The Efficacy of Applied Beneficial Micro-organisms for the Control of Botrytis Induced Fruit Abortion in Persimmons. 2003

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Abstract:
The efficacy of two Bio-fungicides (Serenade® Bacillus subtilis) and (Worm Tech™ Vermicast leachate) were assessed for the control of Botrytis induced fruit abortion in persimmons, in comparison with the application of commonly used synthetic fungicides. The results appear to be very promising with significantly less numbers of fruit aborted when the Bio-fungicides were used. The ratio of fruit on tree compared to aborted fruit was proven to increase from the control @ 14:1, Worm Tech = 30:1 and Serenade = 48:1. We did not find a statistically significant difference in fruit numbers from any of the treatments. Also no benefit was gained by combining the two Bio-fungicides. The trial was compromised by the removal of one of the orchards from the trial, therefore these results should be considered as being preliminary to further research.

Key words:
Bio-fungicides, Serenade®, Bacillus subtilis, Worm Tech™, Vermicast leachate, Persimmons, Botrytis, Fruit abortion.

Introduction

Persimmons (Diospyros kaki L.) have been commercially grown in New Zealand since the late 1970s (Clark & smith 1990). Yet to date (2003) the total NZ area in Persimmon production remains relatively small at only 384 canopy hectares (Hort Research pers com) compared to 12,200Ha Kiwifruit and 2,600 Avocados (Stats NZ year 2000) . The reasons for the slow planting of this crop may have been partly explained by Alistair Mowat in a Hort Research internet publication where he identified possible restrictions for the development of persimmon cultivation including;

1) Lack of knowledge and experience of persimmon cultivation mainly due to very little published literature from research institutions.
2) Climatic limitations including temperatures, humidity and seasonal high winds.
3) High rates of fruit abortion which may be due to;
    a. Heavy shade
    b. Loss of leaf area through hail or wind damage.
    c. Drought stress
    d. Water logging

During the early summer of 2001/2 the Northland peninsular experienced a rainy & humid season and persimmon orchards suffered from an unusual number of aborted fruits (>50% of the crop). The aborted fruit had black marks on the calyx end. Samples were collected and sent to the Agriquality Pest and Disease laboratory that made the following diagnosis;
“the spots were Botrytis scald …Botrytis was also attacking the sepal base attachment points to the peduncles causing abortions” (Dance M)

Historically various chemical fungicides had been used but with limited success due to the ubiquitous nature of botrytis spores where reinfection rapidly occurs and the abortion problem persists.
The main market for NZ grown Persimmons is in Japan where there is an increasing demand for fruit produced without the presence of synthetic fungicide residues and fruit grown under an organic regime would be considered as highly desirable. Therefore alternative botrytis control treatments need to be investigated including Bio-fungicides, which are products containing beneficial micro-organisms which are intended to predate on or suppress the germination of Botrytis spores.

Bio-fungicides considered in this trial:

1) SERENADE ® (Elliott Chemicals) a dried culture of the natural bacteria Bacillus subtilis It has successfully been used for both wine and desert grape crops.
2) Liquid Vermicast (Worm Tech™), a filtered leachate of Vermicast compost containing a variety of several species of bacteria and fungi.

The efficacy of these Bio-fungicides for Botrytis control on persimmons was previously unknown, therefore a pilot trial was established in the spring/summer of 2002/3

Methods
Two Orchards were selected for the trial, a) Near Kerikeri. b) Near Warkworth Orchard (a) was set up as a twice-replicated block design and Orchard (b) was a single replicate block design giving three replicates in all. In both trial orchards there were additional control blocks which received synthetic chemical fungicides including; Roveral® and Scala®, which were not applied to either of the Bio-fungicide treated blocks. To assess wether there could be any synergy between the Bio-fungicides, separate blocks were designated to receive a combination of both products.

Table 1 Treatment

Treatment	October	Early November	Mid November	Late November
Serenade		Serenade		Serenade
Worm Tech		Worm Tech	Worm tech	
Serenade + Worm Tech		Serenade	Worm tech	
Chemical Fungicide	Roveral	Roveral		Scala

Abortion assessment
On the 22nd of January 2003 we inspected the orchards and gathered data.
Ten evenly spaced trees were selected from each treatment from which we counted the numbers of fruit and empty calyxes (aborted fruit). The trees are wire trained with two horizontal leaders (0.5m high). We counted the eastern side only of each tree, therefore the counts represents numbers per half tree.

Statistical analysis

The computer software SPSS Systat was used to process the data. The charts were produced using ANOVA and the separate variance of the mean averages for the Bio-fungicides compared to the chemical fungicides were calculated using two sample T Tests with "highly significant" = P <0.01 and "not significant" = P>0.1

Results

For reasons beyond our control orchard (a) was removed from the experiment at the time of fruit counting therefore the following data relates to orchard (b) only.

Table 2 Fruit numbers:

Treatment	Mean	Std Error	T test with Chemical Fungicide
Serenade	129.2	20.6	Not significant
Worm Tech	135.4	15.9	Not significant
Serenade & Worm Tech	154.4	19.7	Not significant
Chemical Fungicide	155.7	17.9	

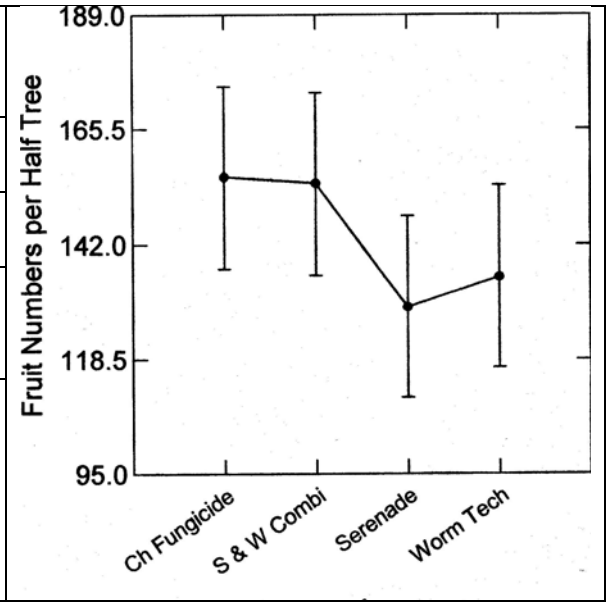
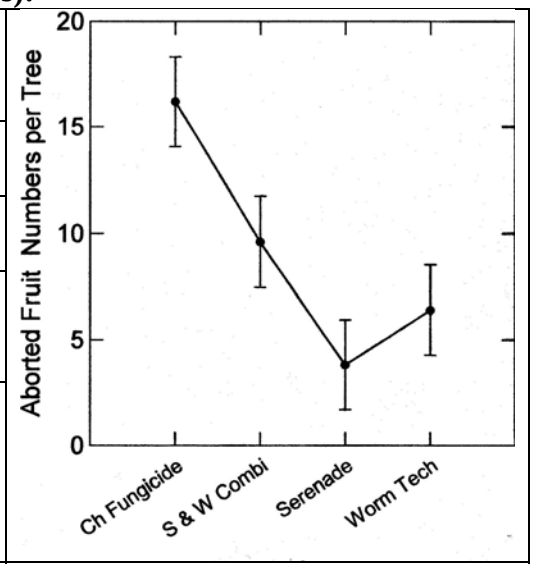


Table 3 Aborted fruit (empty calyx numbers):

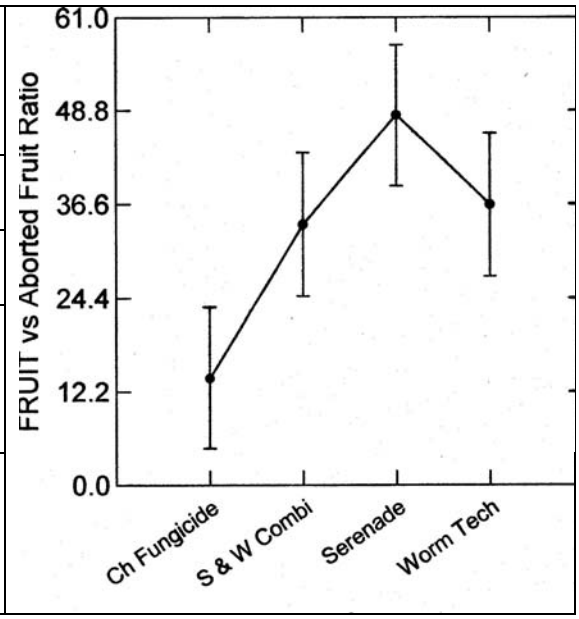
Treatment	Mean	Std Error	T test with Chemical Fungicide
Serenade	3.8	0.7	Highly significant
Worm Tech	6.4	1.8	Highly significant
Serenade & Worm Tech Combined	9.6	2.4	Not significant
Chemical Fungicide	16.2	3.0	



The question arose as to whether the higher numbers of fruit in the control blocks may be due to a difference in tree size or flower numbers? This question was addressed by dividing the numbers of fruit from each tree by their respective numbers of aborted calyxes to arrive at a fruit retained vs. aborted fruit ratio.

Table 4 Fruit vs. Abortion ratio:

Treatment	Mean	Std Error	T test with Chemical Fungicide
Serenade	48.2	11.3	Highly significant
Worm Tech	29.8	8.7	Highly significant
Serenade & Worm Tech Combined	34	11.4	Not significant
Chemical Fungicide	14	3.2	



Conclusion:
The fruit numbers were not statistically different between treatments (Table 2). A possible reason for the apparent higher fruit numbers in the Chemical Fungicide treatment was that the average tree size appeared to be a little larger in that block.

Aborted fruit were significantly less for both Bio-fungicide treatments compared to the Chemical Fungicides (Table 3). There does not appear to be any advantage in combining the Serenade and Worm Tech products.

The possibility of the trial being influenced by tree size variations was removed by the creation of a ratio for each tree i.e. fruit number divided by the aborted fruit number (Table 4) which confirmed the efficacy of the Bio-fungicides.

Although there is no apparent increase in fruit numbers through the use of Bio-fungicide products, it is reasonable to assume that if fruit abortion is reduced then the overall yield should be increased; this matter needs to be investigated further.

A note of caution to be stressed is that due to the removal of orchard (a) from the trial (for reasons not related to Botrytis fruit abortion) the experimental design was compromised, therefore these results should be viewed as preliminary to further investigation. Given the serious nature of this problem for persimmon growers, along with great loss of yield and considering the promising results gained thus far we shall be recommending the use of bio-fungicides for botrytis control but will be carefully monitoring the results.

References

Clark C.J & Smith G.S, Scientia Horticulturae, 42 (1990) 99 - 111
Dance M Agriquality Pest & Disease Lab (pers com)
Mowat A www.hortnet.co.nz/publications/science/pers3.htm
Statistics New Zealand Agricultural Production Survey June 2000 www.stats.govt.nz/

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