Photon Apple Trial Manual

2009 to 2015

May 2019

PHOTON® APPLE TRIAL RESULTS FOR THE 2009 TO 2015 SEASONS

Introduction

Five replicated Photon trials were conducted over three seperate seasons on Granny Smith, Pink Lady and Fuji apple varieties.

- The first trial was on Granny Smith apples and was located in Ardmona, Victoria.
- The second trial was on Pink Lady apples in Shepparton East, Victoria.
- The third trial was on Granny Smith apples also in Shepparton East.
- The fourth trial was in Shepparton East on Fuji apples and
- The fifth trial was in Shepparton East on Golden Smoothie apples

This Infonote provides details of each of the trials and highlights how Photon performed to reduce heat stress and sun damage in each trial.

2009/2010 Trial on Granny Smith Apples

Application

A total of six applications of Photon were made over the growing season beginning at fruit set. Applications were made at approximately 21 day intervals. Photon was applied at the label rate 40g/ha with Agral® at the standard label rate.

Figure 1: Apple size when treatment was applied on the 28th of October.

Assesment Details

Yield - Apples were harvested from each tree. Apple weights were recorded.

Sun damage/Heat Stress - At harvest all apples from the centre tree in each plot were harvested and rated according to the following rating system in Figure 2.

Figure 2: Sun damage rating system


Rating 1   Rating 2   Rating 3   Rating 4

The trial commenced on the 28th of October 2009 and was harvested on the 17th of March 2010. Temperatures for November were significantly above average with 19 days of temperatures exceeding 30°C and 11 exceeding 35°C.

Results and Discussion

Fruit Size

On the 10th December the diameter of 20 randomly selected apples on each tree were measured. The results are presented in Graph 1. The Photon treatment significantly increased apple fruit size when compared to the untreated control. It is hypothesised that by managing the heat stress that occurred including 5 days in a row with temperatures over 30°C and hotter, that cell division was maintained for longer in each day, thus giving larger fruit.

Graph 1: Fruit diameter in mm
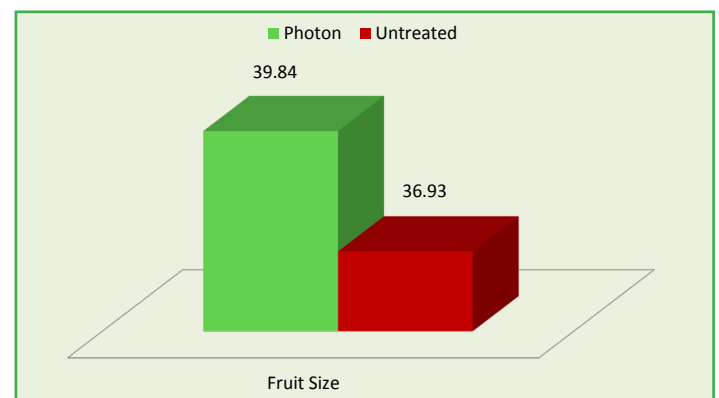
Heat Stress and Sun Damage

On the 16th of February the numbers of sun damaged apples per tree were counted from the ground. Whilst the numbers of sun damaged apples were not high, with the untreated control having 22 apples sun damaged per tree; the degree of sun damage was very severe (rating 4).
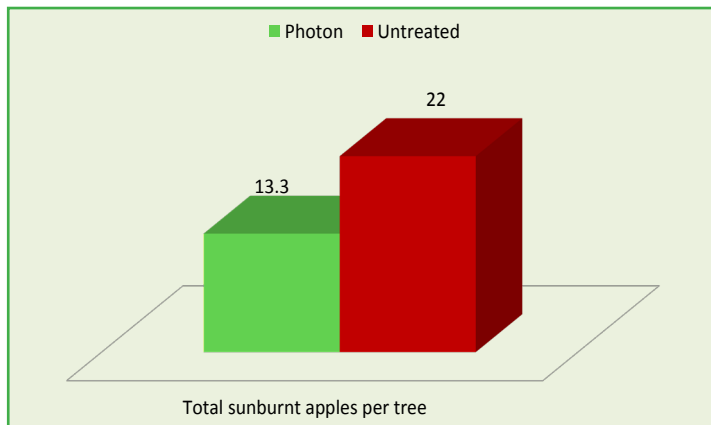
Figure 3: Untreated apples showing level 4 sun damage

Heat Stress and Sun Damage Continued

The Photon treatment significantly reduced the incidence of sun damage when compared to the untreated control as shown in Graph 2.

**Graph 2: Photon effect on total sun damaged apples per tree**

At harvest all apples on each tree were rated for the level of sun damage as detailed in the rating system in the assessment section. The data is provided in Graph 3. When compared to the untreated control Photon significantly reduced the incidence of sun damge as shown by the percentage of apples with rating 0 (no sun damage)

Graph 3: Treatment effect of sun damage and the % of apples in each rating category
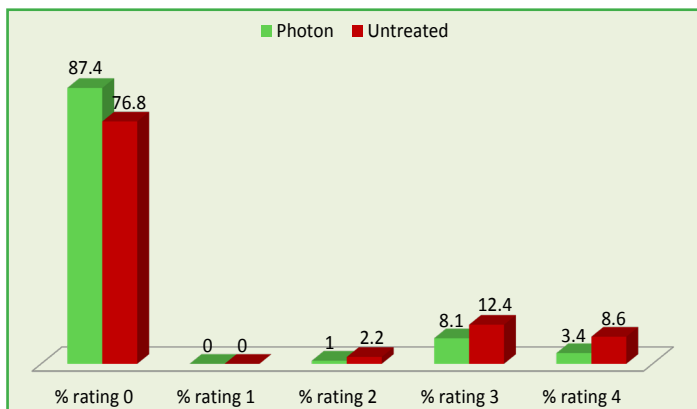
Graph 4 shows a break out of apples of commercial standard (ratings 0 & 1) which would be considered grade 1 premium apples for export and domestic markets and rejected apples (Ratings 2 to 4), which would be sold for juice or paste. The application of Photon has provided a significant increase in the percentage of apples of commercial standard considered as grade 1 premium apples when compared to the untreated control.

Graph 4: Commercial evaluation of the treatment effect on sun/heat stress damage
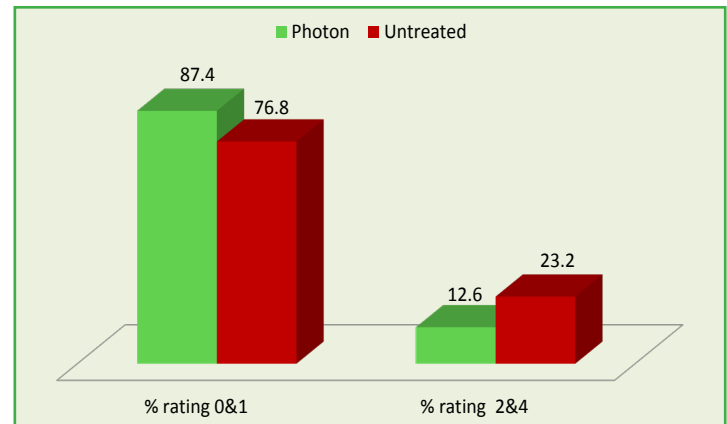
Crop Yield

The application of Photon significantly increased the fruit weights (grams per apple) and the overall apple yield per tree when compared to the untreated control. This increase in weight is assumed to be due to the management of heat stress over the summer months, in particular during the period following full bloom throughout November. There was an increase of approximately 9 kgs per tree of rating 0 and 1 apples (see Graph 5).

**Graph 5: Treatment effect on yield**
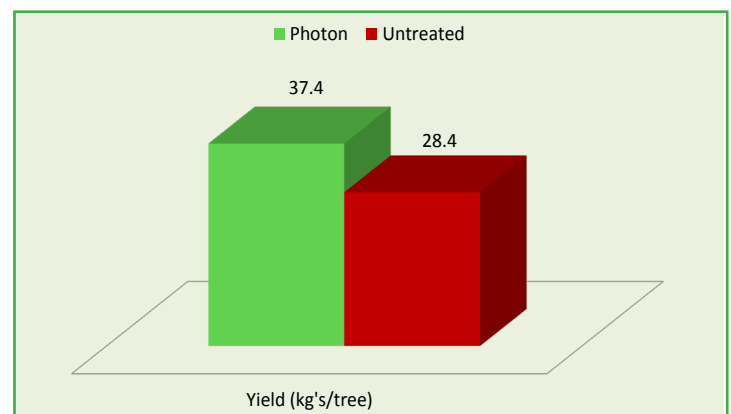
Economic Analysis

Application of Photon resulted in a payback per ha of $15,456. The details on how this was calculated are provided in Table 1.

Table 1: Economic Analysis

Item	Measurement
Cost of 6 applications of Photon @ 40g/ha	$240
Fruit damage due to sun damage - Untreated	23.2%
Fruit damage due to sun damage - Treated	12.6%
Heat stress - additional % marketable yield with Photon	10.6%
Untreated - Total yield per ha (kgs)	43,512
Photon treated - Total yield per ha (kgs)	50,333
Extra yield per ha due to sun damage mitigation (kgs)	7,100
Extra yield per ha due to heat stress mitigation (kgs)	3,800
Total extra marketable yield per ha due to Photon applications (kgs)	**10,900**
Extra cartons/ha @ 10kg per carton (packout 80%)	872
Expected price per carton	$18.00
Gross extra income per ha	$15,696
Less the cost of the treatments	$240
Payback per ha	**$15,456**
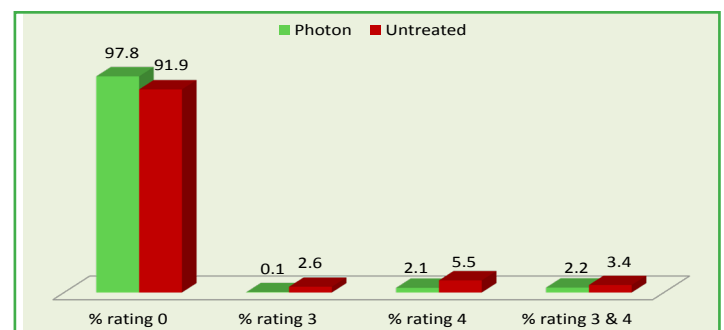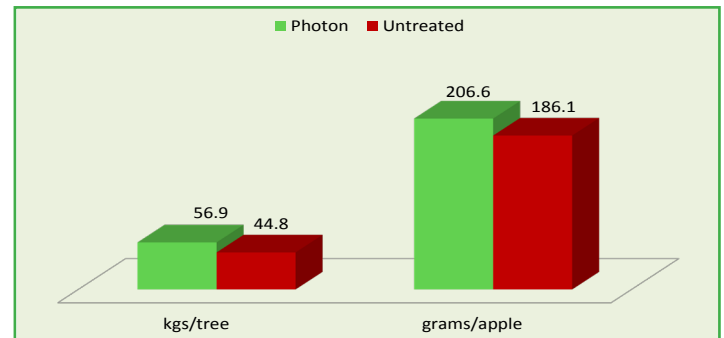
2010/2011 Trial on Pink Lady Apples

Application

In this trial a total of five applications were made over the growing season beginning at fruit set. Applications were made at approximately 21 day intervals. The same application rate was used as for the 2009/2010 trial.

Assessment Details

The same assesments were conducted for this trial as the 2009/2010 trial.

Results and Discussion

Yield

At harvest all apples from each tree were harvested and the total weight of apples recorded. These results are summarized in Graph 6. Photon provided a significant increase in number of kgs per tree and also significantly increased the apple weight.

Figure 5: Untreated apples showing sun damage

Economic Analysis

Application of Photon resulted in a payback per ha of $8,193. The details on how this was calculated are provided in Table 2.

Table 2: Economic Analysis

Item	Measurement
Cost of 5 applications of Photon @ 40g/ha	$200
Fruit damage due to sun damage - Untreated	8.1%
Fruit damage due to sun damage - Treated	3.4%
Heat stress - additional % marketable yield with Photon	4.7%
Untreated - Total yield per ha (kgs)	36,556.8
Photon treated - Total yield per ha (kgs)	39,624.96
Extra yield per ha due to sun damage mitigation (kgs)	2178
Extra yield per ha due to heat stress mitigation (kgs)	3068
Total extra marketable yield per ha due to Photon applications (kgs)	5246
Extra cartons/ha @ 10kg per carton (packout 80%)	420
Expected price per carton	$20
Gross extra income per ha	$8,393
Less the cost of the treatments	$200
Payback per ha	$8,193

2011/2012 Trial on Granny Smith Apples

Application

A total of five applications were made over the growing season beginning at fruit set (See Figure 5). Applications were made at approximately 21 day intervals. The same rate was again used in this trial.

Assessment Details

The same assesments were conducted for this trial as the 2009/2010 trial.

Results and Discussion

Heat Stress and Sun Damage

An assessment of sun damaged apples per tree was undertaken on the 5th of January following two very hot days. Graph 8 shows the total number of sun damaged apples per tree. The untreated control had a mean of 11.5 sun damaged apples per tree whilst Photon significantly reduced the number of sun damaged apples per tree to only 4.

A second assessment of the number of sun damaged apples per plot of three trees was undertaken on the 8th of February. This data is summarized in Graph 9. The trees were grown as Tatura trellis, "V'd" with the rows running north and south. The number of sun damaged apples on the east, west and in the centre of the "V" were counted and recorded separately.

Graph 8: Treatment effect on number of sun damaged apples per tree (January 2012)
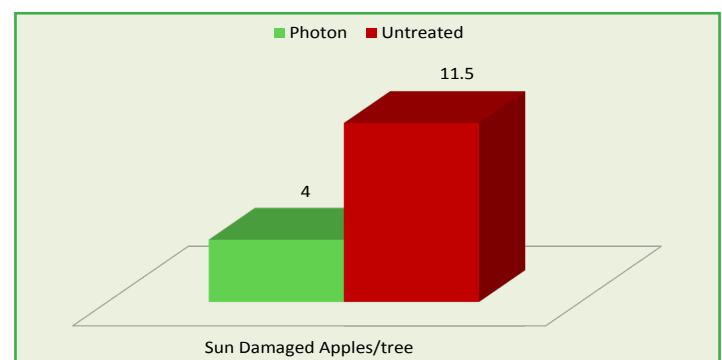
The untreated control had significantly more sun damaged apples on the east, west and in the centre of the trees than the treated trees. The application of Photon significantly reduced the number of sun damaged apples per tree.
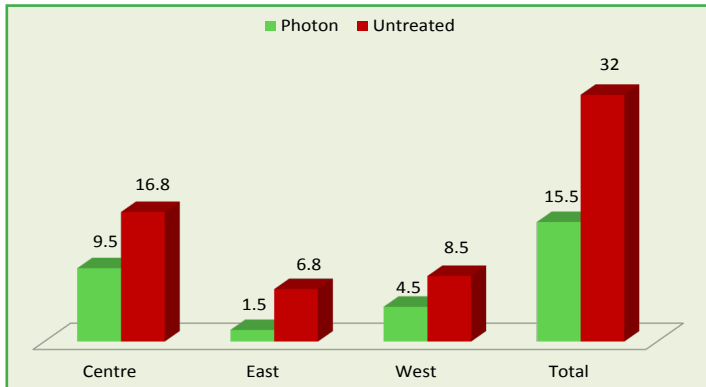
Figure 5: Photon first application timing

SIPCAM

Graph 9: Treatment effect on number of sun damaged apples per tree (February 2012)

Legend: Photon (green), Untreated (red)

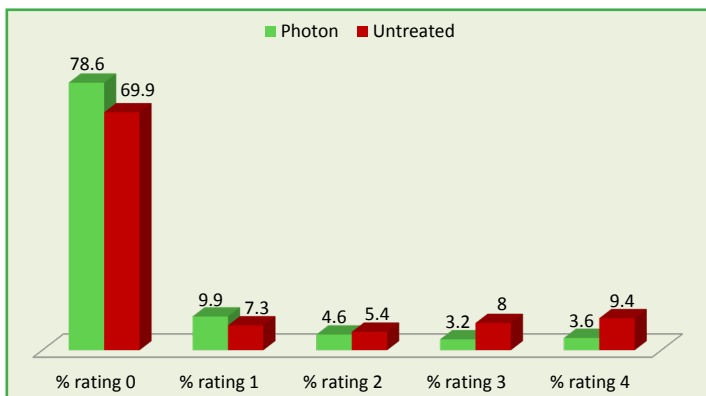| Location	Photon	Untreated
Centre	9.5	16.8
East	1.5	6.8
West	4.5	8.5
Total	15.5	32

Heat Stress and Sun Damage Continued

At harvest all apples were rated for sun damage according to the rating system and the results are shown in Graph 10.

Statistically there were the same numbers of apples per tree enabling the apples in each rating category to be converted to percentages.

The application of Photon significantly reduced the incidence and the degree of sun damage as measured by percentage of apples with no sun damage (rating 0) and the number of apples with severe sun damage (rating 3 & 4), when compared to the untreated control.
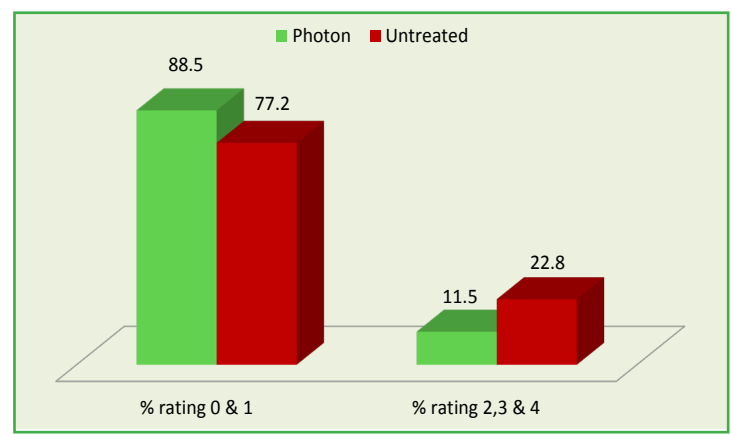
The application of Photon increased the number of apples with no sun damage (rating 0) by the order of 10%, whilst reducing the number of apples with severe sunburn (rating 3 & 4) by 13%.

Graph 10: Treatment effect on sun damaged apples

Legend: Photon (green), Untreated (red)

Rating	Photon	Untreated
% rating 0	78.6	69.9
% rating 1	9.9	7.3
% rating 2	4.6	5.4
% rating 3	3.2	8
% rating 4	3.6	9.4

Apples of ratings 0 and 1 are considered to be of class 1 whilst apples of rating 2, 3 and 4 are either class 2 and in the case of class 4 graded out as juice. Graph 11 provides a summary of the percentage of apples of ratings 0 and 1. The untreated control had 77.2% of apples as rating 0 and 1 (class 1) whilst Photon significantly improved the percentage of apples in class 1 to around 90% an improvement of 13%. Commercially this means that there were 13% more Granny Smith apples available to be packed as class 1. The application of Photon significantly reduced the percentage of apples in ratings 2, 3 and 4 when compared to the untreated control. These treatments reduced the percentage of fruit as class 2 or juice from 22.8% to around 10%.

Graph 11: Treatment effect on commercial rating of apples

Legend: Photon (green), Untreated (red)

Rating	Photon	Untreated
% rating 0 & 1	88.5	77.2
% rating 2,3 & 4	11.5	22.8

Figure 6: Untreated apples showing sun damage

2013/2014 Trial on Fuji Apples

Application

A total of seven applications were made over the growing season beginning at fruit set. Applications were made at approximately 15 to 21 day intervals. Photon was applied at the label rate 40g/ha with Agral® at the standard label rate. The photograph below shows that the Fuji trees were open with long overhanging limbs which is the worst case scenario for sun damage.

**Figure 7: Fuji apple trees in trial**

Assessment Details

The same assesments were conducted for this trial as the 2009/2010 trial.

Results and Discussion

Heat Stress and Sun Damage

An assessment of sun damaged apples per tree (as assessed from the ground) was undertaken on the 21st of January, 5th February and the 25th February. At each assessment the level of sun damge on the apples was severe (ratings 3 & 4). At each assessment the application of Photon significantly reduced the number of sun damaged apples per tree when compared to the untreated control.

**Graph 12: Treatment effect on number of sun damaged apples**
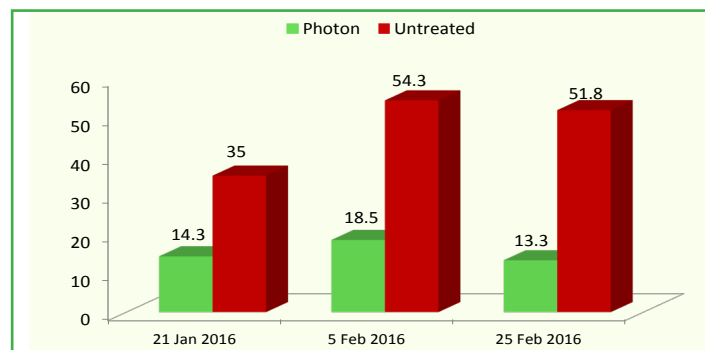
**Figure 8: Sun damaged apples (LHS), Photon treated (RHS)**

At harvest all apples were rated for sun damage. Graph 13 provides a summary of the number of apples in each rating. The data shows that in apple numbers there were 80 more apples/tree with no sun damage; that would be packed as Class 1 apples for fresh market.

Graph 13: Treatment effect on apple quality/number of apples per tree for each rating
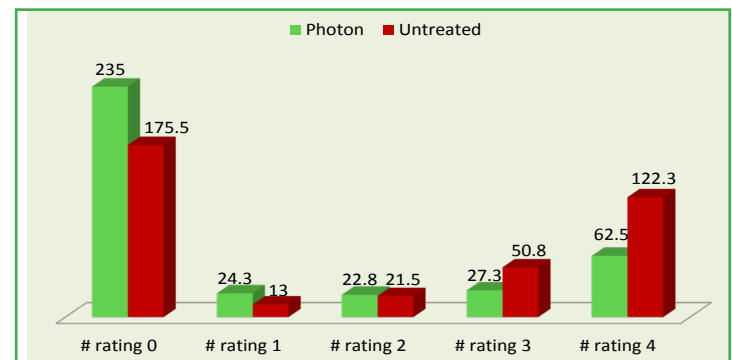
Graph 14 shows the same data expressed as a percentage in each rating category. The application of Photon, significantly reduced the incidence and the degree of sun damage as measured by percentage of apples with no sun damage (rating 0) and the number of apples with severe sun damage (rating 3 & 4), when compared to the untreated control.

Graph 14: Treatment effect on apple quality % of apples in each rating
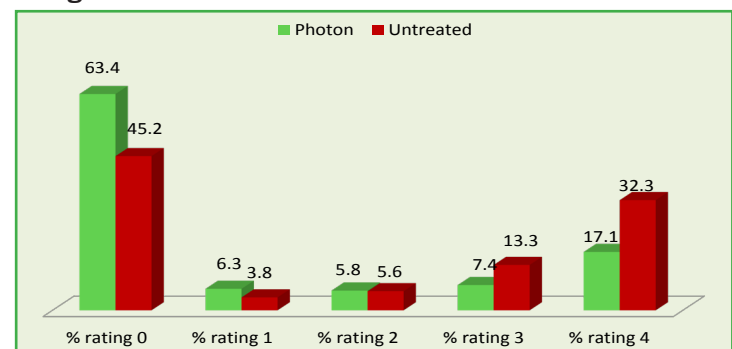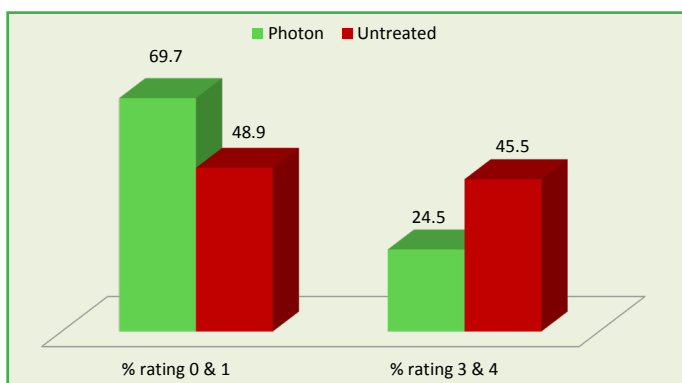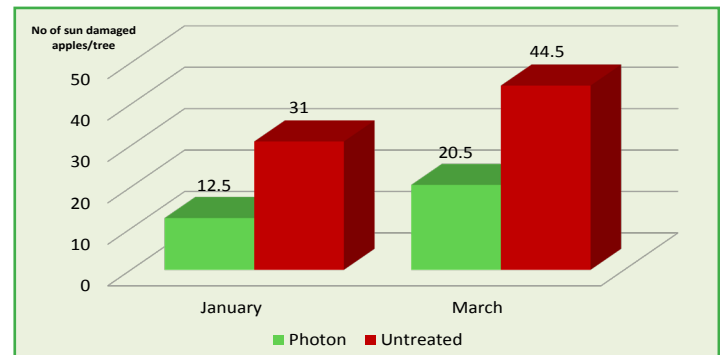
PHOTON® APPLE TRIAL RESULTS FOR THE 2009 TO 2015 SEASONS

Graph 15 provides a summary of the apples according to what may happen commercially. Apples of rating 0 and 1 would be packed as Class 1, whilst apples of rating 3 and 4 would be graded out as juice.

The application of Photon increased the number of apples with no sun damage (rating 0 & 1) by the order of 20%, whilst reducing the number of apples with severe sun damage (rating 3 & 4) by 19%.

The application of Photon provided statistically equivalent levels of improvements in apple quality.

Graph 15: Treatment effect on commercial rating of apples

At each assessment the application of Photon significantly reduced the number of sun damaged apples per tree when compared to the untreated control.

Graph 16: Treatment effect on the number of sunburnt apples per tree

Figure 9: Photon treated apples in March


Figure 10: Sun damaged untreated apples in March

2014/2015 Trial on Golden Smoothie Apples

Application
A total of seven applications were made over the growing season beginning at fruit set. Applications were made at approximately 21 day intervals

Assessment Details
The same assesments were conducted for this trial as the 2009/2010 trial.

Results and Discussion
Heat Stress and Sun Damage
An assessment of sun damaged apples per tree was undertaken on the 9th of January and the 3rd March. Graph 16 shows the total number of sun damaged apples per tree. At each assessment the level of sun damage on the apples was severe (ratings 3 & 4).

Heat Stress and Sun Damage Continued

At harvest all apples were rated for sunburn according to the rating system as detailed in the assessment section. Graph 17 provides a summary of the number of apples in each rating.

There was no statistical difference in the total number of apples per tree. Thus the percentage of apples in each rating category can be calculated

Graph 17: Treatment effect on apple quality/number of apples per tree for each rating
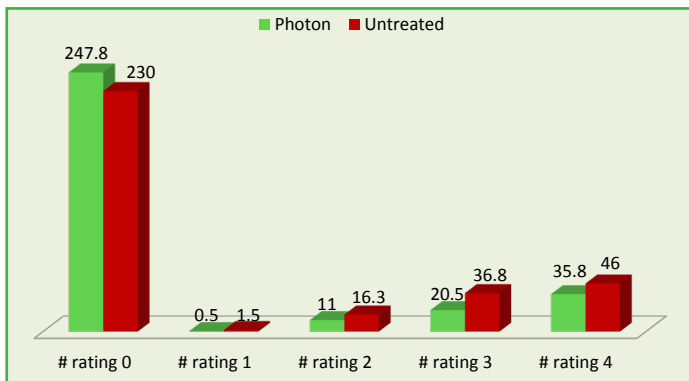
Graph 18 shows that Photon at 4 g/100L provided a high level of apples with no sunburn (rating 0).

Photon increased the percentage of apples with no sunburn by 13% when compared to the untreated control.

Graph 18: Treatment effect on apple quality – percentage of apples in each rating category
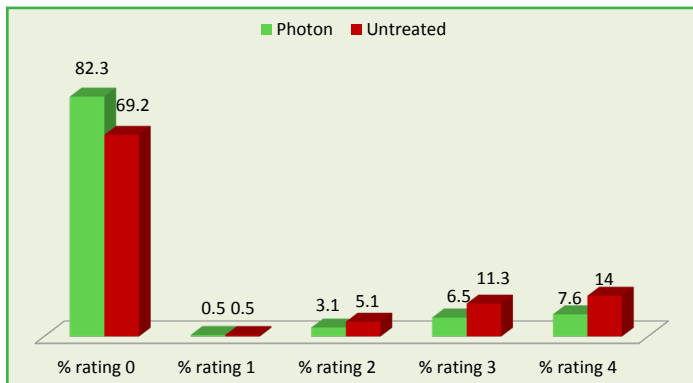
Graph 19 provides a summary of the apples according to what may happen commercially. Apples of rating 0 and 1 would be packed as Class 1, whilst apples of rating 3 and 4 would be graded out as juice.
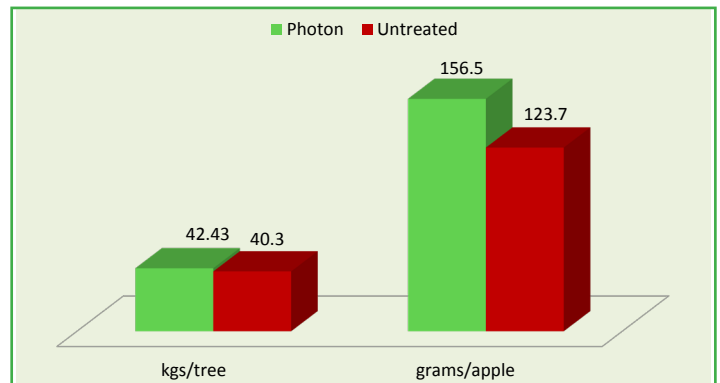
The application of Photon at 4 g/100L increased the number of apples with no sunburn (rating 0 & 1) by the order of 13%, whilst reducing the number of apples with severe sunburn (rating 3 & 4) by 11%.

Graph 19: Treatment effect on commercial rating of apples
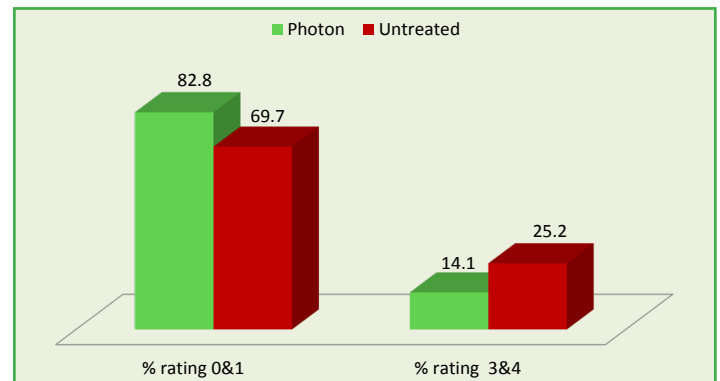
At harvest all of the apples from each tree were weighed. As the total numbers of apples per tree were counted the apple weight in grams per apple could be calculated. Graph 20 provides a summary of this data. The application of Photon significantly increased apple weight (grams/apple) when compared to the untreated control.

Graph 19: Treatment effect on apple yield and apple weights

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