Grower Summary

HNS 171a

Cordyline and Phormium: Investigation of causes of tip burn and yellow leaf spot syndrome

Annual 2013

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Further information

If you would like a copy of the full report, please email the HDC office (hdc@hdc.ahdb.org.uk), quoting your HDC number, alternatively contact the HDC at the address below.

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Project Number:	HNS 171a
Project Title:	Cordyline and Phormium: Investigation of causes of tip burn and yellow leaf spot syndrome
Project Leader:	Jill England
Contractor:	ADAS UK Ltd
Industry Representative:	David Hooker – Hillier Nurseries Steve Carter – Fleurie Nurseries Chris Bowman – Osberton Nurseries Ltd
Report:	Annual Report 2013
Publication Date:	October 2013
Previous report/(s):	N/A
Start Date:	01 May 2010
End Date:	31 July 2014
Project Cost:	£94,550

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Headlines

Application of calcium nitrate (foliar and liquid feed) and potassium nitrate (liquid feed) may reduce both tip burn and yellow leaf spot symptoms.

Background

Cordyline yellow leaf spot syndrome and tip burn in both *Cordyline* and *Phormium* have been identified as major problems to the horticulture industry, affecting production with no clearly established causes, leaving growers unable to take reliable practical courses of action to address them (England 2009). An estimated 1 million and 1.24 million *Cordyline* and *Phormium* plants are grown each year respectively.

Tip burn

No clear cause has previously been established for tip burn in *Cordyline* and *Phormium*. Study HNS 171 estimated the value of *Cordyline* and *Phormium* crops affected by tip burn in excess of £1 million (England 2009). Leaf margin and tip browning symptoms in plants can be caused by nutrient imbalance including calcium, potassium and boron deficiency, and boron and fluoride toxicity, of which fluoride toxicity has been reported in *Cordyline* (Conover and Poole 1971), but not in *Phormium*. Typical macroscopic symptoms of fluoride toxicity are tip and margin necrosis (tip burn) with a distinct reddish-brown line separating it from healthy tissue in both monocotyledons and broad leaved plants (Fornasiero 2001).

Nutrient feeding trials carried out in year 1 of this project proved inconclusive. A large proportion of the *Cordyline* and *Phormium* plants were damaged during severe cold weather experienced during the winter, before the final results could be recorded. Plant tissue analysis revealed that fluoride accumulation in leaves increased with fluoride dose rate. Results also suggested that tip burn was associated with higher calcium levels, possibly through a reduction in potassium uptake, however no firm conclusions could be drawn.

Cordyline yellow leaf spot syndrome

Cordyline yellow leaf spot syndrome is a condition of unknown cause that reduces the quality and profitability of these plants. The symptoms are unsightly yellow leaf spots, initially small raised pustules, apparently water soaked, that sometimes turn necrotic (Figure 1). Sales losses have been reported by nurseries throughout the UK, and HNS 171 estimated the loss across those Cordyline producers who responded to the survey, at £119,437 each year. Additional losses are likely to be incurred once plants are distributed to retail nurseries and

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garden centres as larger plants appear to be affected more than plugs and liners (England, 2009).

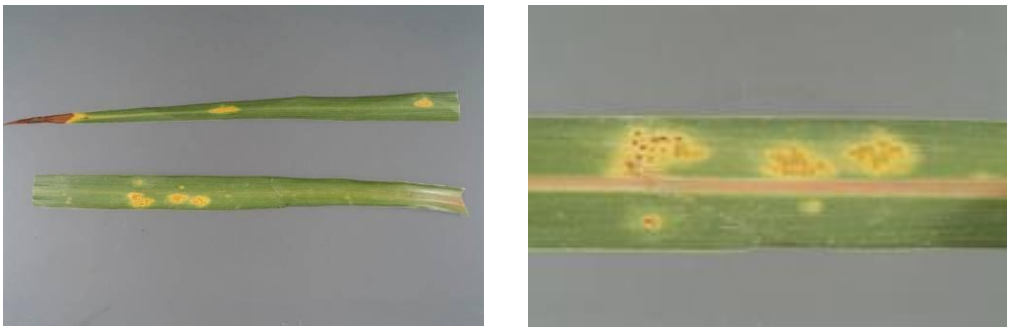

Figure 1. *Cordyline* leaf spot symptoms: raised pustules, initially chlorotic but becoming necrotic (Charles Lane, Fera).

In year 1, 33 *Cordyline* samples were screened for the presence of three viral pathogens (Cucumber mosaic virus, CMV; Tomato spotted wilt virus, TSWV; and *Impatiens* necrotic spot virus, INSV), all commonly found in a wide range of ornamental species and potentially linked to leaf spotting, and virus particles (Transmission Electron Microscope followed by inoculation onto a standard range of bio-indicator plants to assess whether any 'transmissible' pathogens were present). None of the viruses screened for, nor virus particles were detected in any of the samples tested, with or without symptoms. It was concluded that there was no commonly identified viral cause for leaf spotting in *Cordyline*.

A controlled environment study of *Cordyline* in year 1 aimed to reproduce oedema symptoms in leaf segments. A range of environmental conditions were investigated, but none of the combinations of light, temperature and humidity used reproduced the symptoms.

Summary of the project and main conclusions

Two areas of work were carried out during 2011/12:

- **Objective 1. Tip burn:** Investigate the involvement of nutrient imbalance and fluoride toxicity in tip burn through nutrient feeding trials.
- **Objective 2.** This section of work was completed in year 1.
- **Objective 3. *Cordyline yellow* leaf spot syndrome:** Monitor the environmental conditions under which *Cordyline* yellow leaf spot syndrome develops in commercially produced crops.

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Objective 1. Tip burn (and yellow leaf spot) nutrition trial

The impact of calcium, potassium and fluoride on tip burn in *Cordyline* and *Phormium* were investigated via a nutrition trial. The trial was set up on 12 October 2011, sited within an unheated polytunnel at East Malling Research. Plants (*Cordyline australis* 'Red Star' and *Phormium* 'Yellow Wave') were potted into 3 L pots and irrigated via drip irrigation, and by hand watering as necessary during the winter. The nutrient feeding trial treatments, based on the results from year 1, previous research and best practice, were foliar and liquid feeds of calcium (applied as calcium nitrate, 1520 mg/L and 150 mg/L respectively), liquid feeds of potassium (applied as potassium nitrate, 200 mg/L and 50 mg/L; and potassium sulphate, 200 mg/L) and liquid feeds of fluoride (applied as sodium fluoride, 3.0 mg/L). Water only was applied as a control treatment throughout. The calcium and potassium treatments were applied weekly. Fluoride was applied at each irrigation. Following the interim assessment (4 July 2012) the fluoride dose rate was increased to 5.0 mg/L. The liquid feed treatments were applied via Dosatron D3 Greenline injectors governed by Galcon DC-4S controllers.

Tip burn was beginning to develop in the *Cordyline* by the planned final assessment (October 2012), although there were no visible differences between treatments, and no tip burn was found in the *Phormium*. However, as both tip burn and yellow leaf spot symptoms were developing on the *Cordyline*, the trial was extended until February 2013, with assessments at the end of November, January and February.

After 29 weeks of treatment, tip burn in *Cordyline* was significantly less in the calcium nitrate (liquid and foliar) and potassium nitrate (high dose rate) treatments than the untreated control and other treatments (Figure 2). The results at all three assessments generally followed the same trend, except that the level of tip burn measured in the control was reduced after 42 weeks, due to the breakdown and loss of dry necrotic tissue. The highest level of tip burn was recorded in all treatments at the week 29 assessment.

Plant quality was scored on a scale of 0-5 (0 = dead plants, 5 = no tip burn). Plant quality scores were greater in the potassium nitrate (high dose rate) and calcium liquid feed treatments, although all plots were given scores of 3 (over 50% of plants saleable) and above after 29 and 38 weeks of treatment, with no symptom-free plots. After 42 weeks of treatment the results generally followed the same trends, but plant quality appeared to have reduced in the potassium nitrate (low dose), potassium sulphate and fluoride treatments and the untreated control. Although the majority of plants in the trial were marketable, increased levels of tip burn and leaf spot result in increased labour cost due to plant cleaning operations at dispatch.

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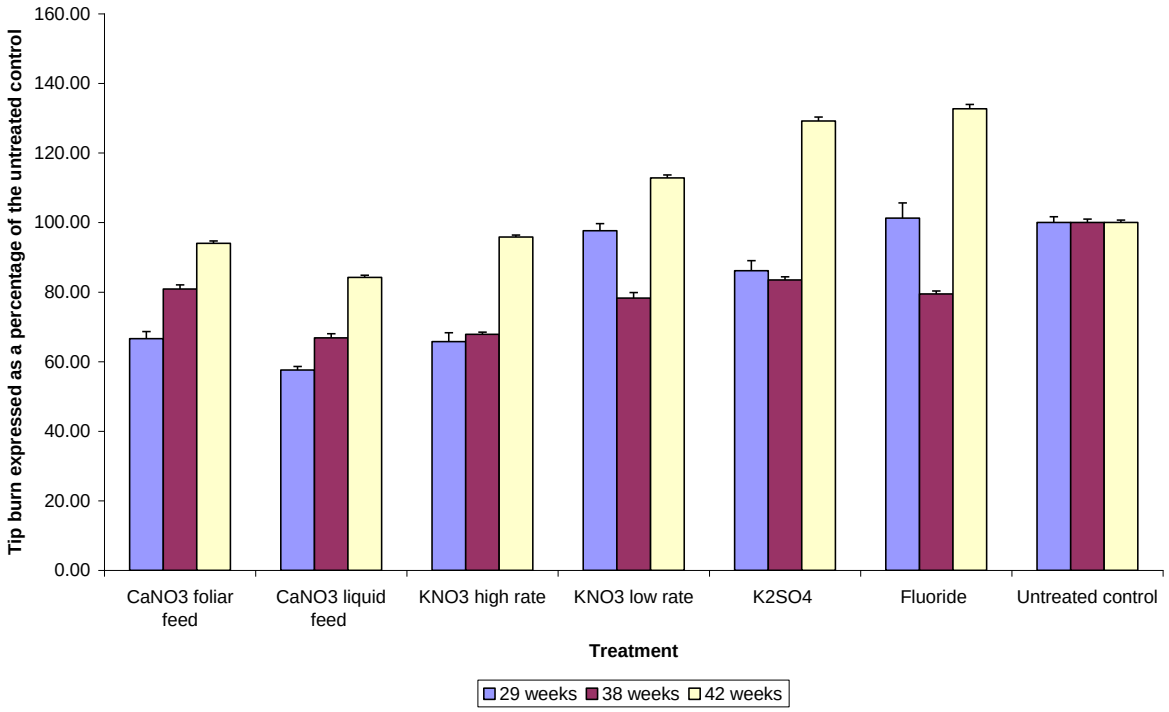

Figure 2. Tip burn, expressed as a percentage of the untreated control, in *Cordyline* 29, 38 and 42 weeks after treatments. Calcium nitrate foliar feed, calcium nitrate liquid feed, potassium nitrate high rate liquid feed, potassium nitrate low rate liquid feed, potassium sulphate liquid feed, fluoride liquid feed, untreated control.

Assessed after 38 and 42 weeks of treatment, the number of plants in each plot with yellow leaf spots followed the same general trend as seen with tip burn, with fewer plants with leaf spots in the calcium nitrate (foliar and liquid feeds) and potassium nitrate (high dose rate) treatments than the untreated control and other treatments. The same trend was found when yellow leaf spot symptoms were assessed using a system based on the NIAB scoring method for recording plant disease (0 = No leaf spot observable; 0.1 = Trace of leaf spot; 1= Leaves with one small lesion; plants with a few scattered lesions; 5 = Leaves appear 1/10 affected; affected leaves with a few lesions; 10 = Leaves appear 1/4 affected/ affected leaves with a few large or many small lesions) (Figure 3). Tissue samples were passed to Fera to investigate the cause of yellow leaf spot at each assessment, but no pest, pathogen or oedema was found on any of the samples.

Objective 3. Cordyline yellow leaf spot syndrome – environment monitoring

The environmental conditions of two *Cordyline australis* crops were monitored at Stoneyfield Nursery and Palmstead Nurseries. Watchdog 1000 Series Micro Station dataloggers with Lightscout 36681 PAR Light Sensors dataloggers were placed within the crop at plant height (light sensor positioned above the crop) to record temperature, humidity and PAR

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(photosynthetically active radiation) light. Incidence of *Cordyline* yellow leaf spot syndrome was recorded, along with details of the production systems and infrastructure at each site.

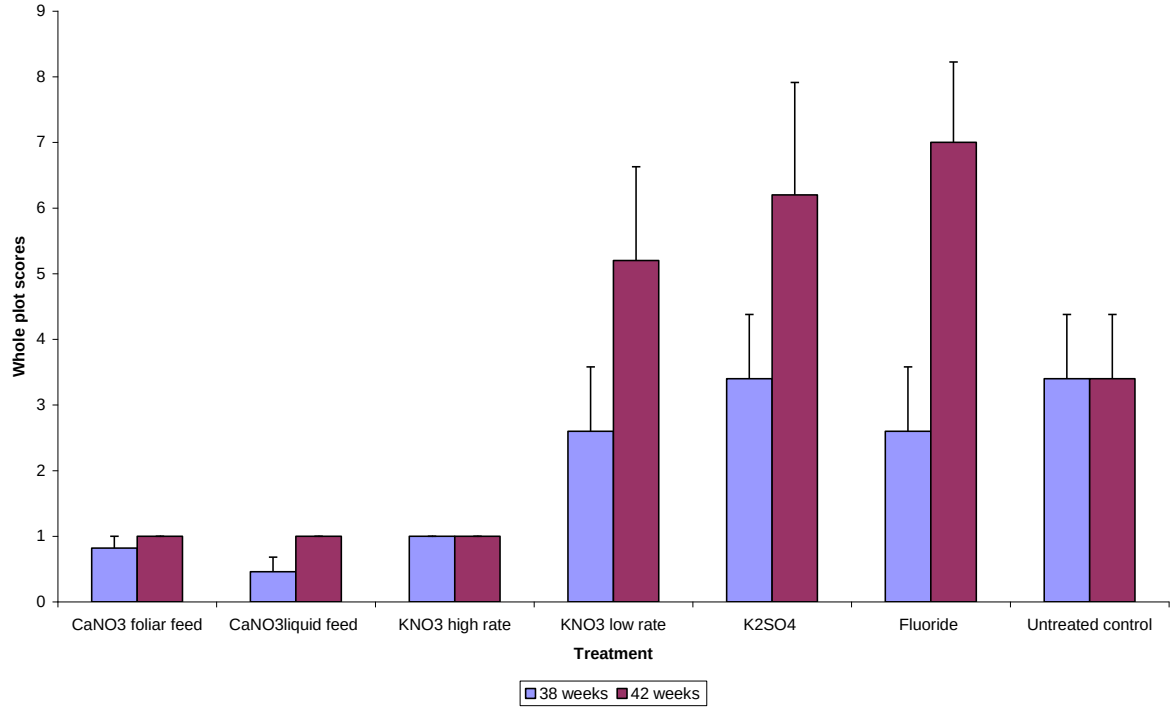

Figure 3. *Cordyline* yellow leaf spot syndrome symptoms, whole plot scores 38 and 42 weeks after treatments. Calcium nitrate foliar feed, calcium nitrate liquid feed, potassium nitrate high rate liquid feed, potassium nitrate low rate liquid feed, potassium sulphate liquid feed, fluoride liquid feed, untreated control.

Palmstead Nurseries. The *Cordyline* plants included in this trial were produced in an unheated, side-ventilated multi-span polytunnel, on drained beds covered with Mypex. Liners had been transplanted into 3 L pots (March 2011). Crops were irrigated with mains water during winter. Overhead irrigation (computer controlled, linked to a weather station, with some manual input) parameters were set to maintain a dry regime. Growing media consisted of coarse peat (100%) with nutrition provided by Osmocote Pro (16:11:10 @ 3.2 kg/m^3). The number of plants in the batch reduced throughout the monitoring as they were sold. Plants were initially placed pot thick but the distance between plants was increased to approximately 30 cm as space became available. At the start of the monitoring (12 December 2011) some leaf spotting was evident, affecting 1-2 leaves on less than 5% of the crop. By 16th March 2012 the majority of the older leaves of originally affected plants were heavily spotted (new leaves were not affected), and approximately 10% of the previously unaffected plants (9 plants/100) were now showing symptoms.

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Stoneyfield Nursery. The *Cordyline* plants used in this trial were grown under glass. Plugs had been transplanted into 1 L pots and placed pot thick on the floor (Mypex over soil). The temperature was maintained above 1°C (diesel fuelled boilers, vented outside). A vent and fan system was used for ventilation above 12°C. The crop was hand watered during the winter (borehole water) maintaining 25% moisture in the growing media once the plants had rooted through. Growing media consisted of 75% peat, 25% wood fibre, pH 4.5-5.5. Nutrition was provided by a combination of fertilisers, Nutricote 140 Day (16-10-10 @1.5Kg/m³); Plantacote 12 month (18-6-12 @1.5 Kg/m³), fritted trace elements and liquid feed applied as necessary (Solufeed Vigil, 16:10:18). None of the plants were affected by leaf spots during most of the monitoring period. However, symptoms had appeared by the final assessment (4 May 2012) and batches of 20 plants from central rows of plants were sampled and an average of 10% were affected (**Error! Reference source not found.**).

Temperature and humidity fluctuated more, and over a greater range, at Stoneyfield Nursery than Palmstead Nurseries. The greatest differences were seen in light level readings; at Palmstead Nurseries the light level exceeded 200 μM/m^2/s on one day only, however at Stoneyfield Nursery it was above this level for approximately 75% of period that data was collected. Whilst incidence of leaf spot was lower under the conditions at Stoneyfield Nursery compared with those experienced at Palmstead Nursery, it would be premature to conclude that this can be entirely attributed to the environmental conditions without comparing the incidence of symptoms on similar plant material under different controlled environmental conditions. It may also be significant that the plant material at Stoneyfield Nursery was younger than that at Palmstead Nursery.

Financial benefits

- Control of tip burn in *Cordyline and Phormium* could save the horticulture industry an estimated £1 million annually.
- Control of *Cordyline* yellow leaf spot syndrome could result in savings estimated at £120,000.

Action points for growers

The results from this trial need to be confirmed by further work in the final year of the project. However, application of calcium and potassium nitrate do appear to reduce incidence of tip burn and yellow leaf spot. Many growers do already apply foliar feeds of calcium nitrate to reduce tip burn.

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