EVALUATION OF THE EFFECTS OF CROPAID NATURAL PLANT ANTIFREEZE ON COLD INJURY TO PLANTS, AND ON RELATIONSHIPS BETWEEN GROWTH AND TEMPERATURE

Effect of Cropaid NPA on frost damage to strawberry plants

Report of a study by ADAS UK Ltd., February to July 2006

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REPORT AUTHENTICATION

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Authentication

I declare that this work was done under my supervision according to the procedures described herein and that this report represents a true and accurate record of the results obtained.

..... Jeremy Wiltshire
Study Director

Date 31/8/06

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INTRODUCTION

Cropaid Natural Plant Antifreeze is marketed by Cropaid Ltd, to protect plants from cold harm and freezing. Other benefits claimed, include lowering the budget for heating in glasshouses, season extension, improved disease resistance, increased crop yields and improved quality. Benefits of the product claimed by Cropaid Ltd. include the following, quoted from Ecevit (2005).

- It increases resistance of greenhouse plants such as tomatoes, peppers, aubergine, strawberry, banana and carnation to cold effects and freezing, in turn lowering the budget for heating.
- It increases vineyard plants and crops' resistance against the late spring cold, reducing the financial losses of cold damage.
- It increases resistance of the plants that flower during early spring, such as apple, peach, plum, cherry, apricot to cold harm and freezing.
- The organic ingredients of Cropaid Natural Plant Antifreeze are easily absorbed and used by plants. Therefore, its effects start in a short period of time. It is important for horticulture.
- It gives plants more photosynthesis capability. Leaves become thicker, stronger and healthier. These properties make plants stronger against the outside effects and illnesses. It lowers the need for chemicals/pesticides.
- Plants yield more crops and/or produce more flowers.
- The Thiobacillus subspecies in Cropaid Natural Plant Antifreeze produces rusticyanin. Rusticyanin, that is absorbed very quickly by the plants, gives plants the ability to produce natural antifreeze proteins. They also help plants to absorb more minerals quicker.

This work tested the hypothesis that Cropaid NPA protects plants against frost injury.

METHODS

Strawberry plants were grown in a glasshouse until start of flowering, then they were placed outside for 1 week before exposure to night frost in closed cabinets.

There were two treatments:

1) Treated with Cropaid NPA,
2) Untreated.

The treated plants had been treated with Cropaid NPA at weekly intervals from early canopy development. Treated plants were sprayed with 5 g of Cropaid Natural Plant Antifreeze per litre of water, with a fine spray, to achieve good coverage of foliage, to the point of run-off. For untreated plants, water only was applied in the same way.

A picture of a typical plant about one week before chilling is shown in Figure 1.

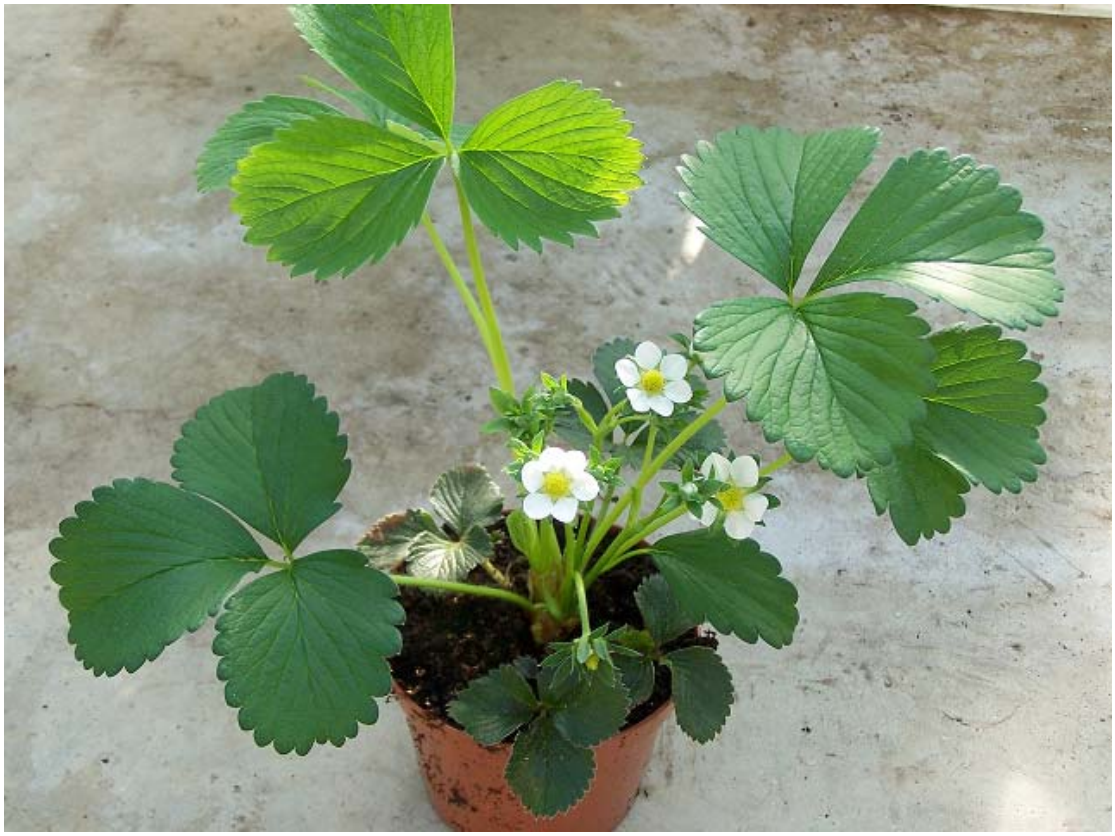

Figure 1. An example strawberry plant before chilling.

The cabinet temperature was decreased progressively until the minimum temperature of −3°C was reached. After 2.5 h at −3°C, the temperature was increased progressively to ambient temperature and the plants were returned to ambient conditions. Temperature changes were designed to mimic the profile of temperature change that could occur in UK ambient conditions in May (Figure 2).

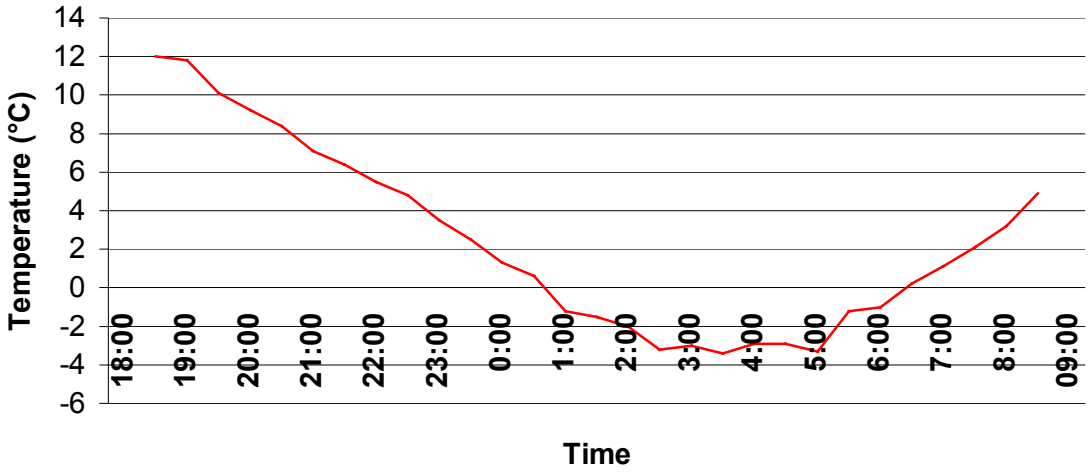

Figure 2. Temperature profile during exposure of strawberry plants to frost.

Plants were assessed for frost damage 1 day and 2 days after exposure to night frost.

RESULTS

A common feature of both treatments was partial petal drop during the cooling period, before the minimum frosting temperature was reached and in the first 6 hours after thawing, at which point the retained petals showed no sign of discoloration.

After 24 hours, retained petals were either not discoloured or showed browning at their outermost margins, not exceeding 20% of the petal surface area.

The receptacles (the centre of the flower, normally yellow) of the flowers showed browning in both treatments.

Leaf damage and leaf curl occurred, typically affecting about 20% of the entire leaf area, with limited discoloration. There was no sign of waterlogging or desiccation in the damaged regions.

Results of the assessment after 24 hours are shown in Figure 3.

Effects of Cropaid NPA on basal leaf damage, petal browning and petal drop were statistically significant ($P<0.05$). Effects on leaf curl, and collapse of the petiole or peduncle were not statistically significant at the 5% probability threshold.

After 48 h, no further symptoms of foliar injury were observed indicating that the injury seen after 24 hours was not progressive. However, browning of the receptacle tissues was evident in both treatments (Figure 4).

These data were analysed using generalised linear models, treating the data as binomial. The results showed that application of Cropaid NPA gave a significant decrease in receptacle damage ($P=0.047$). Of the untreated flowers 39% showed significant receptacle browning, and 23% of the flowers on treated plants were similarly affected.

Pictures of example plants are shown in Figures 5-8.

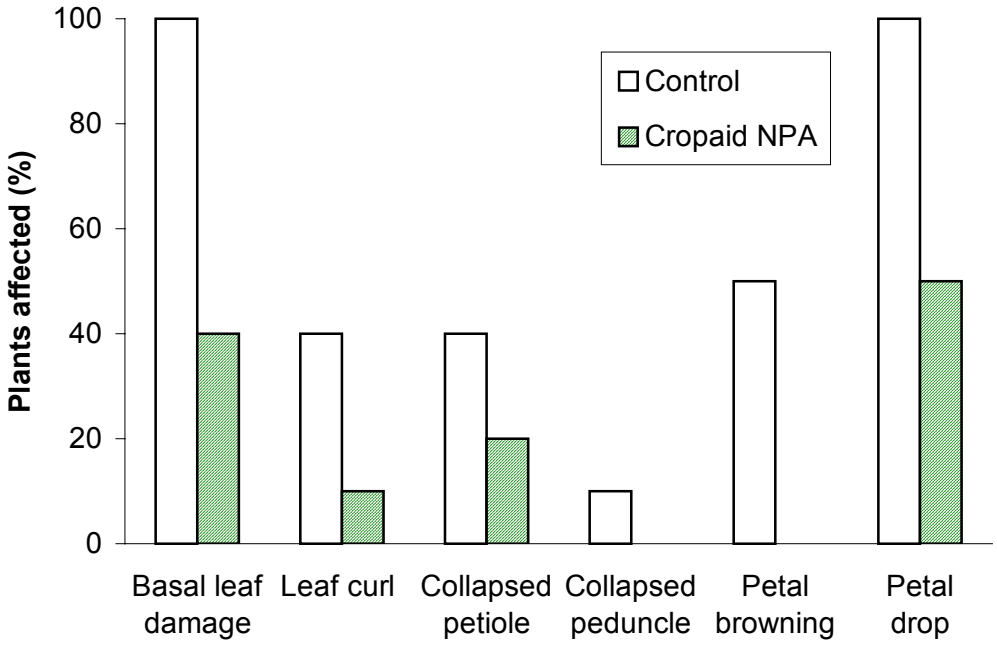

Figure 3. Symptoms of frost injury 24 hours after removal from the frosting cabinet (petiole = leaf stalk, peduncle = flower stalk).

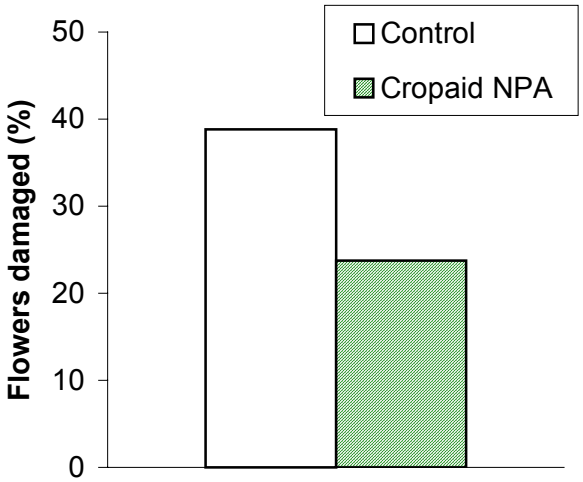

Figure 4. Floral symptoms (damage to receptacle) 48 hours after removal from the frosting cabinet.

Figure 5. A typical control plant, prior to frosting, with dark green foliage and unmarked, white petals. The receptacle tissues are yellow-green without any browning.

Figure 6. An untreated plant 24 hours after frosting, showing collapsed petioles, petal browning and browning of the receptacle tissues.

Figure 7. Petal and receptacle discoloration in an untreated plant 48 hours after frosting.

Figure 8. Persistent leaf lamina damage in a Cropaid NPA treated plant 48 hours after frosting.

DISCUSSION

The symptoms of injury, where they occurred, were expressed with equal severity in treated and untreated plants. However, it is clear that the incidence of injury to flowers and leaves was reduced by treatment.

Application of Cropaid NPA decreased basal leaf damage, petal browning, petal drop and receptacle browning. These results demonstrate the potential of Cropaid NPA to decrease incidence of frost damage to leaves and flowers of strawberry plants.

Flowers that show receptacle browning do not usually produce a fruit. Frost damage of this type is likely to affect the timing of fruit production, with a consequent decrease in yield for a short period when the damaged flowers would have produced mature fruit. This would add to the variability in yield, making it difficult for producers to guarantee constant supplies to customers.

When frost causes receptacle browning in commercial crops, it is usual for other flowers, not showing browning, to be damaged to a lesser extent. These less severely damaged flowers produce fruit that is mis-shapen and often unsaleable. Yield of saleable fruit is decreased and continuity of supply is more difficult.

Maintenance of a healthy leaf canopy is important to maximise yield and fruit size. Thus, effects of frost on leaf damage would be expected to influence yield and fruit size.

It has been suggested that the effects of Cropaid NPA on strawberry frost resistance would be greater if the plants were treated earlier, during plant production. The distributor recommends that plants should be dipped in Cropaid NPA solution before planting. Further tests would be needed to confirm that these changes in application and production methods would result in a commercial benefit.

It is concluded that application of Cropaid NPA has potential to decrease the risk of economic loss through frost damage, by decreasing damage to flowers and foliage when frost occurs.

ACKNOWLEDGEMENT

Professor Brian Grout at Writtle College is gratefully acknowledged, for help with exposure of plants to frost, frost damage assessments, and the photographs in this report.

CONCLUSIONS

This work tested the hypothesis that Cropaid NPA protects plants against frost injury.

There was evidence that Cropaid NPA protects strawberry plants against frost injury.

Application of Cropaid NPA to strawberry crops has potential to decrease the risk of economic loss through frost damage, by decreasing damage to flowers and foliage when frost occurs.

REFERENCE

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