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 field-grown potato plants

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

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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.

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Date 31/8/06

Report authorised by: .....

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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.

MATERIAL AND METHODS

Seed potato tubers were planted at Terrington St Clement, Norfolk, on 07 March 2006, in a deep silt soil. The seed tubers, of variety Swift had been sprouted to encourage rapid emergence. There were two treatment factors (Table 1).

Table 1. Treatment factors.

Treatment factor	Treatment ID	Treatment details
Seed treatment	S1	No application of Cropaid Natural Plant Antifreeze to seed tubers
	S2	Application of Cropaid Natural Plant Antifreeze to seed tubers
Foliage treatment	F1	No application of Cropaid Natural Plant Antifreeze to foliage
	F2	Application of Cropaid Natural Plant Antifreeze to foliage

All combinations of these treatment factors gave four treatments:

1) S1 F1
2) S1 F2
3) S2 F1
4) S2 F2

There were nine replicates of each treatment, and each plot was a single plant.

Seed tubers were planted shallow, under 50 mm of soil, to encourage rapid emergence. Plots were covered with fleece until after full emergence: full emergence was on 10 April; an application of Cropaid NPA was made to emerged foliage on 11 April. This application was followed by rain within 2 hours, so re-application was made on 12 April. Fleece was removed on 13 April.

Growth measurements were taken on 09 May and 26 May.

Six plants (three S1 F1 and three S2 F2) were dug up and potted prior to exposure to frost in a cabinet, each on a different night. Exposure to frost was for 2 hours and 30 minutes at approximately –3.5°C. Temperature changes between ambient and the minimum occurred over a period of approximately 2 hours. Each plant was treated with Cropaid NPA three days before exposure to frost.

RESULTS

First emergence was on 03 April and full emergence was on 10 April. Progress of emergence is shown in Figure 1. For each individual assessment date, there were no statistical differences in emergence between untreated and Cropaid NPA treated plants. However, analysis of the data set as a whole, by fitting curves, showed that emergence of Cropaid NPA treated plants was consistently, and significantly ahead of emergence of untreated plants, by about 12% of emergence. The Cropaid NPA treatment was approximately one day ahead of the untreated.

Frosts recorded after removal of fleece are detailed in Table 2. No frost damage to plants was seen in the field.

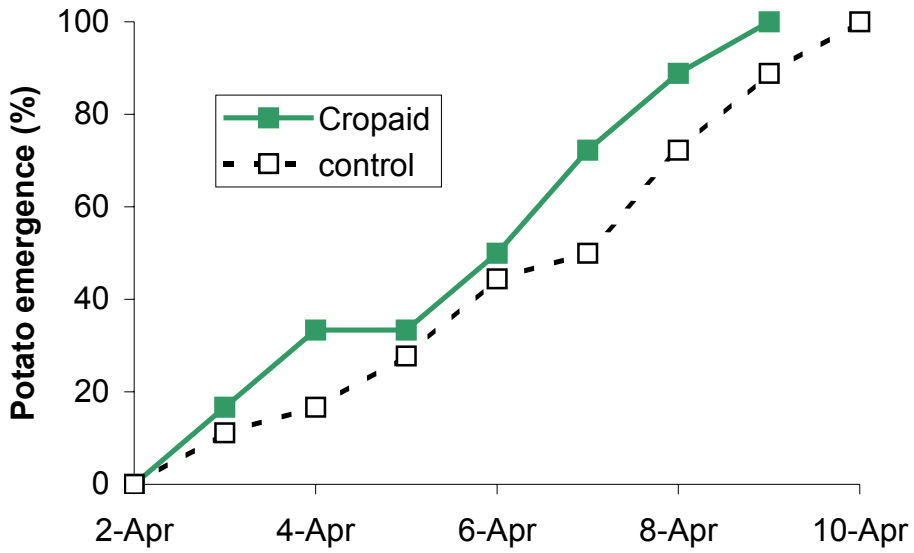

Figure 1. Effect of Cropaid NPA applied to seed tubers before planting, on time of potato plant emergence.

Table 2. Frosts recorded after removal of fleece.

Date	Air minimum (°C)	Grass minimum (°C)
15 April	5.2	-0.8
16 April	4.5	-0.1
17 April	4.2	-0.4
28 April	4.2	-0.9
02 May	2.2	-2.0

Growth measurements are shown in Figures 2 to 5. On 26 May, untreated plants had fewer leaves per stem than treated plants (Figure 3), and this difference was close to statistical significance at the 5% probability level (P=0.056).

Differences in vigour were not statistically significant at the 5% probability level, but there were significant differences at the 10% probability level. On 09 May (Figure 2), vigour was lower in plants with Cropaid NPA application to seed tubers, compared with other treatments (P=0.083). However, on 26 May vigour was greater in plants treated with Cropaid NPA, compared with untreated plants (Figure 3) (P=0.087).

Differences in stem number between dates are because some plants had been removed before 26 May, so these data were collected from fewer plants.

Values for stem height on 09 May (Figure 4) were significantly lower in plants with Cropaid NPA application to seed tubers, compared with other treatments (P=0.041).

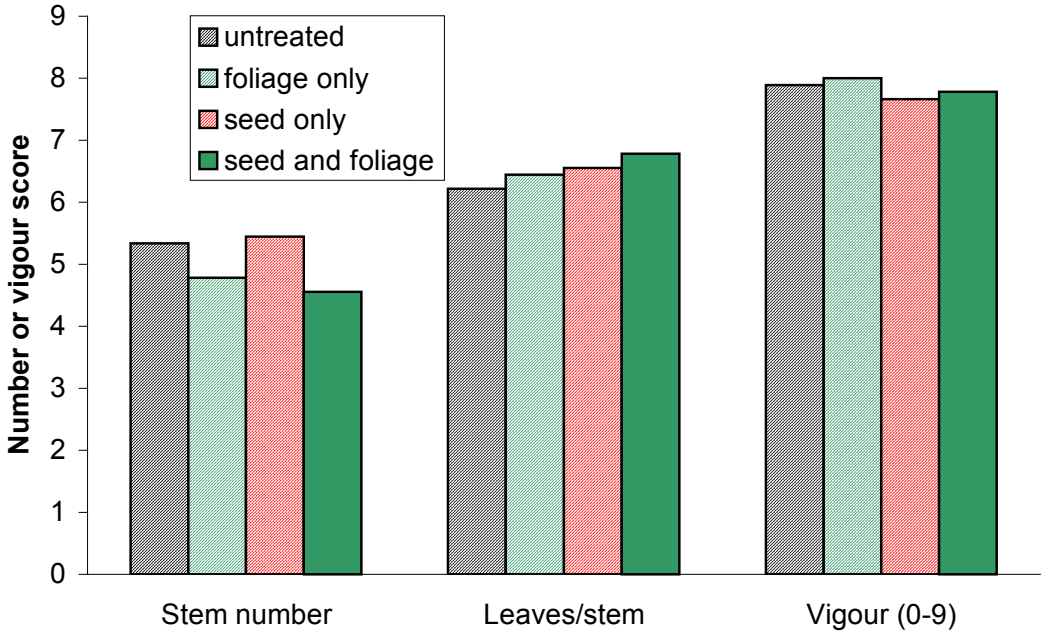

Figure 2. Effects of Cropaid NPA treatment to seed tubers only, foliage only, or both, on stem number per plant, leaf number per stem and vigour score (0-9), on 09 May.

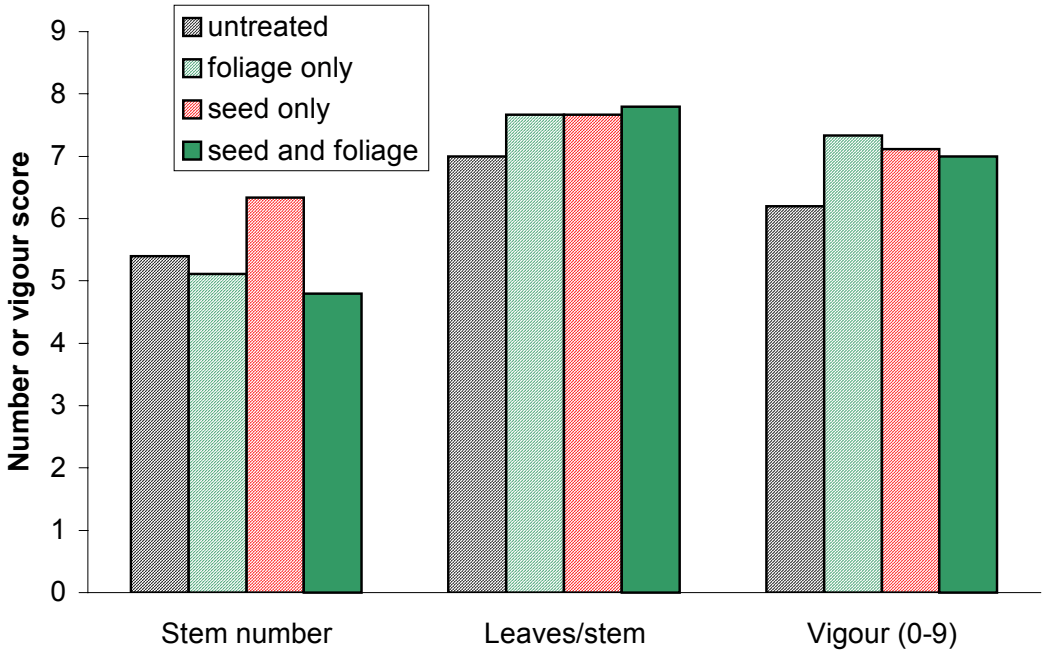

Figure 3. Effects of Cropaid NPA treatment to seed tubers only, foliage only, or both, on stem number per plant, leaf number per stem and vigour score (0-9), on 26 May.

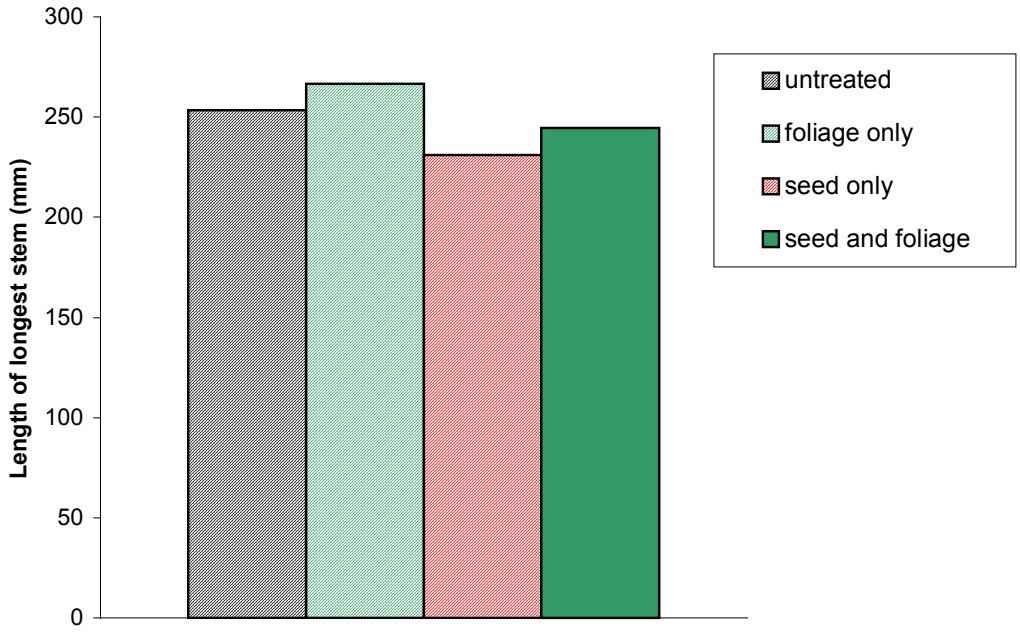

Figure 4. Effects of Cropaid NPA treatment to seed tubers only, foliage only, or both, on length of longest stem (mm), on 09 May.

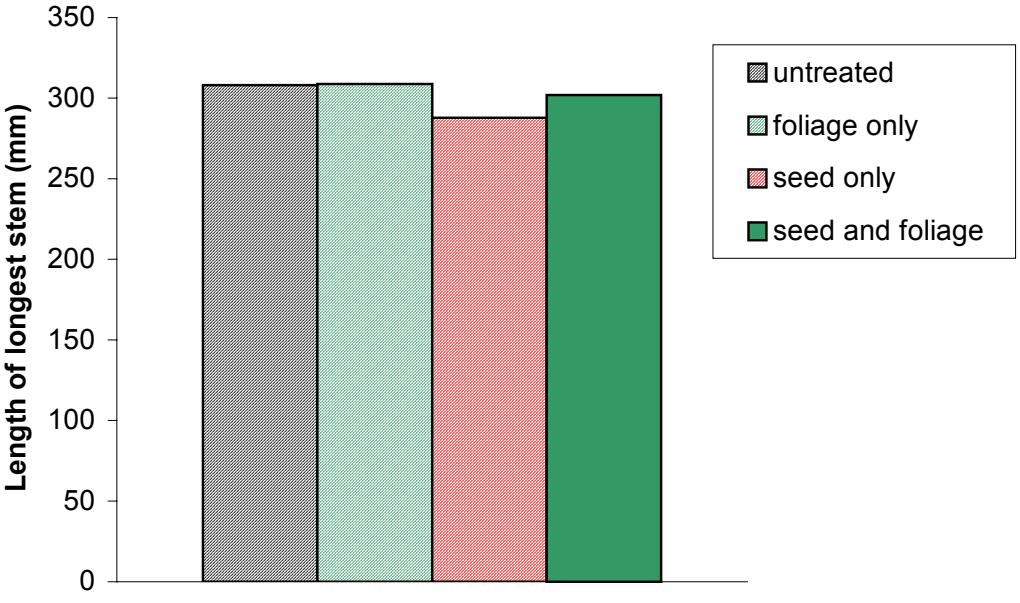

Figure 5. Effects of Cropaid NPA treatment to seed tubers only, foliage only, or both, on length of longest stem (mm), on 26 May.

After exposure to frost in a cabinet all plants were damaged by frost (Figure 6). The three plants treated with Cropaid NPA were less severely damaged than the three untreated plants (averages: for Cropaid NPA treatment, 57% leaf area lost compared with 73% for untreated). These data have not been analysed statistically because there are too few replicates. An example pair of plants is shown in Figure 7.

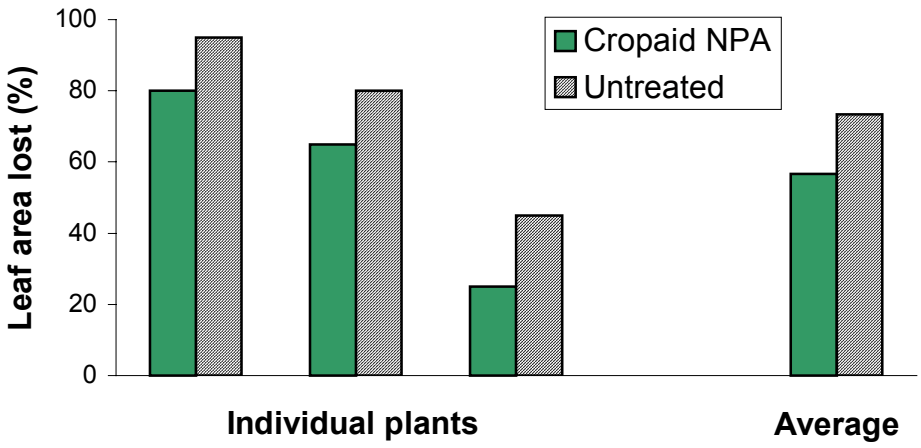

Figure 6. Frost damage to potato plants (% leaf area lost).

Figure 7. Example pair of potato plants after exposure to frost for 2 hours and 30 minutes at approximately –3.5°C. The top plant was untreated and the bottom plant was treated with Cropaid NPA three days before exposure to frost.

DISCUSSION

This study provides further evidence of product activity, to accompany clear evidence of improved frost resistance in strawberry plants in another study by ADAS.

Cropaid NPA treatment advanced emergence by one day, after application to seed tubers. This small, but statistically significant effect indicates more rapid growth of sprouts after planting into a cold soil. Planting date was approximately five weeks earlier than the normal planting date for this site.

There was some indication that Cropaid NPA advanced growth stage (evident from increased leaf number per stem) and, at six weeks after emergence, increased vigour score.

The frost resistance test using a cabinet was not done in ideal conditions for testing this product. The cabinet used for this test was not suited to simulation of a natural diurnal temperature profile. A more natural (gradual) decline and subsequent increase in temperature might be expected to cause less severe frost damage. Despite this, for each of the three pairs of plants tested, the Cropaid NPA treated plants were less severely damaged than untreated plants.

CONCLUSIONS

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

There was evidence of decreased susceptibility to frost injury following application of Cropaid NPA to potato plants. Decreased susceptibility to frost damage on a field scale would decrease the risk of economic loss, especially in early crops. A consistent decrease in frost damage risk may also allow earlier planting of early crops, allowing earlier access to markets when potato prices are usually higher.

REFERENCE

ECEVİT, F. M., 2005. The report of the results on applications and trials of bimas natural plant antifreeze for assisting plants against cold harm and freezing. Document supplied by Cropaid Ltd., Unit 11, Imperial Park Industrial Estate, Towerfield Road, Shoeburyness, Essex, SS3 9QT, UK.