A Field Trial to Evaluate the Efficacy of Botry-Zen® for *Botrytis cinerea* Control in Strawberries

Report for Botry-Zen (2010) Limited

June 2018

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EXECUTIVE SUMMARY:

Botry-Zen® was evaluated for efficacy against *Botrytis cinerea* fruit rots in a strawberry field trial at Tai Tapu, near Christchurch.

Disease levels were initially low but increased dramatically following periods of rain to reach moderate levels by the final disease assessment.

Botry-Zen® applied weekly over a 4-week period significantly reduced the total percent by number, of *Botrytis* infected fruit (at harvest and following 4 days ambient storage) at the time of the final assessment compared to the water control. However, disease control was less than in plots where 3 applications of the fungicide Switch® had been applied over a 4-week period).

Botry-Zen® appeared to be most effective when applied to protect the flowers and developing fruits in a preventative capacity.

Botry-Zen® may prove useful for reducing Botrytis infection within an integrated spray programme as an alternative to other fungicides with a protective mode of action. It should be applied so that protection is in place over flowering and repeated so that cover is provided throughout the harvest period. Botry-Zen® may also provide protection for periods when use of conventional fungicides may not be possible due to potential residue issues, or to assist in resistance management. It would also prove useful in organic production systems.

OBJECTIVE:

To test the efficacy of Botry-Zen®, alongside a conventional fungicide, for the control of harvest and postharvest rots of strawberry fruit by the fungus *Botrytis cinerea*.

METHODS:

A trial was established on the 10th March 2018 on the property of Craig Scott, Tai Tapu (near Christchurch) (Fig. 1). A single row of the strawberry cultivar 'Aromas' was divided into linear plots each with 8 plants (approximately 1.2 m of row per plot). A two plant over-spray buffer zone was included at the ends of each plot. The trial design was a replicated complete block consisting of three treatments; a control of water plus Nufilm, Botry-Zen® plus Nufilm, and Switch® (Table 1) and 10 blocks making a total of 30 plots.

Treatments were applied using a motorised knapsack sprayer pressurised to 60 PSI delivering 16.5 mL of water per second, equating to approximately 75 mL per plot (625 L/Ha). Four applications of Botry-Zen® plus Nufilm were applied, on each of the 10 March, 16 March, 23 March and 30 March. Three applications of Switch® were applied, on each of 10 March, 16 March and 30 March. Water plus Nufilm was applied to the negative control plot at each spray application date.

Plots were assessed for disease on six occasions, 16 March, 23 March, 30 March, 6 April, 13 April and 20 April. Ripe fruit were harvested from each designated plot and the total number of fruit, individual fruit weights and rots were recorded. Fruit was also incubated after harvest for four days at ambient temperature to allow identification and recording of fruit that had a latent Botrytis infection at harvest. At the first assessment, several open flowers were tagged to determine their fruit maturity date.

Figure 1: Trial Site at the property of Craig Scott, Tai Tapu

All data were subjected to analysis of variance (ANOVA) for randomised block designs using the statistical package R (R Core Team 2014). Differences between treatment means were assessed by the unrestricted least significant difference (LSD) method at P=0.05.

Table 1: Treatments and application rates applied to the strawberry plants

Treatment	Ingredient	Product	Rate (75 mL delivered per plot)
1	Nu Film + water (control)	Nu Film	0.3 mL/L
2	*Ulocladium oudesmasnsii* + Nu Film	Botry-Zen®	8 g/L + 0.3 mL/L
3	Cyprodinil + fludioxonil	Switch®	0.8 g/L

RESULTS:

This trial was established in autumn and due to the cooling temperatures and regular rain events, moderate levels of fruit rot due to *Botrytis cinerea* were observed (Fig. 2). The total percent fruit number infected with *Botrytis* (harvest and post-harvest infections) in the control plots for assessments 1, 2, 3, 4, 5 and 6 were 4.3%, 5.0%, 32.8%, 5.6%, 25.1% and 53.6%, respectively. The higher levels of infection corresponded to rain events in the week prior to harvest (Fig. 2).

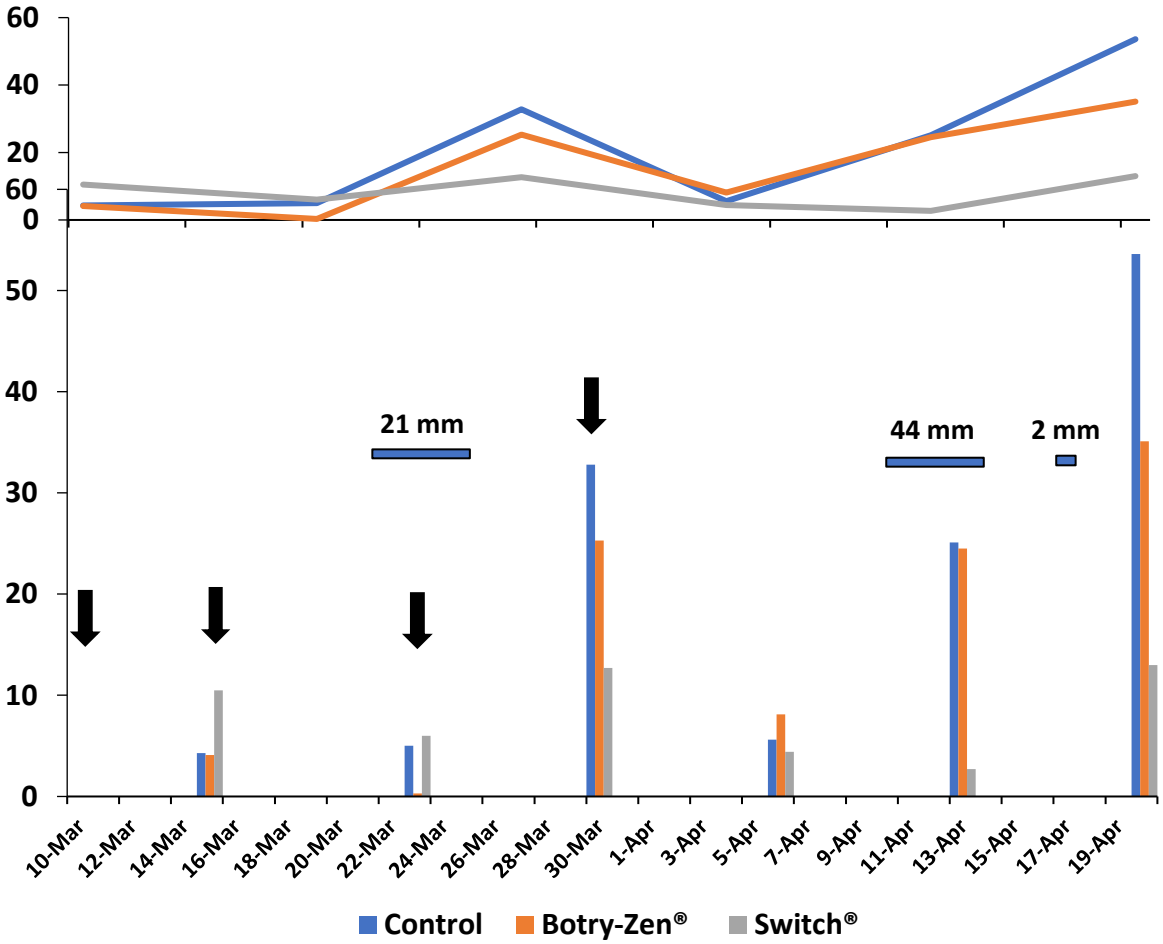


Figure 2. A timeline showing total (harvest and post-harvest infection) percent fruit number infected with *Botrytis* as a bar graph (bottom) and line graph (top). The black arrows indicate Botry-Zen® spray applications and the blue horizontal bars, rain events with total mm of rain presented (NIWA Lincoln Broadfield Ews (17603)).

DISEASE ASSESSMENTS

Assessment 1 (16 March 2018)

Assessment 1 assessed levels of *Botrytis* infection in the plots one week after the first spray application. Infection levels were low within the plots.

Assessment 2 (23 March 2018)

At Assessment 2 disease levels remained low and relatively unchanged compared to Assessment 1.

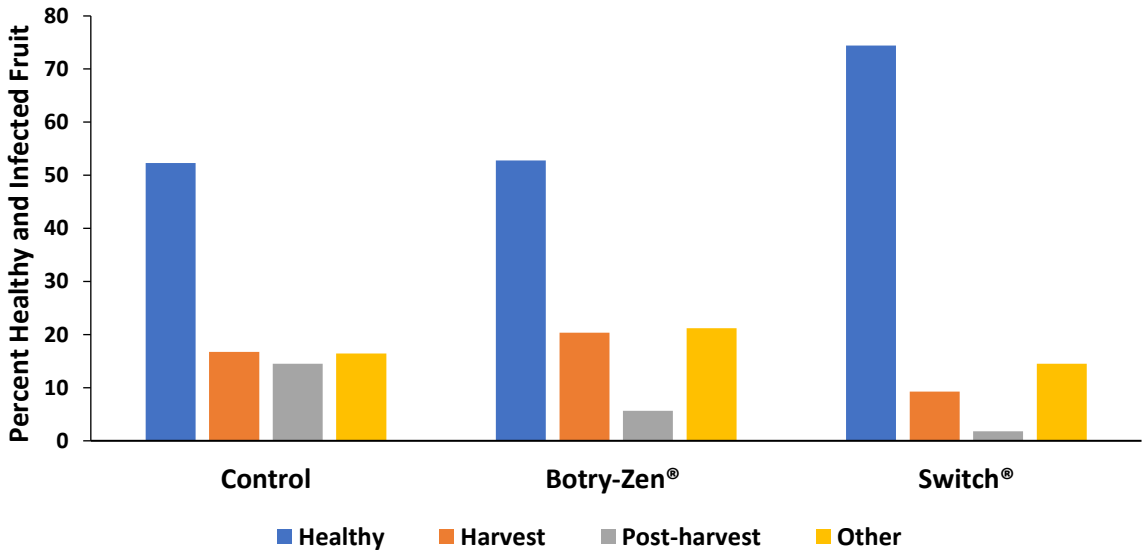
Assessment 3 (30 March 2018)

At Assessment 3, disease levels in the control plots had increased to moderate levels (total number of *Botrytis* infected fruit was 31%), likely due to the rain event the previous week. There was an indication that the Switch® treatment reduced disease levels compared to the water control.

Table 2: Proportion by number of Healthy fruit, Botrytis infected fruit and other fruit rots at Assessment 3, with tabulated results below.

	Healthy Fruit		Infection at Harvest		Post-Harvest Infection		Total Infection	
Water	52.3	a[1]	16.7	a	14.5	a	31.3	a
Botry-Zen®	52.8	a	20.4	a	5.6	ab	26.0	ab
Switch®	74.4	a	9.3	a	1.8	b	11.1	b
LSD	22.4		12.0		11.3		17.6	
P Value	0.087		0.170		0.077		0.068	
Significance	10%		NS		10%		10%	

[1] Means with the same letter are not significantly different to each other (LSD post hoc test)



Assessment 4 (6 April 2018)

Disease levels dropped following a period of dryer weather. The total percent by number of infected fruit in the control was 8.59%. There were no significant differences between any of the treatments.

Table 3: Proportion by number of Healthy and Botrytis infected fruit at Assessment 4.

	Healthy Fruit		Infection at Harvest		Post-Harvest Infection		Total Infection	
Water	82.2	a[1]	1.8	a	4.25	a	8.59	a
Botry-Zen®	74.5	a	6.1	a	3.33	a	7.22	a
Switch® ®	81.5	a	3.9	a	2.51	a	6.08	a
LSD	17.9		7.7		7.3		9.2	
P Value	0.614		0.518		0.884		0.849	
Significance	NS		NS		NS		NS	

[1] Means with the same letter are not significantly different to each other (LSD post hoc test)

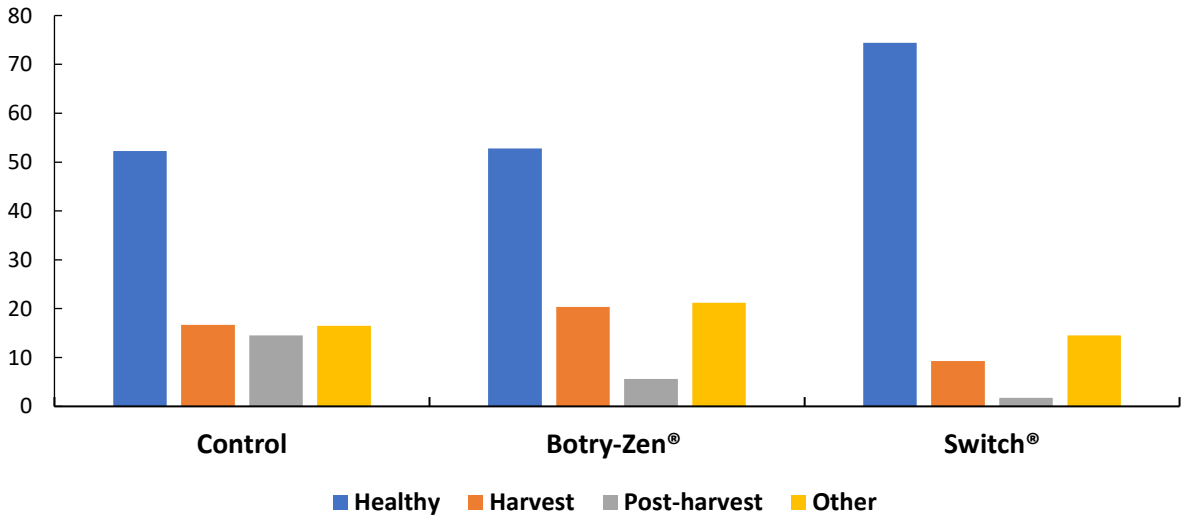
Assessment 5 (13 April 2018)

Disease levels increased due to a moderate rain event (44 mm) just prior to and at the time of this assessment. The total percent by number of infected fruit in the control was 29.9%. At this assessment Switch® increased (P<0.05) the percent healthy fruit and decreased (P<0.05) the percent postharvest *Botrytis* infected fruit and total percent *Botrytis* infected fruit compared to the Botry-Zen® and the water control (Table 4).

Table 4: Proportion by number of Healthy and Botrytis infected fruit at Assessment 5 with tabulated results below.

	Healthy Fruit		Infection at Harvest		Post-Harvest Infection		Total Infection	
Water	37.5	b[1]	4.33	a	25.6	a	29.9	a
Botry-Zen®	37.6	b	0.63	a	26.8	a	27.4	a
Switch®	65.4	a	0.53	a	1.4	b	2.0	b
LSD	26.4		6.0		18.9		21.5	
P Value	0.061		0.339		0.018		0.025	
Significance	10%		NS		*		*	

[1] Means with the same letter are not significantly different to each other (LSD post hoc test)



At this assessment there were relatively high levels of post-harvest *Rhizopus* rot (leak) with the percentage of *Rhizopus* infected fruit in the control, Botry-Zen® and Switch® treatments being 32.52%, 35.67% and 32.64%. This level of postharvest infection was likely related to the damp conditions during the harvest period.

Assessment 6 (20 April 2018)

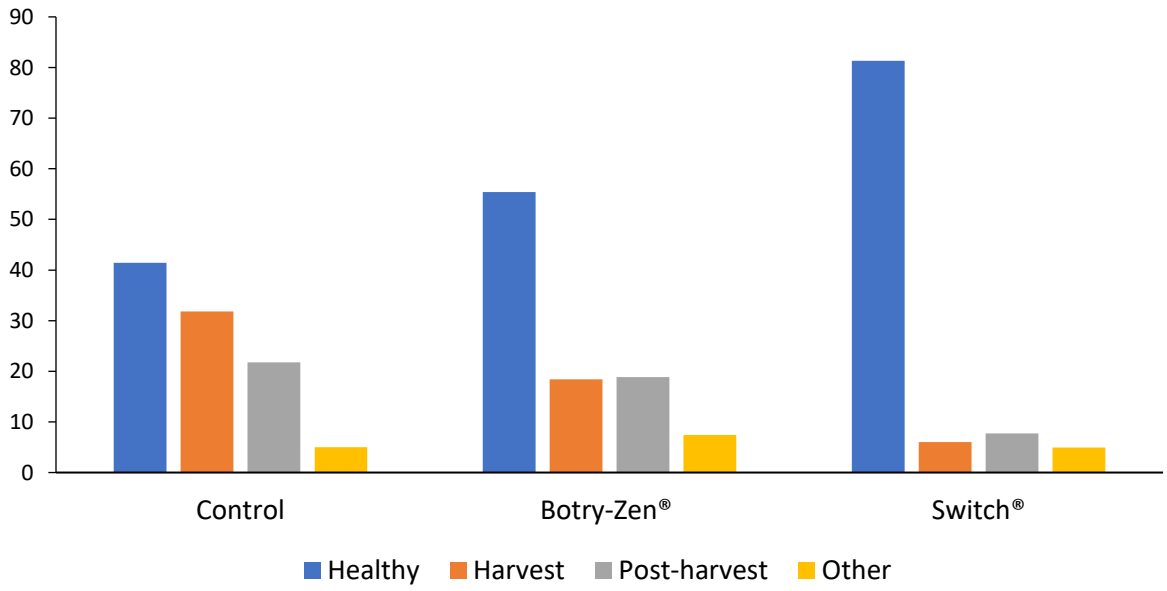
Disease levels were moderate to high at the time of this assessment. The total percent by number of infected fruit in the control was 53.6%, the highest over the period of the trial. At this assessment Switch® increased (P<0.05) the percent by number of healthy fruit and decreased (P<0.05) the proportion of Botrytis fruit rots compared to the control. In addition, Switch® reduced (P<0.05) the total percent *Botrytis* infected fruit compared to Botry-Zen®.

At this assessment Botry-Zen® reduced (P<0.05) the proportion by number of *Botrytis* infected fruit at harvest and total *Botrytis* infected fruit (harvest and after four-day storage) compared to the control.

Table 5: Proportion of Healthy and Botrytis infected fruit by number at Assessment 6 with tabulated results below.

	Healthy Fruit		Infection at Harvest		Post-Harvest Infection		Total Infection	
Water	41.4	a[1]	31.8	a	21.8	a	53.6	a
Botry-Zen®	55.4	a	18.4	b	18.4	ab	37.2	b
Switch®	81.3	b	6.0	b	7.8	b	13.8	c
LSD	17.3		13.0		13.4		13.7	
P Value	<0.001		0.004		0.096		<0.001	
Significance	***		**		10%		***	

[1] Means with the same letter are not significantly different to each other (LSD post hoc test)



YIELD

The yield components of total fruit weight and total number of berries were recorded at each assessment date. Over the period of the trial, total cumulative fruit weights over the 10 plots of the treatments (12 linear metres total) ranged from around 5.5 kg to 6.9 kg. At assessment 6 (final harvest) significant differences in some yield components were observed (Table 6).

Switch® significantly increased the percentage weight of healthy fruit compared to the water control.

It should be noted that conditions were provided post-harvest for the detection of latent Botrytis infections, something that would not normally occur prior to the fruit leaving the growers property.

Table 6: Proportion by weight of Healthy and Botrytis infected fruit compared to the total fruit pick at Assessment 6.

Treatment	Percent Healthy Fruit at Harvest	Total percent Botrytis infected fruit (Harvest+Post harvest)	Percent Botrytis infected fruit at harvest
Water	40.5 a	54.5 a	35.2 a
Botry-Zen®	53.2 ab	41.7 a	23.0 ab
Switch®	79.7 b	14.9 b	5.7 b
LSD	17.9	14.8	19.6
P Value	<0.001	<0.001	0.017
Significance	***	***	*

CONCLUSIONS:

This trial was established to evaluate Botry-Zen® for the control of *Botrytis* fruit rots on strawberry.

Conditions during the early part of the trial period were warm and sunny. Disease levels were initially low but two significant rain events provided wetness and humidity allowing for some disease development in the fruit, both at harvest and in storage.

Botry-Zen® was able to significantly reduce the percentage of *Botrytis* infected fruit, in number by the time of the final assessment. This coincided with ripening of fruit tagged as flowers at the start of the trial. This probably reflects the time required for the *Ulocladium oudemansii* fungus in Botry-Zen® to colonise and protect flowers and the developing fruit from Botrytis infection. This contrasted to the fungicide Switch® which provided relatively rapid protection and control.

Switch® provided a higher level of control than Botry-Zen®. Switch® is the gold standard for Botrytis control and provided a tough test for comparison due to its multi-site action against Botrytis. The number of recommended spray applications of Switch® are, however, restricted in number and there may be situations where it cannot be applied due to residue issues. This could provide an opportunity for appropriately timed Botry-Zen® applications to provide cover when Switch® or other fungicides cannot be used.

Botry-Zen® showed efficacy against *Botrytis* in a field situation under moderate disease pressure. Results suggest that the mode of action is protectant, and this could be utilised in a spray programme as an alternative to other fungicides with a protective mode of action although this

comparison was not tested in this trial. Botry-Zen® may provide a replacement for conventional fungicides at times when they cannot be used, or in an organic growing situation.

REFERENCES

(NIWA Lincoln Broadfield Ews (17603). The National Climate Database available online https://cliflo.niwa.co.nz/ 08/05/2018

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