Project number: 6395
Funding source: Teagasc
Date: December 2018
Project dates: Oct 2014 – Dec 2017

Future Fruit:

The feasibility of '*one-year*' long-cane raspberry production and an investigation into the presence of *Drosophila suzukii* in Ireland.

Key external stakeholders:
Soft Fruit Growers, Agronomists, Crop Protection Specialists, Research Community, Government Departments

Practical implications for stakeholders:

- Traditional raspberry production involves training canes from year to year. One year long-cane raspberry production makes use of the cane for one season before replacing the canes each season
- Yields for one year long-cane raspberry production are comparable to traditional systems in Ireland
- Raspberries can be grown below standard water usage without a negative effect on quality parameters
- The economic feasibility of reduced watering should be reviewed to ensure that standard water usage is economically efficient
- Drosophila suzukii or Spotted Wing Drosophila or SWD was detected in Ireland for the first time in 2015
- The early detection of SWD will allow growers the opportunity to alter crop management practices to reduce the initial impact of this invasive pest species.

Main results:

- Long-cane raspberry production is an economically feasible production system in Ireland
- Raspberries can be grown below standard water and fertiliser inputs without affecting fruit yield or quality
- Spotted Wing Drosophila (SWD) was detected for the first time in Ireland. Managing this pest will be of prime importance to the Irish soft fruit industry over the short to medium term
- SWD was detected on 3 of 4 locations throughout Leinster over an 18 month period in 2015 and 2016
- The peak population was measured in week 46 of the year 2015 and in week 40 in 2016

Opportunity / Benefit:

This research has highlighted and demonstrated the potential for soft fruit growers in Ireland to use a one year long-cane production system for the growing of raspberries. Using this production method in conjunction with a closed loop irrigation method can lead to a tighter management of irrigation and fertigation utilisation with possible reduction in water and nutrient costs. While supervision of the system would be necessary, there would be savings in labour costs. The second objective of this study was to determine whether Spotted Wing Drosophila was present in Ireland. The project was successful in detecting SWD at three locations in 2015. Having established its presence, the project focused on monitoring the population dynamics over 18 months to give growers and researchers further understanding of the adaptability of this pest to the Irish environment. The early detection of this economically important pest allowed for the investigation of the life cycle ,population dynamics and control management to be investigated and disseminated to industry before the pest has attained a commercially damaging population size.

Collaborating Institutions:

University College Dublin (UCD)

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External collaborators: Mr David Brogan (UCD), Assistant Prof Dr Caroline Elliott-Kingston (UCD), Assoc. Prof Dr Owen Doyle (UCD)

1. Project background:

Raspberries are the second largest soft fruit crop in Ireland. Raspberries attain a higher price per kilogram that strawberries, yet strawberries return a higher return per ha. Therefore there is an opportunity for soft fruit growers to increase profits by concentrating on increasing production efficiencies and lowering production costs. Growers can be enabled to increase the efficiency of their growing operations by adopting new production systems and investigating new decision support tools. Long-cane raspberry production has been shown in Europe to increase production and extend the cropping period. This production system involves growing canes in the first season to bud stage and then placing the canes in cold storage at 2°C. They are then transferred to the grower, keeping them chilled until they are planted out depending on the required cropping time. Long-cane production could have the potential to cut labour costs associated with training canes in a multi-year system of production, as well as potential to decrease pest and disease carry over as the canes can be discarded after the cropping season and new clean canes brought in.
A closed loop irrigation system is one that uses data derived from sensors to drive irrigation events. Therefore it is essentially an automated data driven irrigation system. The feasibility of introducing a closed loop irrigation system would depend on offsetting the increased capital cost with labour savings, nutrient and water cost saving and an increase in consistency of irrigation that takes direct plant use into account through constant monitoring. This system would allow the grower tighter control of the fertigation with less reliance on operator experience/inexperience. For a closed loop system to work effectively the optimal set points for the data logger should be used. While the optimal set points have been researched and are known for strawberries this is not the case for raspberries.

Spotted Wing Drosophila (SWD) has become a major economically important pest internationally. Since first being recorded, concurrently in 2008 in California, Spain and Italy, it initially spread rapidly throughout North America and Europe, and subsequently throughout much of the world. It has in some cases caused 80% crop losses. While other Drosophilid flies present a mostly benign risk to soft fruit growers, SWD presents a much greater risk. The female SWD's ability to lay eggs into the flesh of ripe and ripening soft skinned fruit has the result of making fruit un-marketable. This ability is by means of a well-developed, heavily toothed ovipositor. While Raspberries are a preferred host to SWD, it is highly polyphagous and is a pest of all major soft fruit in Ireland, as well as stone fruit. Its host plants also include many native hedgerow species which would allow it to transverse the Irish landscape with ease. The female is highly fecund, with a capability to lay up to 600 eggs, with a capacity to complete its life cycle in 12 days.

2. Questions addressed by the project:

- Is long-cane raspberry production under protection in Irish conditions feasible?
- Is using a closed loop irrigation system for precision irrigation in raspberry production feasible?
- Does coir give comparable results to peat for protected raspberry production in Ireland?
- What is the optimal Volumetric water content (VWC) of substrates for protected raspberry production in Ireland?
- Is *Drosophila suzukii* present in the Irish environment?
- If present what are the current population dynamics of *D. suzukii?*

3. The experimental studies:

In 2015 experiments were conducted to evaluate the feasibility of coir as a peat replacement for raspberry production. 600 raspberry plants of two varieties were grown in a polytunnel in either coir or peat. A number of plant parameters were analysed including, stomatal conductance, EC, leaf temperature, in addition yield and quality parameters such as Brix levels, fruit weight and number of the berries were recorded post-harvest. In 2016 experiments were carried out to evaluate the feasibility of a closed loop fertigation system and elucidate the optimal VWC levels for raspberry production. Three treatments using three VWC levels were devised with 600 raspberry plants of two cultivars being grown in a polytunnel with stomatal

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conductance, ECp, leaf temperature, Brix, fruit weight, fruit number being recorded. Nutrient and water application was controlled by data loggers. This regulated the VWC levels to between 45-50%, 50-55% and 55-60% with soil moisture sensors. Additionally the VWC levels were independently examined and water usage for the three treatments was recorded with water flow meters.

A Spotted Wing Drosophila monitoring programme was initiated on 2015 with 30 SWD traps placed on four soft fruit farms in Leinster. The traps were sampled by growers on a weekly basis and returned by post to Teagasc from the 1st of June to the 14th of September. One of the farms continued to be monitored continuously throughout the winter. On the back of the positive detections in 2015 the monitoring programme was expanded into 2016 to 16 farms. The sampling started on the 31st of May to the end of November. The samples were analysed for the presence of SWD, males and females counted and other drosophilids were recorded.

4. Main results:

(1) Long-cane production was shown to be feasible with all pre-experimental yield targets across two substrates and three VWC treatments being achieved for both cultivars. With further experience this production method has the potential to surpass traditional methods in terms of yield and therefore should be in important consideration for growers looking to increase production and increase efficiencies.

(2) This research has shown that the use of coir in raspberry production is feasible with yields comparable to the use of peat. While the yields were slightly lower for coir it would be foreseen that with experience, growing in coir will achieve at least comparable yields as observed in peat.

(3) Using a closed loop irrigation system using sensors and a data logger to drive fertigation decisions is feasible and pre-experimental yield targets were achieved. With further refinement and proficiency there is potential for further gains in yield and quality. The potential reduction in labour and increase in consistency that the system introduces is an attractive feature that growers should take into account.

(4) An important finding of this project was that a reduction of irrigation to below the standard irrigation level was not found to have an effect on the qualitative characteristics of raspberries. Consequently irrigation levels should not be led by fruit quality considerations but rather by economic concerns.

(5) The analysis of stomatal conductance within this project was novel within horticultural research and found that there was a difference in stomatal conductance between two commercial cultivars, despite receiving equal amounts of water and nutrients. This has consequences for the cultivar selection, specifically for where deficit irrigation regimes are in place or water usage is an important consideration.

(6) The one year long-cane system significantly reduced pest and disease control issues. Only a single plant strengthening product was applied weekly and was successful in maintaining pest populations below an economic threshold, this is an important aspect to this growing method.

(7) SWD was recorded for the first time in Ireland. It is of a major benefit to the industry in Ireland that this was detected early. This has allowed for an early warning to the soft fruit industry allowing further research and investigation into control options and management before the populations of SWD increase to damaging thereby limiting economic impacts on the soft fruit industry.

(8) Population dynamics were monitored and recorded to inform future control management. The monitoring programme revealed the peak population in 2015 to be week 45 while in 2016 the peak was week 40. Levels of trapped SWD were highest in autumn with lower numbers being recorded in the spring and summer. It is likely the high autumn catches are a result of the traps being place in the hedgerows, and as cultivated crops become unavailable to SWD at the end of the season, the SWD return to the hedgerows, thus showing a peak in the population.

(9) The rate of SWD population increase and spread should be a primary concern to the Irish soft fruit sector

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5. Opportunity/Benefit:

One year long-cane raspberry production has been shown to have excellent yields, with a decrease in pest and disease incidence. There is also a reduction in labour costs when combined with a closed loop irrigation system that is sensor led, will increase consistency of irrigation leading to water and nutrient efficiencies and consequent savings, while maintaining fruit quality. While this project was specific to raspberry production the closed loop and soil moisture sensor irrigation methods can be applied to other substrate grown crops. Optimal VWC levels would need to be research for different crops and indeed as shown for each cultivar for optimal yields and plant growth. Additionally this project has shown that the use of stomatal conductance measurements are a useful tool in crop research and this should be further developed.

The SWD monitoring programme has been of major benefit to the soft fruit industry in Ireland and has highlighted the need for the further research of control management of this pest. The data from this project will be used in future projects to inform the population spread, growth and development of SWD as it disperses through the Irish landscape. Monitoring the population dynamics will inform future management with the aspiration to ensure that pesticide use is minimised and cultural and biological management tools can be developed to effectively manage SWD.

6. Dissemination:

6 SWD Identification workshops held for the Soft Fruit sector
Factsheet and informational sheets have been published on the Teagasc website

Main publications:

Brogan, D. (2018) The feasibility of one year long-cane raspberry production under protection in Irish conditions and an investigation into the presence of Drosophila suzukii in Ireland. M.Sc. Thesis. University College Dublin. 193pp.

Popular publications:

Gaffney, M., Brogan, D., Doyle, O., Elliott-Kingston, C., Callaghan, D. 2015. Improving raspberry production in Irish conditions. TResearch. Carlow: Teagasc.
Gaffney, M., Brogan, D. & Kehoe, E. 2017. Spotted wing drosophila in Ireland. TResearch Carlow: Teagasc.
Gaffney, M., Kehoe, E. & Brogan, D. 2016. Spotted Wing Drosophila (*Drosophila suzukii*). Carlow: Teagasc.

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