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SUNCROPS

**EVALUATION OF SUN
DAMAGE CONTROL IN
APPLE TREES**

TECHNICAL REPORT

April 2013





THE SUNSCREEN SUNCROPS CONTROL OF SUNBURN ON APPLE TREES

Technical report

INTRODUCTION

In the irrigated valleys of the provinces of Neuquén River Black and located to the north of Argentina Patagonia fruit activity occupies a cultivated area of 60,000 hectares, spread over 30 locations. The fruit is the main economic activity in the region characterized by strong export tradition.

The analysis area is characterized by semi-arid climate with summers that have extremely high temperatures and high solar radiation. These extreme environmental factors in fruits promote physiological disorder known as "sunburn", "burning fruits", "sunny" or "sunburn".

Production losses caused by sunny apple and pear fruit in the Upper Black River Valley are high. For the season 2002/03 the fruit discarded by sunny quantified packing plant input was 24.7% for Red Delicious clones, 38.1% for Braeburn, Granny Smith 41.9% for and 55.6% to Fuji. These examples indicate that the problem changes in intensity depending on the variety of apple but in any case always observed losses.

The sunny climate factors most important inducers are high solar radiation and high temperatures. The intensity and the time that the fruits bear these factors are what determine the oxidative stress situation which will result in irreversible tissue damage.



The injury occurred in fruit, is initially at epidermal and sub-epidermal level; affecting the appearance, which also produces changes in the maturity of the sector in fruit concerned, with subsequent softening and putrefaction end, reducing the possibility of storing them.

SUNCROPS TM, sunscreen is developed based on kaolinite; which acts reflecting UV, IR and visible, thus lowering the temperature in the plant organs and preventing sunburn on fruit.

OBJECTIVE

To evaluate the effect of applying sunscreen SUNCROPS, in controlling sunburn in apple fruit in the Upper Black River Valley and Neuquén during the 2012-13 season.



MATERIALS AND METHODS

Plant material

The plot on which the test was performed belongs to the "El Morumbi" signature John Patalano and sons SA in the rural area of the town of Guerric, identified as Chacra 100 and Cuadro 4. The health status and general condition of the plantation are good, we can see the performance of the pertinent cultural tasks and represents a holding which accompanies the correct productive development work by the makers.

This square land has a total area of 4.36 hectares, with a plantation composed of rows interspersed apple Red Delicious and Granny Smith, both species of approximately 35 years of age, conducted in system "trellis" in the East-West, ratio of two rows of Red Delicious a Granny Smith. The planting is 4 x 4 mts. between row and between plants.

The study was conducted in Granny Smith, with an experimental design of 5 rows (replicates) per treatment, each separated by two border rows (untreated).

Treatments

T0: Control

T1: sprays SUNCROPS

T2: SUNCROPS spray with bars

Product concentration used was 2.5% (w/v) in the first application and subsequent to 1.5%, using a volume of 1200 L / Ha.



The equipment used for the application:

- Sprayer Arbus 2000, with a bar with 6 sprinklers and sprayers N°18 and 100 Lbs of pressure, pulled by a Massey Ferguson 275 tractor up 2nd floor, reducing high as 2000 rpm.
- Sprayer PAZIMA 2000 mp 11, with sprinklers 2 (3), 2 (3), 2 (3), 2 (3), 2 (3) 1.8 (3) 1.5 (3) to 180 Lbs of pressure, and Valtra tractor driven at 2 ° velocity running, known as low as 2200 rpm.

Treatments began on 05/12/12 and repeated at intervals of approximately 15-20 days, as detailed in Table 1. In total there were six applications throughout the season. The harvest took place on 11/03/2013, and recorded temperatures forecast for the first half of March were high therefore decided to hold the sixth application. This last application was not standard in the protocol but was deemed necessary given the climatic conditions of that period.

Table 1. Application dates

Number of application	1°	2°	3°	4°	5°	6°
Date	05/12/12	21/12/12	04/01/13	24/01/13	14/02/13	05/03/13

Determinations

The incidence of sun damage to fruit was determined on 5 replicates of 2 trees where each was analyzed 100 fruit/tree exposed face (instead of the canopy, where the fruits are more strongly; expressing the symptom of sunburn).

Damage levels, were determined by visually on the surface of the fruit (Figure 1), which were classified as:

- Fruit "*HEALTHY (SANO, in Spanish)*" fruit not show any signs of damage or deterioration.
- Fruit with "*SLIGHT DAMAGE (LEVE, in Spanish)*" that had mild fruit yellow-green color in the affected area. The fruits with this level of damage are marketed under the categories "commercial or 2nd".
- Fruit with "*SERIOUS INJURY (GRAVE, in Spanish)*": Fruits coloring tanned, presenting necrosis of the affected area. The fruits with this level of damage are targeted like discard.



Photo 1. - Levels of symptoms sunburn on fruit.

The weight and diameter of the fruits harvest; was determined on 50 fruits /tree, and measured in 5 trees per treatment (Total of 250 fruits for each treatment). Equatorial diameter was recorded, to estimate size and weight of fruit. The flesh firmness evaluation was performed on samples of 20 "HEALTHY-SANO" fruits selected at random from each treatment. For flesh firmness determination, used a handheld pressure gauge (model FT 327, R. Bryce, Alfonsine, Italy), set to piston of 11 mm.



Each fruit were performed on three determinations on opposite sides of the equator. The concentration of soluble solids in juice was measured using portable refract meter; index and evaluation was performed using starch-iodine solution (iodine).

Vegetative index, were measured by collecting 10 plant shoots/ statistical repetition and after was measured: the leaf area by dry matter of a surface of ten discs of 0.8 cm diameter, chlorophyll contents with SPAD index by averaging of 10 measurements.

Statistical design

Completely Randomized Design with 5 replications. To detect differences between treatments ANOVA analysis was performed when differences were found between treatments mean comparisons were performed using LSD test at 5% significance. For the analysis of sunny fruits percentages were converted to arcsine to achieve normality of the data and be able to apply the analysis of variance. We used generalized linear models procedure with INFOSTAT statistics program.

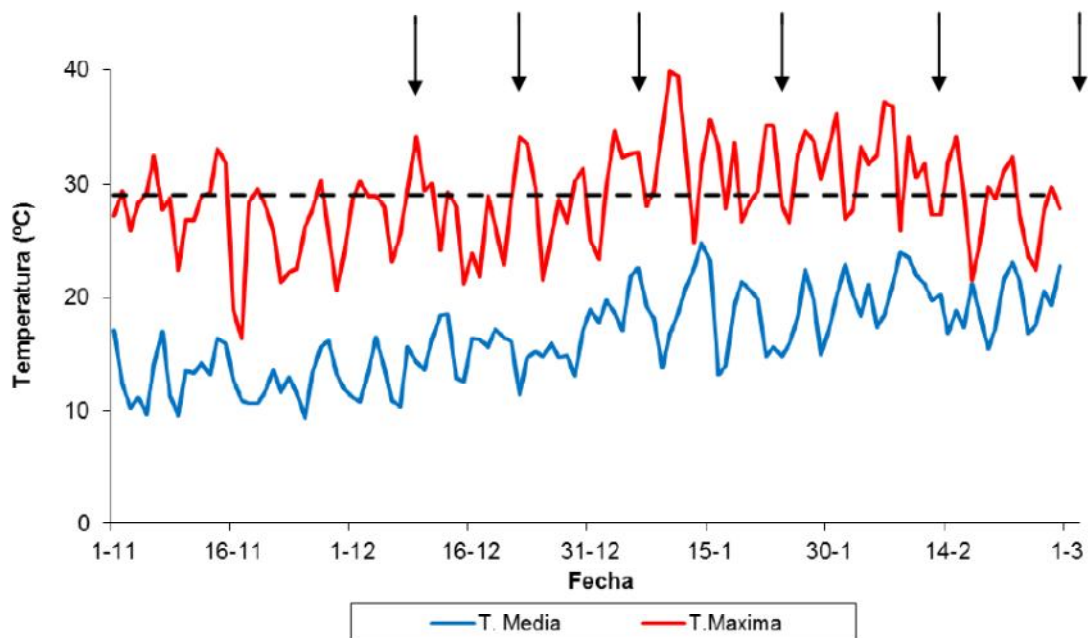
RESULTS

1.-Evolution of temperature

According to climate data of agro-meteorological station of the National Institute of Agricultural Technology High Valley EEA (RIO NEGRO) and taking 29° C of temperature (Temperatura in Spanish) like to damage threshold. We can see that the T° Max of the months of January and February exceeded this value with great frequency.

In the Figure 1, can be compare the maximum attained with application of sunscreen (Black arrows).

Red lines: Maximum temperature, Blue lines; Medium temperature



Graph 1: Evolution of the average and maximum temperature during the study period. The dashed line indicates the threshold of 29 °C and the black arrows times of spraying.



2. Incidence of sunburn

Applying of sunscreen SUNCROPS, was effective in reducing sun damage by Granny Smith apple fruits. SUNCROPS treatments regardless of the application used tool, decreased by 12% the amount of fruits with SLIGHT sun damage or sunburn.

In the category of SERIOUS INJURY was a reduction of 12% of fruit affected when SUNCROPS spray was applied, while applications with bar indicated a reduction of 32%, being the latter statistically significant ($P < 0,05$).

Therefore SUNCROPS treatments reduced the percentage of fruit with sun damage and increased the healthy (Table 2 and Graph 2).

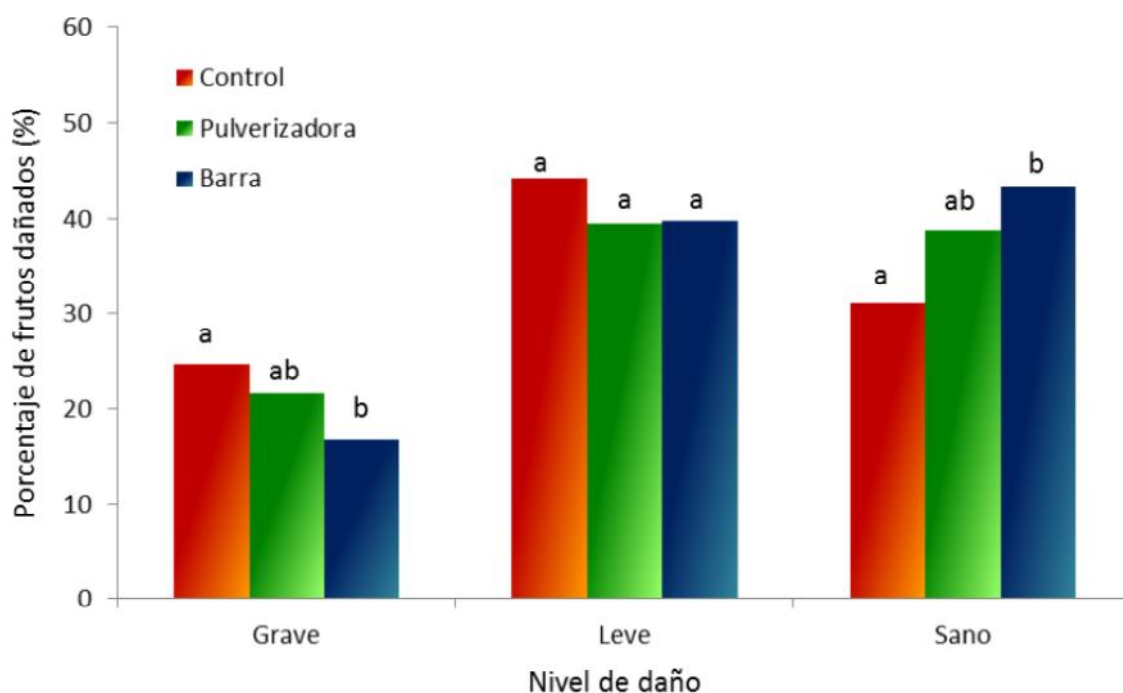
In the field, it was observed that the applications were more homogeneous and work better when the product reached the top of the trees when are using.

Table 2: incidence of sunburn in Granny Smith apple fruits treated with respect to the control SUNCROPS

TREATMENT	SUNBURN LEVELS (%)		
	<i>Healthy</i>	<i>Slight damage</i>	<i>Serious injury</i>
Control	31,07 a	44,29 a	24,64 a
Sprayer	38,87 ab	39,55 a	21,58 ab
Bar or Tower	43,46 b	39,83 a	16,71 b

Different letters in the column indicate significant differences ($P < .05$).

ENGLISH	SPANISH
Control	Control
Sprayer	Pulverizadora o Nebulizadora
Bar or Tower:	Barra
Percentage of fruits damaged	Porcentaje de frutos dañados
Level of damage	Nivel de daño



Graph 2: Percentage of fruits damaged by sunburn, Control and treatments with applied SUNCROPS. With spray compare to a bar. Different letters on the bars of the graph indicate significant difference ($P < 0.05$)



3. Fruit quality

The quality factors and maturity of the fruits, in general there was no difference.

Only registered increased flesh firmness, which was significantly higher than the control when applied with spray bar (Table 3).

Table 3: Morphological and quality index of maturity in Granny Smith apple fruit. SUNCROPS treated compare to control.

Treatment	Weight (g)	Diameter (mm)	Flesh firmness (Lbs.)	Soluble solids (°Brix)	Index starch (%)
Control	203,6 a	77,8 a	18,1 a	11,8 a	20 a
Sprayer	212,7 a	79,1 a	17,4 a	11,7 a	27 a
Bar or Tower	205,1 a	78,1 a	19,2 b	12,4 a	25 a

Different letters in the column indicate significant differences ($P < .05$).

4. Vegetative items

Regarding vegetative aspects, such as chlorophyll, dry matter and leaf area, there was no difference due to the application of the product (Table 4).



Table 4: Vegetative variables in Granny Smith apple trees, treated compare with the control SUNCROPS

Treatment	Chlorophyll (SPAD)	Dry matter (mg/cm ²)	Foliar area (cm ²)
Control	43.75 a	11.37 a	19.12 a
Sprayer	42.87 a	10.89 a	18.85 a
Bar or Tower	42.92 a	11.04 a	19.52 a

Different letters in the column indicate significant differences ($P < .05$).

CONCLUSIONS

The results obtained in this study agree with the technical assessments carried out field, at both levels of analysis concluded that:

- The product SUNCROPS exerts protective effect against the "Sunburn" of fruits.
- The level of protection of the fruits was higher when using bar tool.
- The fruit quality was generally not modified by the treatments though, could be increase the firmness of flesh.
- The vegetative parameters were not affected by the application of SUNCROPS.

Finally, in the conditions in which the study was conducted, we can conclude that SUNCROPS is a valid product to prevent a control of "Sunburn" in apple fruits.



RECOMMENDATIONS

Given the differences between the application with sprayer and tool bar, which were appreciated from the execution of the test, even in the statistical results, further analysis are recommended further analysis of product concentrations and application tools.