton, but especially through the top layer. (P)

12. A jiffy pad instead on an inverted pulp tray on the top layer gives more protection to the fruit. (P)

13. Uneven sizing will cause uneven loading on the larger apples and severe bruising can occur. (P)

14. Apple trays placed incorrectly in the carton, i.e. back to front, will cause uneven loading and severe bruising. (P)

15. Pallet stackers can, by throwing the carton onto the pallet stack, cause shock loading and bruising within the carton. (V)

16. Pallet stacking in the cold store without pallet support can cause uneven loading and collapse of cartons, thus causing pressure bruising. (P)

17. Forklift drivers must again be taught how to handle the palletised load of cartons correctly, otherwise sideways or top-to-bottom bruising will occur. (V)

18. Bagging of apples can cause severe bruising, especially if done automatically by machine as in the U.S.A. Even our place pack thrift bag produces more bruised fruit than the carton pack, if incorrectly handling. (V)

19. Walking on top of the cartons in recooling tunnels in cold stores and when pulling the sail over the load on the transport vehicle is not recommended.

This then deals with the bruising damage that can be controlled and monitored by the producer.

Bruising and damage can still occur all along the transport chain to the consumer. This must be very carefully monitored by those responsible for moving the fruit from the pack-house and cold store to market and through to the consumer.

HOW DOES ONE PREVENT OR CONTROL BRUISING

1. A good quality control or monitoring system, from picking through transport and the pack-house, is essential to prevent damage before it occurs or to halt it if any sign of bruising appears.

2. Know your fruit, the stage of maturity and whether the fruit is or has become more bruise-prone.

3. Make sure the quality controller is properly trained and knows what he or she must look for.

4. Sample fruit from various places in the picking line at least twice weekly and leave for 24 hours and then examine for bruising damage.

5. A better method is to stop the packing line full of fruit at closing time and examine the fruit the next morning, two hours before packing commences. The increase in the incidence of bruising will show up very clearly.

6. Work in conjunction with your inspector as a team. He too, can assist greatly in preventing damage before if has gone too far.

7. Do not allow anyone to walk on top of pallet stack, whether in the cold store or on the transport vehicle.

8. Use pallet support systems when stacking more than one high in the cold store.

9. With taste and flavour becoming more important as a quality parameter, bruising will occur more easily as the apple softens and becomes more tree ripened, and the apple will therefore have to be handled more gently.

10. There are a number of different types of electronic apples available throughout the world. This is another tool by which to select the best machine to handle fruit or to pin-point places where damage is occurring on existing machinery.

<u>Wilting or the removal of excess moisture from the fruit to make the apple less turgid, using the techniques of air management and lower relative humidity in our cold stores down at -0.5˚C</u>

1. Do not attempt to wilt at ambient temperature as this can cause severe stress on the fruit which will break the cell wall, causing man-made bitter pit to appear.

2. When removing excess moisture from the fruit in the cold store, it is essential that the air passes over and through the fruit in the bins and not around the bins, short-circuiting back to the cooler and the fans.

   Air takes the route of least resistance and must be forced through the bins either with mobile fans, using curtains or making sure that the whole back wall of the false ceiling cold store is filled, so that the air must pass through the bins. Air is the vehicle by which moisture is moved from the fruit onto the coils in the cold store.

3. To be able to wilt in a cold store, it is essential that the relative humidity in the cold store is lowered to between 70% and 75%. This can only be done with large temperature differences (T.D.) between the coolant (the Freon or ammonia in the coils) and the air passing through coils.

4. With our modern cold store design to run at a high relative humidity of between 90% and 95%, with a large surface area of cooling coils, it is only during pull-down that one gets a large T.D. As soon as the fruit comes down to temperature, the back pressure regulator closes, the T.D. drops to 1 - 2˚C and the relative humidity rises from 90% to 95%. Very little, if any, moisture will be removed from the fruit at these high relative humidities, even if the air is passing through the fruit.

   This will become self-evident as to the number of times one has to defrost or clean the coils. With lower relative humidities, one would have to defrost 2 or 3 times per day, but with high relative humidity in the store, the defrost periods can stretch to as much as once per week. Moisture which appears on the coils can only come from one source and that is the fruit.

5. There are two recognised methods by which one can lower the relative humidity in modern RA cold store:

(a) <u>The on/off method</u>

Override the back-pressure regulator control system with the low temperature thermostat, causing the back pressure regulator to close completely when the temperature in the store drops too low; opening again when more cooling is called for. By this method, one can at all times maintain a large T.D. while the back pressure regulator is open, and very satisfactory moisture deposit will be placed on the coils.
Due to there being a 1 or 2 degree temperature difference between the on and the off period, the fruit in the store will tend to be 0,5 - 1˚C higher than it should be at -0,5˚C.

(b) <u>Making the cooler surface area smaller</u>

Close off the valves to one or two cooler blocks, starving them of coolant, and blank them off to prevent the air flow through these coils, using some polythene sheeting as soon as the back pressure regulator starts to close with too low a temperature in the air off the coils. This will keep the back pressure regulator wide open all the time, with resultant lower relative humidity in the store.

By opening the doors of the cold store, or loading more fruit and inducing some heat into the cold store, one will also keep the back pressure regulator wide open with a large temperature difference between coolant and air. This

will lower the relative humidity quite considerably and thus bring about a loss of moisture from the fruit itself.

6. An immature fruit wilts far more than a mature fruit. Therefore, a Golden Delicious picked in the early part of the picking window (weeks 8 and 9) must be under conditions of low relative humidity in a cold store for one week prior to being packed. Fruit picked in the middle of the picking window (week 10) requires wilting for 10 days. Fruit picked towards the end of the picking window (weeks 11 and 12) requires wilting for fourteen days, with air at all times moving through the fruit.
7. An apple wilted for too short a period of time, will only lose moisture immediately under the skin. This moisture will be re-absorbed as soon as the fruit is put into water and will again bruise as easily as if it was never wilted. The moisture loss should occur right through the fruit.

SOME DO'S AND DON'TS IN THE PRECOOLING AND RECOOLING OF FRUIT IN COLD STORES

1. Air management is as important as temperature management in the process of cooling fruit both in cartons and in bins.

(a) ± 0,4m^3/second of air per pallet of fruit to be cooled is required as a ball park figure.

(b) The air must pass through the cartons on the pallet, not by-pass the pallet through gaps in pallet stacks and pallet openings. Cold store plastic should be used to seal all gaps.

(c) The pressure drop across the pallet stack of fruit should not be less than ± 10 mm of water gauge. Here a simple manometer is essential to determine the pressure drop. Without pressure drop across the pallet stack, very little, if any carton cooling is taking place.

(d) The forward velocity of the air in the plenum towards the fan should at no time or place exceed 5m/second.

(e) Carton cooling in Cold Stores with pallets stacked 3 high is very difficult to accomplish especially as the gaps between the pallets are never properly sealed at this level. Further, labour working under these conditions in sub-zero temperature with high wind speeds is not very productive.

2. Temperature Management. Temperatures should at all times be maintained at a level so as not to do damage to the fruit through freezing when cooling. On the other hand, temperature off the coils should not rise above 0˚C otherwise the store is being overloaded and cooling is inadequate. It is equally important to monitor the return air temperature as this tells one how much work the air is doing.
3. At least 1 or 2 thermo-couples should be put into each pallet once to determine the cooling potential of the stack and the tunnel.
4. The thermo-couple must be inserted into the flesh of the apple in the middle carton on the pallet on either the third or fourth layer.

5. An occasional thermo-couple must also be put in the apple on the outside of the pallet stack to determine its rate of cooling and to prevent any freezing damage taking place.

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