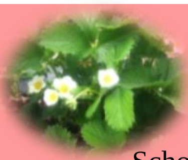

Sustainable strawberry production including the use of a rule based prediction system for controlling Strawberry Powdery Mildew

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Introduction

Figure 1 Mycelium infected strawberry plant. B. Liu (2013).

- Powdery mildew, *Podosphaera aphanis* (Braun, 1982), is a major fungal disease affecting strawberry production. The pathogen infects strawberries in nearly all organs and appears to be specific to this crop (Fig. 1) (Dodgson et al. 2008).
- The **prediction system** monitors temperature and humidity, and records the accumulated number of hours (144) of disease conducive conditions needed for the fungus to develop from conidiospore development through colony formation to conidiospore production thus to alert the grower when fungicide spraying is necessary.
- The hypothesis tested here was that Green House Gas (GHG) emissions could be more associated with fungicide applications than other pesticides used in strawberry production. Therefore the use of the prediction system could enable farmers control disease with fewer fungicide sprays which potentially lowers GHG emissions and results in a more sustainable production system.

Aim

Assess the efficacy of conventional disease control ('insurance spray') of strawberry powdery mildew in the tunnel on a commercial farm scale, calculate and compare the GHG emissions of pesticides applied in the tunnel during the trial.

Materials and methods

- Five beds of cultivar Sonata in the third year of harvesting were growing in Ladybird trial tunnel. The untreated control with no fungicide spray was 10m of each bed, the remaining beds received 'insurance sprays' designed to give good disease control.
- The assessment for untreated control and treated was each based on five replicates of 10 leaves each week. The disease level was expressed as % cover of colonies (amount of mycelium) per leaflet.
- The GHG emissions associated with fungicide applications were calculated as GHG emissions (kg CO2/ha) = fungicide application rate (kg a.i./ha) × emission factor (kg CO2/kg a.i.)

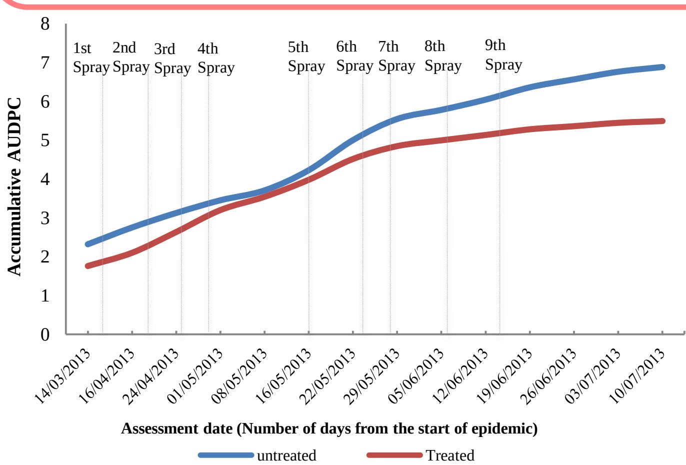


Figure 2 AUDPC against date for treated (sprayed with fungicides) and untreated beds. The graph is based on the mean results of all five beds. The horizontal axis shows the date of each sampling. The vertical grey line represents each fungicide spray.

Results

- Disease levels as shown by the AUDPC (Area Under the Disease Progress Curve) were lower in the treated plots throughout the trial (Fig. 2). It can be shown that the intense use of fungicides only gave moderate disease control during the trial.
- GHG emissions of fungicides account for 78.31% of overall GHG emissions of all pesticides applied in Ladybird Field during the trial (Fig. 3).
- Fungicides Fenomenal and Trianosan DG produced higher level of GHG emissions (Fig. 4).

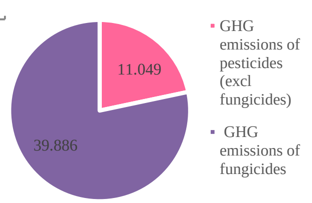
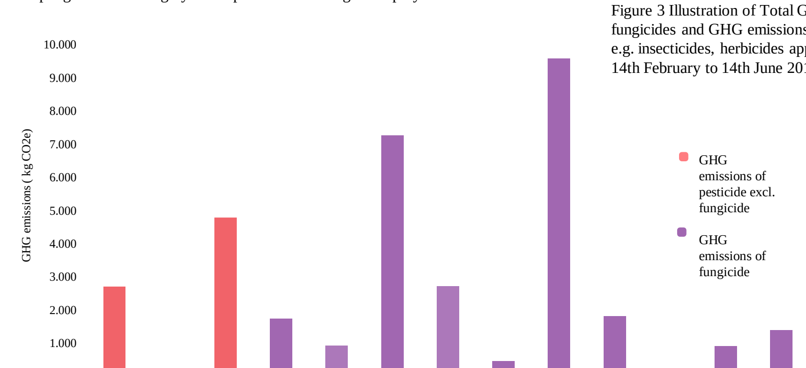


Figure 3 Illustration of Total GHG emissions (kg CO_2e) of fungicides and GHG emissions (kg CO_2e) of other pesticides e.g. insecticides, herbicides applied in Ladybird Field from 14th February to 14th June 2013.

GHG emissions of all pesticides applied at Ladybird field during the trial (kg CO_2e)	50.935
GHG emissions of fungicides only applied at Ladybird field during the trial (kg CO_2e)	39.886
GHG emissions of other pesticides e.g. herbicides, insecticides applied at Ladybird field during the trial (kg CO_2e)	11.049
Proportion of GHG emissions of fungicides against GHG emissions of all pesticides (Figure 3)	78.31%



Pesticide product	Diquat	Shark	Stomp 400 SC	Equity	Rovral Flo	Thianosan DG	Rovral WG	Fortress	Fenomenal	Signum	Systhane 20EW	Amistar	Teldor
GHG emissions (kg CO_2e)	2.710	0.054	4.796	1.744	0.926	7.267	2.725	0.454	9.592	1.820	0.240	0.908	1.390

Figure 4 GHG emissions of individual pesticide of individual application applied in Ladybird field during the trial period (14th February to 14th June 2013). The red bar represents an individual herbicide or insecticide product and the purple bar represents an individual fungicide. The value below represents the GHG emissions (kg CO_2e) of this pesticide on a single application in Ladybird field in the trial period.

Discussion

Though the disease was reduced by fungicide applications, the level of disease control was not considered to be efficient given to the large amount of fungicides used during the trial. This could be attributed by factors such as the trial was carried out in a third year crop with a variable amount of overwintering disease in the tunnel. Since fungicide applications contributed to nearly 2/3 of the overall GHG emissions of pesticides applied throughout the trial, the use of the prediction system can allow farmers spray with precision, use less fungicides to gain better disease control, hence reduce the subsequent GHG emissions in strawberry production.

Future work

To compare fungicide use of farms which use the prediction system and those which use 'insurance spraying'; to investigate the role of prediction system in sustainable strawberry production; to study wild pollinators at commercial strawberry farms: how are they affected by local biodiversity and whether they play certain role in the spread of strawberry powdery mildew.

Acknowledgement

Thanks to Harriet & Henry Duncalfe, Maltmas Farm for providing the field trial. Thanks to Xiaoming Xu for helping to develop the prediction system.

References

Dodgson, J., Hall, A and Parker,S. (2008). Control of strawberry powdery mildew under protection. Project SF 62 & SF 62a.

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