Int. Agrophysics, 1994, 8, 467-468

FRUIT TO FRUIT DAMAGE IN APPLE HANDLING SYSTEMS

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A b s t r a c t. During handling apples can be easily damaged if they strike hard objects. Grading equipment is likely to cause such damage unless adequate measures are taken to protect against such impacts. This can be achieved by using appropriate padding materials on all surfaces likely to contact fruit. However, it is very difficult to prevent apple to apple impact on commercial equipment when large volumes of fruit must be graded efficiently. Under these circumstances apple to apple impacts can be a major cause of bruising damage.

Experiments have been conducted to assess the behaviour of fruit under these impact conditions, and the results of these experiments are presented.

K e y w o r d s: fruit damage, apples

INTRODUCTION

Apples can be bruised easily if they impact against other objects during handling. Studies in grading sheds have shown that properly padded surfaces do not cause bruising. However the impact of one apple against another apple can easily damage one or both fruit. Both in the grading shed and in the orchard, these apple to apple impacts cannot be avoided easily when large volumes of fruit are being handled [1,2].

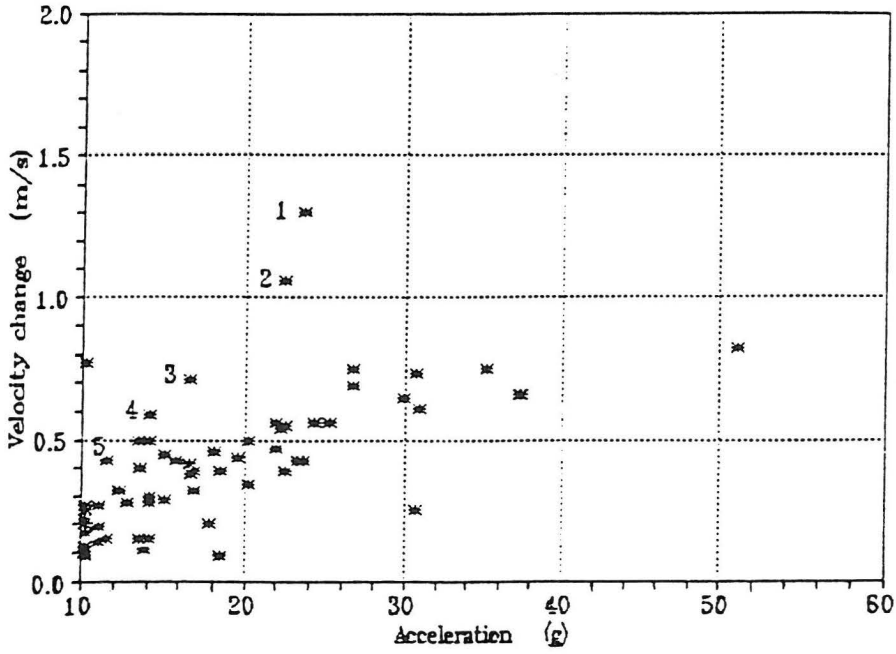

Fig. 1. Instrumented sphere data from grading machine. Impacts marked 1-5 are from impacts against fruit. At least impacts 1-2 would cause bruising. Other impacts shown may not cause damage.

Table 1. The linear relationship between bruise area and peak acceleration and bruise thresholds for fresh Gala, Splendour, Fuji, Braeburn, and Granny Smith apples in apple-to-apple impact (1991 season)

Variety	Regression equation	Coefficient of determination R^2	Bruise threshold (g)	Equivalent height (cm)
Gala	A_b=0.07(±0.002) PA-0.16(±0.18)	0.97	26	5.45
Splendour	A_b=0.06(±0.006) PA-0.27(±0.33)	0.89	21	3.25
Fuji	A_b=0.08(±0.008) PA-0.77(±0.45)	0.84	22	3.52
Braeburn	A_b=0.05(±0.003) PA-0.67(±0.16)	0.91	33	6.42
Granny Smith	A_b=0.06(±0.007) PA-0.28(±0.39)	0.83	21	3.69

EXPERIMENTAL STUDIES

Laboratory studies have examined critical impact energy levels, and measuring impacts in commercial situations in New Zealand.

Apple to apple bruising studies using Granny Smith apples showed:

1. In general only one apple is bruised;
2. The total bruise volume is related to the impact energy;
3. The variation in contact area (which is related to the bruise area) can be inferred from elasticity theory.

Instrumented Sphere (IS) studies (Fig. 1) showed:

1. The IS can be used to determine whether a handling system is likely to damage fruit;
2. The damage level depends on the impact energy and the variety tested;
3. Dangerous drop heights ranged from 6 cm for Braeburn to 3 cm for Splendour varieties (Table 1).

OTHER RESEARCH IN PROGRESS AT MASSEY UNIVERSITY

1. Modelling of Fruit Structures and Bruising;
2. New Measurement Techniques for Physical Properties of Fruit and Vegetables;
3. Skin Splitting Problems in Selected Cultivars;
4. Packaging Studies.

REFERENCES

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2. **Pang D.W., Studman C.J., Ward A.**: Bruising damage in apple-to-apple impact. J. Agric. Eng. Res., 52(4), 229-240, 1992.