



Mana Kai Rangahau

*New Zealand Institute for Crop & Food Research Limited
A Crown Research Institute*

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Causes of squash fruit blistering symptoms

J Fletcher

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*A report prepared for
LeaderBrand Produce*

Copy 1 of 6

*New Zealand Institute for Crop & Food Research Limited
Private Bag 4704, Christchurch, New Zealand*

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1 *Executive summary*

Squash fruit with serious skin defects from a number of crops around Gisborne were examined and the cause of the skin defects determined. Blister-like growths or protrusions which had formed on fruit surfaces were determined to be oedema. Light or dark flat or raised scab-like lesions giving field spot symptoms were caused by infections by the bacterial pathogen *Pseudomonas syringae* pv. *syringae*. Similarly, angular leaf spotting of squash leaves was also caused by infections of *P. syringae* pv. *syringae*. A summary of previous research is presented and suggestions for the management of the bacterial disease are given. Little information is available on the causes or management of oedema in squash. Research is needed to develop adequate management systems for this disease.

2 *Introduction*

LeaderBrand Produce was concerned about the widespread incidence of blemishes on harvested squash fruit in the Gisborne and Tolaga Bay districts. The presence of these blemishes gave rise to unacceptable levels of rejected fruit at the pack house. LeaderBrand wished the nature and cause of these fruit symptoms to be determined, and suggestions to be made for avoiding the problem in future growing seasons.

Of further concern was the identity of a leaf-spotting symptom, attributed to angular leaf-spotting, its relationship (if any) to the fruit symptom and how this damage may be controlled.

An interim report was prepared in February summarising field observations and outlining proposed work. This is the final report.

2.1 *Summary of activities, observations and definition of fruit symptoms*

The pack house and 11 crops at different ages and stages were visited. Fruit at each site were examined and an estimate of fruit damage incidence was recorded (Table 1). Other field observations were also made and recorded.

It became apparent that two major symptoms, with slight variations, were present in most, but not all crops examined. The descriptions of the symptoms relate to those outlined in the current Grade Standard issued by NZBSC and they are illustrated on pack house posters.

The symptoms are described as:

1. **Oedema** – blister-like growths or protrusions have formed on the fruit surface. These are usually pointed, up to 2 cm or more in height, and exceed the grade standard (GS) size requirement. In practice these appear to be easily damaged thus downgrading the fruit. There may be one or more of these on the fruit surface. At times the tip of the blister may also show slight damage indicating a secondary fungal infection. In younger fruit, blisters appear to form as sharp points on the skin surface. This fruit damage was not usually related to ground spot (soil contact) damage, although at times they can occasionally occur together. These fruit symptoms were not the same as the blister associated with virus infections caused by ZYMV or WMV2 (Figures 1 & 2).

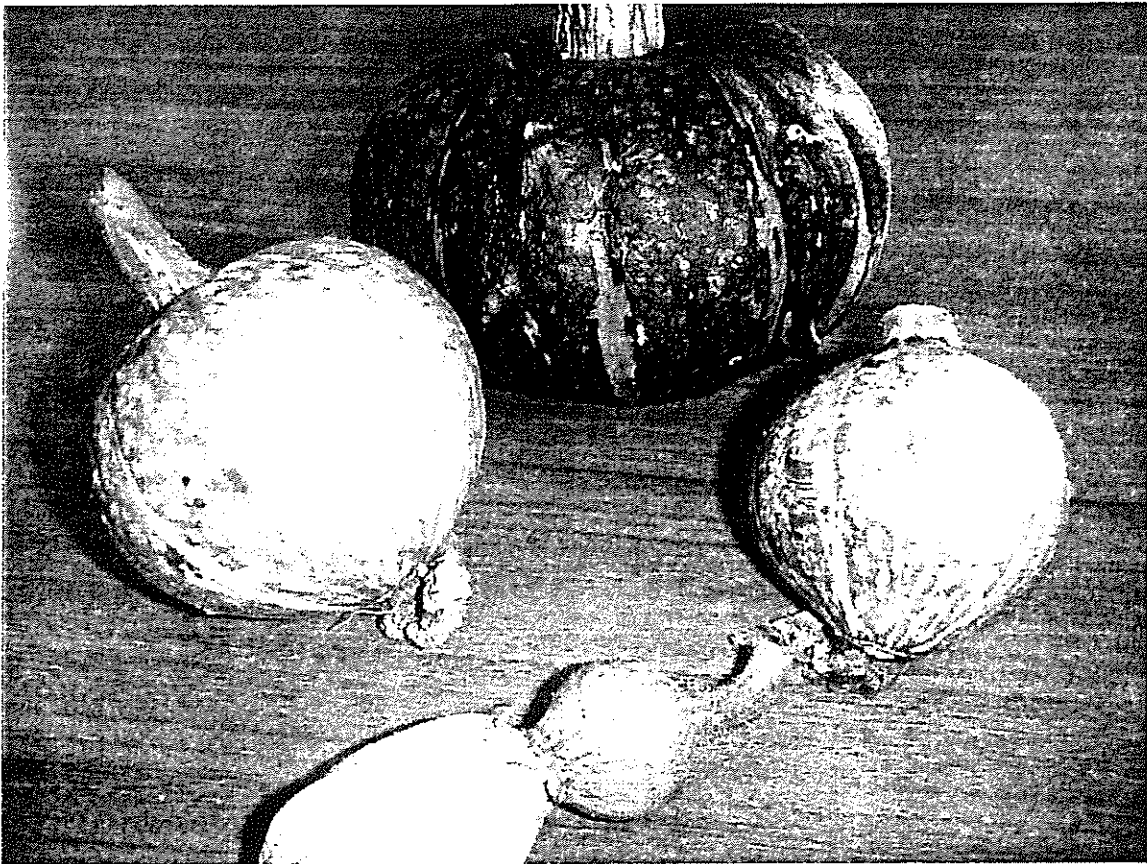


Figure 1: Young buttercup squash fruits with the initiation of oedema and an older fruit with strong oedema symptoms (pointed protrusions and associated scabbing).

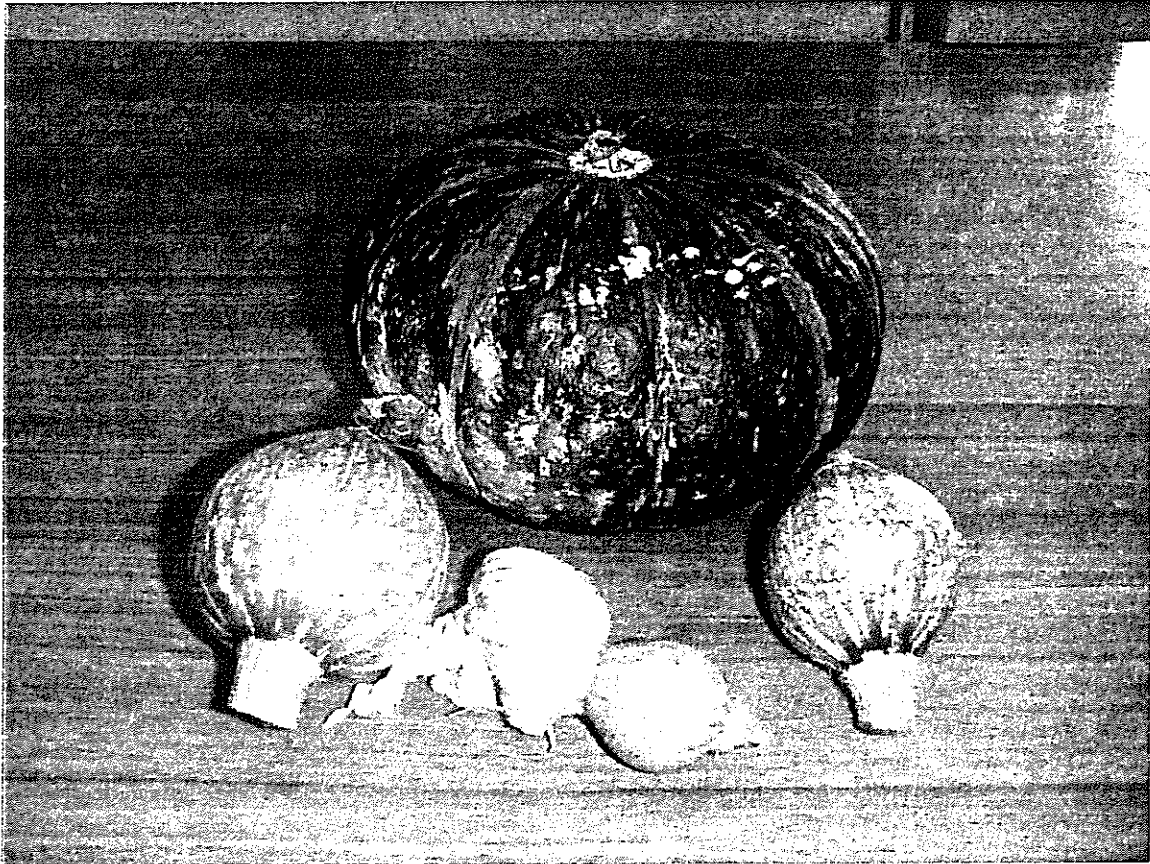


Figure 2: Young squash fruits with the initiation of oedema and an older fruit with mild oedema (blistering) and moderate field spot symptoms caused by *Pseudomonas syringae* pv. *syringae*.

2. **Field spot** – sometimes called 'pin rot' or 'warts'. In mature fruit a light or dark flat or raised scab-like symptom ranging in size from a few millimetres to about a centimetre across. These lesions may be scattered singly over the surface or clustered in groups. In younger fruit, lesions appear of lighter colour and less developed. At times they appear to have caused distortion or miss-shaping of part of the fruit surface. This damage is not usually related to ground spot damage although at times they can occur together. Earlier research (Braithwaite & Ganey 1993) has attributed these spots to fungal infections (*Fusarium*, *Phoma*, *Rhizoctonia* and other fungal species) or to bacterial infections of *Pseudomonas syringae* pv. *syringae* (Sharrock et al. 1995 & Hawthorne et al. 1995) (Figure 2).
3. **Leaf spotting** – water soaked lesions developing to larger angular lesions. Larger lesions often form a white necrotic crust (Figure 3).



Figure 3: Bacterial leaf spotting on buttercup squash caused by *Pseudomonas syringae* pv. *syringae*.

2.2 Pathology and testing of specimens

Specimens of field spot, particularly young fruit, were given to Mark Braithwaite (MAF NPPRL, Lincoln) to examine and try to isolate any causal organisms.

Specimens of the oedema symptom and the leaf spotting symptom were also sent to Dr LH Cheah (pathologist, Crop & Food Research, Palmerston North) and Bruce Bycroft (fruit physiologist, Crop & Food Research, Palmerston North).

2.3 Results

2.3.1 Oedema

Crop & Food Research staff examined the affected fruit and concluded no pathogens were associated with these symptoms. They could not offer a direct explanation of the cause other than to comment that it was more prevalent during the current wet season.

A search of databases (University of Minnesota; Ontario MAFRA, Canada; Cornell University) and an examination of available information unfortunately gives little further information, apart from confirming moisture stress as a likely cause. Symptoms described by the databases and other information as

oedema were not always the same as those we experience on our squash fruit.

2.3.2 *Field spot*

MAF NPPRL isolated *Pseudomonas syringae* pv. *syringae* from the field spot damage on all fruit it examined. No other pathogens, fungal or bacterial, were detected. This is consistent with the observations and conclusions of Sharrock et al. and Hawthorne et al. (1995). One very young fruit had a single lesion possibly caused by insect feeding penetration.

2.3.3 *Leaf spotting*

Dr L.H. Cheah of Crop & Food Research similarly determined that the leaf spotting symptom was that of angular leaf-spot, also caused by *Pseudomonas syringae* pv. *syringae*.

2.4 *Discussion and recommendations*

Oedema symptoms in squash appear to be associated with higher plant moisture levels. It seems clear there is little reason, other than anecdotal information, for its prevalence in some areas (Tolaga Bay) and lower incidence (Hawke's Bay) in others. The causes of oedema may also be associated with different soil types or other factors such as moisture fluctuation. There appears to be very little information on the management of oedema in squash.

Field spot (or wart) symptoms isolated this season around Gisborne were directly attributable to infections with *Pseudomonas syringae* pv. *syringae*. Research into effects of this bacterial pathogen and its management have been well covered in the reports of Sharrock et al. and Hawthorne et al. (1995).

To reiterate, their observations concluded:

- Bacterial infection was initiated via microscopic wounding of glandular hairs and possibly stomata.
- Soil and infected plant tissue are likely sources of infection especially in fruit washing water.
- Bacterial isolates from leaves with angular leaf-spot had the capacity to cause wart symptoms.
- There was increased incidence of wart symptom in experimental crops grown on silt soils in South Auckland.
- High nitrogen levels were associated with higher incidence of wart symptoms.
- No consistent climatic or other nutrient factors were associated with susceptibility to wart symptoms.
- Close crop rotations appear to increase the incidences of wart symptoms and other susceptible crops such as maize may also increase field inoculum.

- Copper spraying of fruit before harvest had no effect on the incidence of wart symptoms.

From this research Hawthorne & Sharrock recommended:

- Longer rotations between squash crops.
- Reducing the use of nitrogen fertilisers.
- Minimising the handling of fruit to reduce damage.
- Avoiding immersing fruit in water, but if necessary, only to immerse soon after harvest in uncontaminated water.
- Storing fruit in a cool environment after harvest to minimise tissue rotting.

From the above information a further recommendation for management of field spot would be the early use of copper sprays, particularly on young crops, during wet periods. This would help reduce the build-up of the angular leaf-spot associated with bacterial field spot infections. The use of targeted foliar nutrient sprays (after leaf nutrient testing) may help minimise excessive nitrogen applications. Nitrogen management may be particularly important especially when growing squash crops on silt soils.

There seems to be little detailed understanding of the management of oedema in buttercup squash and it would seem to be an area where further research needs to be done in order to be able manage this problem. Particular areas of attention include the importance of fluctuations in moisture, applications of fertilisers, soil types and cultivar sensitivity.

Research is being conducted by Crop & Food Research into the physiology and management of squash production. The goal is to produce a computer model to aid grower decision making. Some of the information from this programme may be useful in understanding problems such as oedema.

Table 1: Incidence of fruit skin symptoms and other field observations on buttercup squash in Gisborne crops, February 28, 2002.

Crop	Growth stage	Oedema	Skin spot	Overall estimated incidence	Mildew	Aphids	Mosaic virus	Leaf spot
Racecourse	mature	+(17%)	+(60%)	77%	+	-	-	
Kents, Bell Rd	mid	+	+	60-70%	-	-	-	
Ladelli, Jackson Rd	young	+	+	70%	-	-	-	
Beasley	Young	+	+	40%	+	Whitefly	-	+
Grieves, Awapuni Rd	mid	+	+	40%	+	-	-	+
Sisterson, McDonald Rd cv 1	mid	+	+	70%	+	+	-	+
Sisterson, McDonald Rd cv 2	mid	+	+	60%	+	+	-	+
Judd, McDonald Rd	mid	+	+	30%	+	-	-	-
Watson (Mecca)	mature	-(30%)	+	30%	+	-	-	-
Te Karaka	mid	-	+(30%)	30%	-	-	-	-
Tangihanga Stn	Mature	+	+	60%	+	-	-	-

3 *References*

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