Factors contributing to sustainable strawberry production

Bo Liu, Avice M Hall, Keith Davies

School of Life and Medical Sciences, University of Hertfordshire, *College Lane, Hatfield, AL10 9AB*

Introduction

In the UK, strawberry production is very intensive, which has been achieved over the last 20 years through the precise use of varieties, nutrients and polythene tunnels. Powdery mildew, *Podosphaera aphanis*, is a major fungal disease affecting strawberry production worldwide and can result in great yield losses. Work at UH has investigated the use of a silicon nutrient (Sirius) with and without potassium carbonate in the fertigation system to reduce disease severity. It has been shown that this form of silicon can significantly reduce disease severity (Jin et al., 2013).

The use of wild pollinators is another important feature of sustainable production. Insect pollinated crops accounted for 20% of UK cropland and 19% of total farmgate crop value in 2007. Most farms nowadays rely on buying in bees to help crop pollination, however, research showed that wild insects can be important pollinators to many crops and can provide more effective pollination service to certain particular crops than honeybees.

Aims

To identify factors that contribute to sustainable strawberry production, including:

- the use of silicon as a nutrient in contributing to delayed epidemic buildup compared with commercial fungicides;
- the role of wild insect pollination to tunnel and open field grown strawberries, and how to encourage the presence of wild pollinators via sustainable farm management.

Silicon trial

Materials and methods

The field trial was set up in two commercial strawberry polythene tunnels in 'Blackberry Field' at Maltmas Farm, Wisbech in April, 2014. In each tunnel has five beds of cultivar J*****.

The silicon nutrient used was Sirius (OrientFT), applied twice a week at a concentration of 0.017% in the fertigation tubes. Four treatments were undertaken (Fig. 1 & 2).

75 leaf samples were taken per treatment fortnightly from 20 May 2014. % cover of colonies (amount of mycelium) per leaflet and the number of colonies per leaf were then assessed in the lab.

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.)

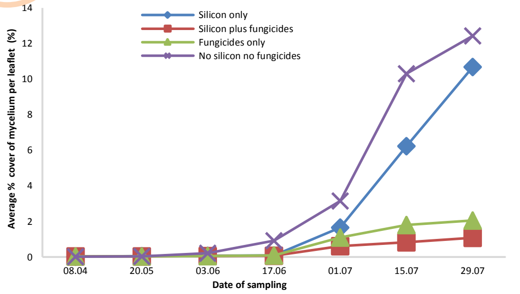

Fig. 1 Average % mycelium coverage per leaflet from Silicon only, Silicon plus fungicides, fungicides only and no silicon no fungicides treatments between 08.04.14 and 29.07.14.

Results

Silicon plus fungicide treatment had both the lowest disease level and the lowest number of colonies present throughout the trial period (Fig 1 & Fig 2). Silicon alone treatment showed a better level of disease reduction than control.

GHG emissions of fungicides accounted for over 70% of overall GHG emissions of all pesticides (Fig 3). Fungicide Trianosan DG and herbicide Trident produced higher level of GHG emissions (Fig 4)

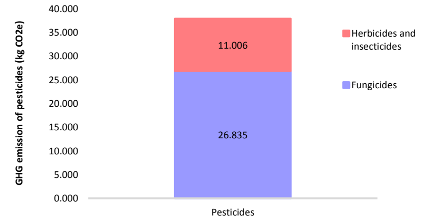

Fig.3 Illustration of Total GHG emissions (kg CO_2e) of pesticides and GHG emissions (kg CO_2e) of other pesticides e.g. insecticides, herbicides applied in Blackberry field between March 2014 and September 2014. Blue bar represent GHG emissions of all fungicides applied and pink bar represent GHG emissions of all other pesticides applied.

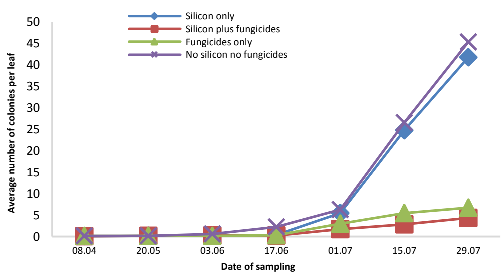

Fig. 2 Average numbers of powdery mildew colonies present per leaf from Silicon only, Silicon plus fungicides, fungicides only and no silicon no fungicides treatments between 08.04.14 and 29.07.14.

Discussion

The results of the silicon trial indicated that silicon nutrient in the fertigation can improve fungicide action if used with commercial fungicides therefore result in better disease reduction. The reduction of fungicides use could play a big part in reducing the overall GHG emissions. The use of silicon nutrient could help to achieve a more efficient use of commercial fungicides and contribute to the sustainable production of strawberries.

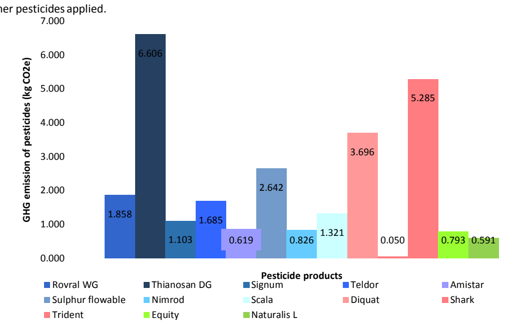

Fig.4 GHG emissions of individual fungicide of individual application applied in Blackberry field during the trial period. Each bar represents an individual pesticide product and the value above represents the GHG emissions (kg CO_2t) of this pesticide on a single application in Blackberry field. **Bars in blue represent fungicides, bars in pink represent herbicides, bars in green represent insecticides.**

Pollinator trial

Materials and methods

The pollinator survey was carried out fortnightly for a two-day period each time starting from April 29, 2014 and included 9 surveys in total. Each individual survey was timed for a 30 minutes walk along the strawberry beds in the tunnel at a steady pace. Five pollinator groups were recorded (Fig 5).

Results

Hoverflies and Bumblebees are the main strawberry pollinators at Maltmas Farm (Fig. 5). Pollinators were found to be most abundant between 10am and 4pm from April to August (Fig 6 & 7). Hoverflies showed the highest level of presence throughout the tunnel (Fig 8). Temperature between 15°C and 22°C were found to encourage the pollination activity (Fig 9).

Discussion

Wild pollinators are the main pollinators of commercial strawberries at Maltmas Farm. Their presence remained relative stable in the tunnel environment throughout the crop season. Since Maltmas farm only relies on wild pollinators to provide pollination to their crops, it is important to improve farmland management to provide a favourable habitat to wild pollinators.

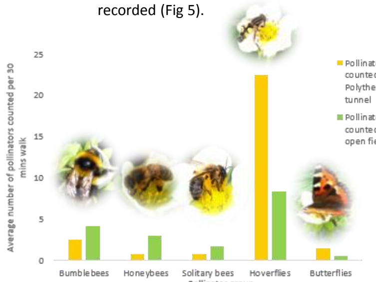

Fig 5 Average number of pollinators on strawberry from each group counted during a 30mins walk in the tunnel compare to the open field per two-day survey period from April to August 2014.

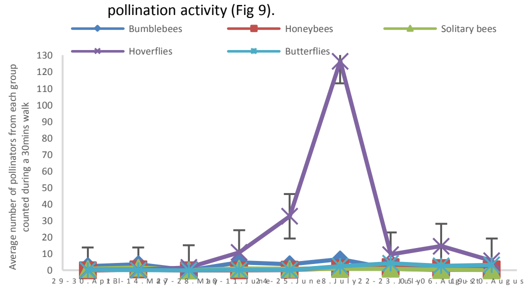

Fig. 6 Average number of pollinators from each group counted during a 30mins walk on each survey period between 29-30.04.14 and 19-20.08.14.

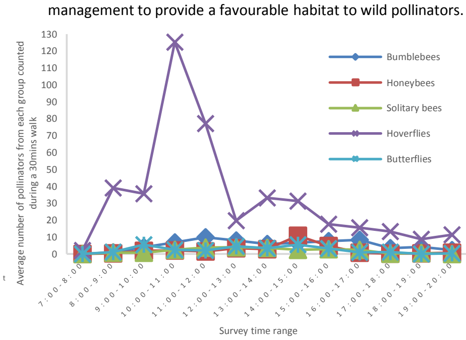

Fig. 7 Average number of pollinators from each group counted during a 30mins walk at different time of day per two-day survey period from April to August 2014.

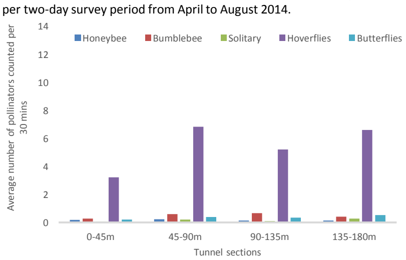

Fig 8 Average numbers of pollinators from each group counted from the section 0-45m, 45-90m, 90-135m and 135-180m within the **tunnel** per 30mins per survey

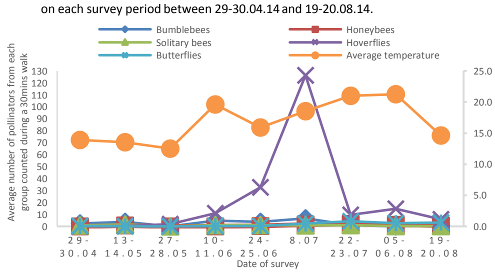

Fig. 9 Average number of pollinators from each group counted during a 30mins walk in relation to the average temperature (orange line) recorded per walk on each survey period between 29-30.04.14 and 19-20.08.14.

Future work

- To investigate the role of the silicon nutrient in strawberry pest control and whether it can help to reduce the use of pesticides; to calculate GHG emissions of the silicon nutrient.
- To demonstrate the importance of wild pollinators to sustainable strawberry production and to discover ways of stimulating the presence of wild pollinators via sustainable farmland management.

References

Jin, X. L., Fitt, D. L., Hall, A. M. & Huang, Y. J. (2013) The role of chasmothecia in the initiation of epidemics of powdery mildew (*Podosphearа aphanis*) and the role of silicon in controlling the epidemics on strawberry. Aspects of Applied Biology (119): 151-153.

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