

■ Technical Paper ■



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Pineapple

Surround[®] for Pineapple

Crop Protectant

■ Technical Paper ■

Surround crop protectant for the reduction of sunburn damage and heat stress in pineapple

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Abstract

Planned applications of Surround Crop Protectant on crops provide plant surface protection from heat and sunburn damage by reducing the damaging effects of harmful infrared (IR) and ultraviolet (UV) radiation.

Pineapple plants and fruits are susceptible to damage from solar radiation and high temperatures. Damage to pineapples can result in significant financial losses. Symptoms include external sunburn or bleaching and internal sunburn or “boiling.” Pineapples with external sunburn show a bleached, yellow-white skin that turns pale grey/brown upon damage to the tissue underneath. These damaged areas are susceptible to disease infection. Sunburn is common during hot (> 32°C or 89°F) periods of the year. Internal sunburn, thought to be the result of high air temperatures, renders the fruit unfit for commercial use. Internal sunburn cannot be detected without cutting open the fruit. Highly translucent fruit appears to be most susceptible to internal sunburn.

Replicated trials in Australia, Costa Rica and South Africa show that applications of Surround WP initially applied before heat events significantly reduce the incidence of external and internal sunburn. In addition, in the hot dry conditions of western Costa Rica, applications of Surround prevent leaf damage, resulting in a significant yield increase ($P>0.05$).

Introduction

Pineapples are susceptible to damage from solar radiation and high temperatures at various stages during the growing cycle. This damage can lead to significant economic losses for pineapple growers.



The symptoms of solar damage in mature pineapple fruit include external sunburn or bleaching and internal sunburn or “boiling.” Pineapples with external sunburn show a bleached,

yellow-white skin that turns pale grey/brown upon damage to the tissue underneath. These damaged areas are susceptible to disease infection. Sunburn is common during hot (> 32°C or 89°F) periods of the year. Internal sunburn, thought to be the result of high air temperatures, renders the fruit unfit for commercial use. Internal sunburn cannot be detected without cutting open the fruit. Highly translucent fruit appears to be most susceptible to internal sunburn.

Surround WP crop protectant is a relatively new product that was developed for plant surface protection. Planned applications of Surround WP on crops provide plant surface protection from heat and sunburn damage by reducing the damaging effects of harmful infrared (IR) and ultraviolet (UV) radiation.



Surround WP contains specially engineered particles of kaolin, a naturally occurring, soft, inert white mineral. Surround WP is formulated as a wettable powder that suspends readily in water and is easily applied with conventional agricultural spraying equipment. Once dry, Surround WP forms a white “particle film” that reflects harmful infrared and ultraviolet light, reducing the incidence of sunburn on plants, fruits and vegetables. Under high temperatures, Surround-treated plants are much cooler than those that are untreated, reducing heat stress.

Surround has been successfully used since 1999 in many countries for protection from sunburn and heat stress in many tree fruit, vine and vegetable crops, including apples, pears, plums, olives, pineapples, tomatoes, mangoes, avocados, citrus, capsicums, melons and grapes.

The objective of the work reported in this paper is to investigate the performance of Surround WP in protecting maturing pineapple fruit from solar injury. The work was conducted in Australia, Costa Rica and South Africa.*

Further work is underway to evaluate the benefit of protection from heat stress in pineapples at critical growth periods, such as immediately after planting; during flower induction; between induction and fruit development; and

during early fruit development. The benefits of season-long heat stress management are also under investigation.

Major findings of Surround field studies in pineapple in Australia, South Africa and Costa Rica

Trial Sites, Application Details and Data Measurements

Australia

Five trials were established in crops of Smooth Cayenne pineapple in Queensland, four in the southeast region and one at Bundaberg. The trials were conducted on commercial processing pineapple farms. Four dose rates, from 25 kg/ha up to 100 kg/ha (22 to 88 lb/acre) for the initial application, were evaluated and compared to an untreated control and a local grower standard.

The initial application of Surround WP was made at the full rate designated for the treatment. Subsequent applications of Surround WP were at half rates, and were made seven to 10 days after the initial application. Further applications were applied as necessary at approximately three-week intervals, or after heavy rain.

Data were collected on spray coverage, crop safety, fruit weight, fruit size and rain-fastness.

South Africa



Five trials were conducted in 2004 in crops of Smooth Cayenne pineapple in the Bathurst area. These sites were situated in the Langholm, Salem, Shaw Park and Martindale areas. At each site, Surround was applied by boom spray at the recommended rates of 50 kg/ha (44 lbs/acre) for initial applications and 25 kg/ha (22 lbs/acre) for the subsequent applications. The number of applications varied from one to three. Unsprayed areas were left as controls. Small plots were established in all areas, with each treatment replicated six times.

Each plot contained approximately 50 fruit for data collection. At harvest, each fruit was weighed and then immediately cut and inspected for the presence of internal sunburn. The sites at Shaw Park and Martindale were

abandoned, as there was no evidence of sunburn in the control fruit.

Costa Rica

The trial was conducted in January through March, in a crop of a “Super Sweet” variety of pineapple, located in Parrita, in the Central Pacific zone of Costa Rica. Two rates of Surround WP, 64 kg/ha (56 lbs/acre) and 92 kg/ha (81 lbs/acre), were tested and compared to an untreated control.

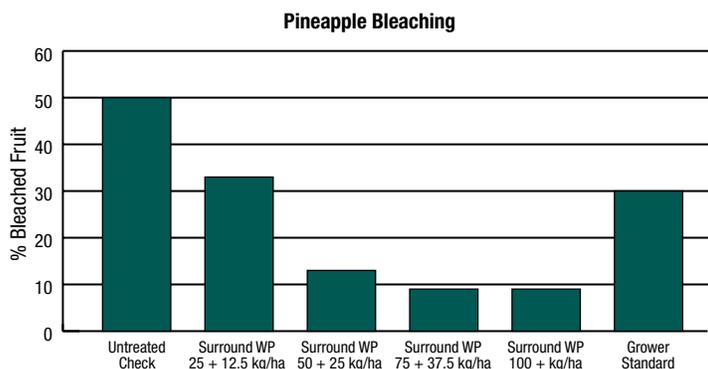
Treatments were applied using the standard farm boom and nozzle spray for foliar fertilizer applications. Three applications per treatment were made at 30-day intervals starting approximately 100 days before harvest.

Data was collected on yield, fruit size and sunburn (reduction of waste).

Results

Australia

Pineapple Sunburn/Bleaching



Fifty percent of the fruit harvested from the untreated control showed signs of sunburn or sun bleaching. In the treated blocks there was a trend toward decreased sunburn with increasing rates of Surround. Rates of Surround above 50 + 25 kg/ha (44 + 22 lbs/acre) provided more than 70 percent reduction in sunburn damage versus the untreated control and more than 50 percent better than the local grower standard.

Fruit Weight

Fruit harvested from each treatment within each trial were weighed. There was a numerical, but not statistical, increase in weight over the untreated control and grower standard and a general trend toward heavier fruit with increasing rates of Surround.



No.	Treatment	A	B	C	D	E	Mean
		Fruit weight – grams					
1.	Untreated Check	1540.9 a	1421.2 a	1595.6 a	1572.2 a	1712.7 a	1568.6 ab
2.	Surround WP 25 + 12.5 kg/ha	1568.8 a	1356.7 a	1758.7 a	1566.7 a	1642.0 a	1578.6 ab
3.	Surround WP 50 + 25 kg/ha	1660.5 a	1412.2 a	1670.7 a	1610.3 a	1619.7 a	1594.7 ab
4.	Surround WP 75 + 37.5 kg/ha	1540.3 a	1486.8 a	1657.4 a	1603.0 a	1636.3 a	1584.7 ab
5.	Surround WP 100 + 50 kg/ha	1591.8 a	1494.3 a	1808.9 a	1556.9 a	1706.0 a	1631.6 a
6.	Grower Standard	1491.3 a	1411.4 a	1495.6 a	1509.7 a	1661.3 a	1513.8 b

Letters indicate significance difference (p=0.05)

There were no measurable differences in fruit length or girth between treatments.

South Africa

Internal Sunburn

In the three sites with internal sunburn in the untreated control, Surround WP crop protectant significantly reduced the incidence of internal sunburn. There was a mean reduction of internal sunburn of 46 percent in the three sites.

Percent of Fruit With Internal Sunburn

There was no evidence of external sunburn in any of the trial sites. During the process of inspecting the fruit it became obvious that the fruit most likely to be affected by internal sunburn were those showing “green shell translucence.” Fruit showing a normal presentation of shell color tended to have typical translucence and were not affected.

Percent of Fruit With Internal Sunburn

Treatment	Site 1	Site 2	Site 3	Mean
Surround WP	16.9	11.7	36.7	21.7
Control	29.3	30.0	61.7	40.3
% Reduction	42.3	61.1	40.6	46.1

There was no measurable difference on fruit weight between treatments.

Yield of pineapple fruits by size in Costa Rica.

Average number of fruits per Fruit Size Category of 100 fruit harvested												
Fruit Size Category (Fruits/box)/Treatment	4	% Incr.*	5	% Incr.	6	% Incr.	7	% Incr.	8	% Incr.	9	% Incr.
0 kg/Ha	4.40	–	35.40	–	30.20	–	11.80	–	5.80	–	1.40	–
64 kg/Ha	6.75	53	40.62	15	23.37	-23	11.50	-3	6.37	10	2.62	87
92 kg/Ha	8.88	102	38.75	9	29.37	-3	10.37	-12	5.25	-9	1.75	25

* % Incr. = percent increment in relation to the control treatment. Percent increases in bold are statistically significant (P>0.05) versus the control.

Costa Rica

Pineapple Yield

In the Surround treatments there was an overall shift toward larger size fruit as measured by the number of fruit per each box category. Surround treatments increased production of fruits of categories (fruits/box) 4 and 5 at percent increments ranging from 9 percent to 102 percent.

Pineapple Fruit Waste

In the Surround WP-treated plots, pineapple fruit waste was reduced 20 percent and 49 percent by the 64 and 92 kg/ha (56 and 81 lbs/acre) rates respectively, as compared to the untreated control. Waste in the untreated control was primarily due to sunburn. Waste in the Surround treatments was lower than the control primarily because there were no sunburned fruit in the Surround treatments.

Treatment kg/ha	Total Waste (% of harvested fruits)	Percent Waste Reduction as compared to the untreated control
0	11.0	–
64	8.75	20.45
92	5.62	48.91

Other Observations

The leaves treated with Surround showed very few symptoms of sunburn. In comparison, the control plot plant leaves showed very conspicuous yellow and/or brown sunburn damage in the leaves.

It was observed that the Surround WP-applied plots appeared to be ready for harvest earlier than the control plots. Given that this was the first harvest of fruit treated with Surround at this farm site, it may be inferred that fruits in the Surround WP-treated blocks reached harvesting size earlier than those in the untreated control. The harvest was not made earlier as this potential

harvesting advantage was not known.

As is standard in research trials, fruits from the border and drainage areas were not collected for measurement. However, it was observed that more of the fruits in the Surround WP-treated plots were healthy at harvest, including those in the border and drainage areas, compared to those in the control plot. This parameter was



not measured in the field.

Conclusions

Pineapple Sunburn

In trials in all three countries, the use of Surround, applied to the pineapple plant and fruit prior to the onset of high temperatures, significantly reduced the symptoms of solar injury, including external and internal sunburn. In addition, increasing use rates of Surround, up to a point of diminishing return, provided a corresponding increase in the reduction of solar injury.

No phytotoxic effects were observed.

Pineapple Fruit Weight

The data suggest that Surround may influence pineapple weight and size if the product prevents leaf damage. Given the variability in the trial conditions (number of applications, application timing, dose rates, temperatures, precipitation, etc.) between the three countries and



individual trial sites, it is unclear whether other conditions may lead to increases in fruit weight and size.

Other Observations

In the Costa Rica trial, where Surround was applied 100 days prior to harvest, there were additional observations made that may be relevant to the use of Surround for heat stress management in pineapple. These should be investigated further. First, in the Surround WP-treated plots a reduction in the yellowing of the pineapple plant's leaves was observed. Second, the fruits in the Surround-treated blocks appeared to be ready for harvest (e.g., had reached harvestable size, earlier than those in the untreated plots.) Third, it was observed that there were more healthy fruit in the Surround WP-treated plots, including those in the border and drainage areas (and therefore not collected for measurement) than in the untreated plots.

It is theorised that the reduction in damage to the leaves may have contributed to the resulting increase in average fruit size recorded at harvest.

Crop Safety

Surround was safe to the pineapple crop in all trials.

Future Development

The results from these trials indicate that there are significant economic benefits to be gained from the management of solar injury and heat stress in commercial pineapple growing. While not statistically significant, the trend of increased fruit size observed in both the Australian and Costa Rican trials points toward the possibility that managing heat stress at key stages of the pineapple growing cycle could result in improved yields.

While not measured in the above trials, another area for investigation is the effect of heat stress management on the quality of pineapple fruits, in particular the content of soluble solids.

Further research into the benefits of using Surround for heat stress management in pineapple continues in Australia, South Africa, Costa Rica, the Philippines and Mexico.

Important: Always read the label before buying and follow label instructions when using this product.

The use of Surround WP in agricultural crop protection applications is covered by US Patents 6,027,740; 6,069,112; 6,110,867 and 6,156,327.

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