An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine

15S759 - Alternative crops for cut foliage sector

Final Report

This project was funded under the Department of Agriculture, Food and the Marine Competitive Funding Programme.

SUMMARY

The main objectives of New Leaves were (1) to identify and develop a number of alternative /novel crops and technologies for the cut foliage sector and (2) to elucidate the epidemiology of shothole disease and key pests on Prunus laurocerasus (Laurel) when grown as a cut foliage crop. In addition, it was proposed to identify integrated pest management (IPM) strategies to control key pests on Laurel. Fifteen species of Eucalyptus were identified that were suitable for growing in Ireland and were established at Teagasc Kildalton as a demonstration plot. Vegetative propagation of Eucalyptus was unsuccessful so it was not possible to bulk up numbers of elite individuals. A micropropagation technique for Eucalyptus was established using seedlings but it needs to be validated using older established plants, which may be harder to micropropagate. Such an outcome would be very beneficial for the sector, allowing elite trees to be propagated and used to establish elite plantations. Novel Hebe polyploid mother plants were produced with excellent cut-foliage characteristics, having larger, more abundant leaves per stem and reduced flowering. They were outplanted at Teagasc Ashtown and a batch of propagated plants are being trialled at Teagasc Kildalton in 2022 to see how they perform. Currently there is no Hebe cut foliage on the market so if the novel polyploids perform well, they would be a useful addition to the range of cut foliage offered by the Irish sector. A crop walkers guide on pests and diseases of Prunus laurocerasus was produced and distributed to the sector. Valuable information on pest and disease lifecycles was gathered and key factors influencing their development were identified. This information is described in a number of factsheets, giving growers useful information on integrated pest management (IPM) strategies for a more sustainable sector.

KEYWORDS

Cut foliage, horticulture, eucalyptus

ACRONYM	NewLeaves
PROJECT COORDINATOR, INSTITUTION	Dr. Helen Grogan
EMAIL	helen.grogan@teagasc.ie
COLLABORATORS, INSTITUTION	University College Dublin, Forest Produce
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Section 1 – Research Approach & Results

Start Date

01 December 2016

End Date

31 December 2020

Research Programme

Research Stimulus Fund

TRL Scale

TRL 5: Technology validated in relevant environment

Total DAFM Award

€558,335.00

Total Project Expenditure

€543,22.23

Rationale for undertaking the Research

Cut Foliage is a new emerging industry, suiting the mild Irish climate. The export market has grown substantially in recent years as Irish foliage is recognized as a high quality product. The Foliage Ireland Group led by Teagasc, are confident that the Cut Foliage sector will contribute to FoodWise 2025 targets of increasing horticultural output by 25%, producing foliage valued in excess of €20 million and generating 400 full-time jobs equivalent in rural Ireland by that time. The market value for cut flowers and fresh foliage was €16 billion in 2009 and annual foliage consumption was €549m. Worldwide, this sector has been growing rapidly at 7- 8% p.a. There is a clear potential to increase Irish production, Irish exports as well as import substitution.

Eucalyptus, Pittosporum, and Viburnum are important plant species in the foliage/filler market today. Other species become important, for novelty purposes (scent, berries, new colours & textures) such as Hebe, Ozothamnus and Brachyglottis. These market demands underpin the selection of novel species which are the focus of this proposal.

The foliage market demands high quality, blemish-free leaves. Thus, there is a need to elucidate the incidence and distribution of pathogens and pests. Epidemiological information on the major pests (tortrix moth, capsid bug and thrips) and pathogens (Pseudomonas syringae causing Shothole disease) is needed to improve targeting control measures more effectively. Increasingly, under the Sustainable Use Directive (SUD) all producers must adopt IPM strategies to tackle pest and disease issues. This project will provide data to underpin IPM.

Methodology

The project was divided into five main Tasks.

Task 1 focused on Eucalyptus. This task evaluated 15 species of Eucalyptus for their potential as new cut-foliage species for the sector. Seed germination characteristics were described, vegetation propagation potential was evaluated, seeds were irradiated to generate novel mutations and micropropagation methods were developed.

Task 2 focused on the development of micropropagation protocols to facilitate developing novel polyploid lines of important species in cut foliage production. Micropropagation protocols were developed for Viburnum tinus, Pittosporum tenuifolium, Brachyglottis greyi and a Hebe speciosa clone. Micropropagated Hebe plants were then used in polyploidy experiments.

Task 3 surveyed cut foliage plantations and nurseries of Cherry Laurel for shothole disease and other pathogens over the course of the project. Bacterial and fungal pathogens were identified using microbiological and molecular techniques. A trial of biostimulant and biocontrol products was undertaken at a Cherry Laurel plantation in Kerry and compared with standard chemical control products for control of shothole disease.

Task 4 studied the epidemiology of shothole disease on Prunus laurocerasis in the laboratory, glasshouse and outside locations, looking at the effects of wounding, temperature, shading and humidity on disease expression.

Task 5 characterised the occurrence and growth characteristics of three pests of Prunus laurocerasis: tortrix moth, green capsid bug and thrips, over the growing season, using passive and active monitoring techniques. Laboratory and glasshouse growth trials for each pest were also conducted. A review of commercially available plant protection products was done to identify application-timings to achieve optimal results

Project Results

Fifteen species of Eucalyptus were evaluated as potential cut-foliage species. Germination characteristics were established and three specimens of each were planted in the Teagasc Kildalton Cut Foliage Plantation in 2017/18?? to showcase Eucalyptus species suitable for the Irish climate. Trials determined that all were difficult to propagate vegetatively, meaning that plantations would need to be established from seed with the understanding that there will be inherent variability between individual plants. A micropropagation protocol was developed and shows promise for propagating elite individuals. Irradiated Eucalyptus seed of four commonly cultivated species (Eucalyptus parvula, E. cinerea, E. glaucescens and E. subcrenulata) produced unique individuals, which were outplanted at Teagasc Ashtown in 2021. They do not show any traits of particular novelty at the moment but they can be evaluated again at a later stage to see if any interesting characteristics emerge over time as they mature.

Micropropagation protocols were developed for Viburnum tinus, Pittosporum tenuifolium, Brachyglottis greyi and Hebe speciosa in preparation for polyploidy experiments. Only Hebe speciosa produced polyploids. Novel Hebe polyploid mother plants were produced with excellent cut-foliage characteristics, having larger, more abundant leaves per stem and reduced flowering. They were outplanted at Teagasc Ashtown in 2021 and a batch of propagated plants are being trialled at Teagasc Kildalton in 2022 to see if how they perform.

Surveys of commercial Prunus laurocerasus plantations indicated that the bacterium Pseudomonas syringae pv syringae, which causes Shothole disease, was the dominant pathogen on all commercial sites surveyed. A crop walkers guide to pathogens and pests of Prunus laurocerasus is now available. A trial of commercial products, plant stimulants and biological control agents, showed all reduced shothole disease compared to untreated controls (larger scale trials are needed), offering the possibility to enhance the environmental sustainability of the cut foliage sector.

Epidemiological studies identified the conditions which lead to increased shothole disease on Prunus laurocerasus. These include exposed sites, mild temperatures and plant-wounding. Some cultivars are more susceptible to the disease, such as Rotundifolia, Novita and Etna. Humidity did not promote symptoms in leaves which were already infected. The information therefore suggests that more sheltered sites should be chosen, and physical damage and wounding of plants (by insects in particular) should be avoided.

Active and passive field monitoring of the key insect pests - tortrix moth, green capsid and thrips - in 2017-2019 indicated a high level of variability, making predicting pest occurrence very difficult. Monitoring the damage to foliage informed a preventative management strategy for each of the key pests. Laboratory-based trails indicated that most key pests require alternative host plants to sustain a population. A review of commercially available pesticides identified appropriate application-timings to achieve optimal results.

Section 2 – Research Outputs

Summary of Project Findings

The project had benefits for several end-users with impacts on research links and industry links. Research links with UCD Agriculture and Horticulture departments have been strengthened and students are now exposed to more information on cut foliage pests and diseases in various lecture modules. Contact with South East Technical University has been advanced. Level 8 students engaged with the New Leaves technician at Teagasc Kildalton for final year project work. Relationships have been strengthened with Munster Technological University (MTU) where Level 7&8 students participate in field-visits to cut foliage sites in the south west. Close liaison with those delivering the 'Floriculture' module of the Level 8 course in Horticulture has resulted in research projects being undertaken at MTU.

The research has strengthened links with the company Forest Produce, a cut-foliage production and processing company who supported and collaborated on this project. Two other companies – Tanners Foliage in Dublin and Irish Green Guys in Kerry are expanding their area of foliage significantly, guided by the technical support of Teagasc cut foliage specialist - Andy Whelton. Following on from the Eucalyptus propagation work under 'New Leaves, Teagasc, in conjunction with above companies (Forest Produce Ltd, Irish Green Guys, Tanners Foliage) are engaged in a small project to advance Eucalyptus propagation work with Fitzgerald Nurseries in Kilkenny. They are progressing vegetative and In-vitro micropropagation techniques for elite Eucalyptus clones obtained from the growers own commercial plantations.

A Eucalyptus nursery in UK, Grafton Nursery, Worcestershire, are interested in our research and attended the Eucalyptus event held in 2019 at Kildalton college. NI cut foliage advisor, xxx, attended a 2nd Cut foliage field event at Teagasc, Kildalton in 2022 with interested potential new growers. Adam Parsons, a Eucalyptus specialist in Australia is interested in our work and keeps in contact with Andy Whelton.

Summary of Academic Outputs

Research Outputs	Total Number	Details
Publications in Peer Reviewed Scientific Journals	2	Afroze, F, Douglas, G, Grogan, H. (2021). A comparative study on seed physiology and germination requirements for 15 species of Eucalyptus. Theor. Exp. Plant Physiol., 33, 411-425, https://doi.org/10.1007/s40626-021-00222-0 Smith, L., Gibriel, H.A.Y., Brennan, C., del Pino de Elias, M., Twamley, A., Doohan, F., Grogan, H. and Feechan, A. (2020). First report of sot hole disease on cherry laurel (Prunus laurocerasus) caused by Micrococcus aloeverae in Ireland. Plant Disease,104 (10): 2722. https://doi.org/10.1094/PDIS-03-20-0521-PDN
Masters Theses	1	Smith, L. 2019. The epidemiology of Pseudomonas syringae pv. syringae (Pss) on Prunus laurocerasus. MSc thesis. University College Dublin, Dublin 4, Ireland
Training Courses	3	Angela Feechan & Leighton Smith. Teagasc Seminar for National Botanic Gardens Horticulture students and staff - 12 Dec 2019. (20 Attendees). The epidemiolgy of shothole on the cut foliage crop Cherry Laurel. Angela Feechan. Agricultural Botany and Emerging Crop Pathogens modules, UCD. 27 Sept 2020. (1) Agricultural Botany: 150 students. (2) Emerging Crop Pathogens: 12 students.

Intellectual Property

Novel Hebe speciosa and Eucalyptus spp clones have been generated and are outplanted at Teagasc Ashtown. If these clones were determined to be of interest then they would need to be protected by plant breeders rights, and a licencing agreement reached with potential propagators of the material.

It is important to state however, that plant breeders rights will not be sought until the material can be validated as of commercial interest to the cut foliage sector and that requires further research to be done. Some trial work with propagated Hebe clones, which show novel of traits of interest, are in progress however the plants and foliage need to be rigorously evaluated from a commercial production and market acceptance perspective. The Eucalyptus material at the moment is not showing promise as being of interest with no discernible novel traits of interest.

Summary of other Project Outputs

Project Outputs	Details	Total No.
New Products	Unique polyploid Hebe clones have been developed that have interesting attributes for the cut foliage sector. However, further development and post-harvest shelf life research is needed to determine their suitability and appeal at a commercial scale. If these clones were determined to be of interest then they will need to be protected by plant breeders rights and a licencing agreement reached with potential propagators of the material. Similarly, there are a number of unique Eucalyptus clones from the irradiation treatment but with no obvious novel traits of interest at the moment. They have been outplanted and will be observed over time to see if interesting traits emerge. Further development research would be needed to determine if they have appeal at a commercial scale. If these clones were determined to be of interest then they would need to be protected by plant breeders rights, and a licencing agreement reached with potential propagators of the material. It is important to state that plant breeders rights will not be sought until the material can be validated as of commercial interest and that requires further research o be done. However, there are limited avenues for research funding for this work	2
New Processes	New micropropagation methods have been developed for a number of species of interest to cut foliage. Of especial interest is the micropropagation protocol for hard-to-propagate material of Eucalyptus. Micropropagation protocols have also been developed for Viburnum tinus, Brachyglottis greyi and Pittosporum tenuifolium and the micropropagation protocol for Hebe speciosa has been improved. This will facilitate further research to generate novel varieties by polyploidy and irradiation, and the bulking up of unique individuals for hard-to-propagate material.	5
New Industry Collaborations Developed	Following on from the Eucalyptus propagation work under 'New Leaves, Teagasc, in conjunction with three companies (Forest Produce Ltd, Irish Green Guys, Tanners Foliage) are engaged in a small project to advance Eucalyptus propagation work with Fitzgerald Nurseries in Kilkenny. They are progressing vegetative and in-vitro micropropagation techniques for elite Eucalyptus clones from growers own commercial plantations.	1

Potential Impact related to Policy, Practice and Other Impacts

Impact	Details
Environmental Sustainability	The New Leaves project had three tasks on pest and disease identification, epidemiology and control. A key output from those tasks is a Crop Walkers guide on Pest and Diseases of Prunus laurocerasus, providing the industry with a colour handbook illustrating in detail the most common pests and diseases encountered in this crop. Knowledge on pest life cycles has been generated and provides good information to growers to manage pesticide applications. Information on non-pesticide approaches to disease control of shothole disease has been generated. There has been an increase in the area of land being given to cut foliage in recent years. This change of landuse leads to increased biodiversity (birds, bees, insects) associated with a continuous cover of shrubs as opposed to grassland or tillage.
Industry	The project has had impact on Industry practice by highlighting all the work done on Eucalyptus spp. Eucalyptus is a high interest species in the cut foliage sector. The project aimed to improve productivity in terms of quality and yield by establishing a vegetative propagation protocol for elite clones of a range of Eucalyptus species. Unfortunately, Eucalyptus is notoriously difficult to propagate vegetatively and this task was unsuccessful. Some success was achieved in micropropagating Eucalyptus from seedlings. This was extra work done when the vegetative propagation was unsuccessful. Further work outside the scope of the project was needed to test older material to establish if micropropagation could be an effective propagation tool. A small industry consortium has funded some exploratory work in this area (€5,000). The increase in cut foliage as an enterprise in Ireland, with an emphasis on Eucalyptus, has led to import substitution of Eucalyptus cut foliage in Ireland by cut foliage buyers. However, the bulk of the produce continues to be exported.
Socio-Economic	The project has had a socio-economic impact as the activities of Teagasc and the New Leaves project team has generated significant knowledge and interest in the sector. New enterprises have been established in recent years bringing employment and wealth in rural areas.

Dissemination Activities

Activity	Details
Workshops at which results were presented	Andy Whelton & Danielle Boland. Update on New Leaves Project. Cut foiage field event at Kildalton College, Co. Kilkenny. 14 August 2018. Brian McGuinness, Danielle Boland, Andy Whelton, Sarah Grauby, Helen Grogan. New Leaves disease survey. Horticulture Open Day, Teagasc, Ashtown, Dublin 15. 15 May 2018. David Wallace. Field walk to view Eucalyptus specimen trees plantation and vegetative proagation trials. Eucalyptus Event. Teagasc, Kildalton College, Co. Kilkenny. 15 August 2019. Andy Whelton. Teagasc Horticultural Development Department. Outdoor Curt Foliage field event. Teagasc, Kildalton College, Co. Kilkenny. 28 July 2022. (45 attendees)
Seminars at which results were presented	Farhana Afroze. Propagation and breeding new Eucalyptus species. Eucalyptus Event. Teagasc, Kildalton College, Co. Kilkenny. 15 August 2019. Angela Feechan. Teagasc Webinar - 22 July 2020. The epidemiolgy of shothole on the cut foliage crop Cherry Laurel. Teagasc Nursery Stock Webinar Meeting for the nursery stock sector, 35 attendees.

Media Events	Helen Grogan, Leighton Smith , Brain McGuiness, Angela Feechan. Spot the difference on cherry laurel https://www.teagasc.ie/publications/2020/tresearch-summer-2020.php T-research Jul 2020 Helen Grogan, Angela Feechan. Shothole study makes new discoveries https://horticultureconnected.ie/horticulture-connected-print/2020/summer-2020/research-summer-2020/shothole-study-makes-new-discoveries-helen-grogan/ Horticulture Connected Jul 2020 Afroze, F., Douglas, G., Whelton, A., Grogan, H. Eucalyptus: a favoured filler. TResearch 17:1 Spring 2022. Pp 8-9. Afroze, F., Douglas, G., Whelton, A., Grogan, H. Hebe 2.0. TResearch 17:2 Summer 2022. Pp 26-27. Afroze, F., Douglas, G., Whelton, A., Grogan, H. Eucalyptus: a favoured filler. Horticulture Connected 9(2): Summer 2022. Pp 40-41.
Other	YouTube videos. Farhana Afroze, Brian McGuinness and Leo Finn. Short video of Hebe polyploids developed duringthe New Leaves project. https://www.youtube.com/watch?v=fc5-QQrBWn8 Farhana Afroze, Brian McGuinness and Leo Finn. Short video of Eucalyptus research done during the New Leaves project. https://www.youtube.com/watch?v=SvQf9Fp5Dbw&t=69s

Knowledge Transfer Activities

Identify knowledge outputs generated during this project.	Prunus laurocerasus, a crop walkers guide to pests and diseases. Teagasc, 2021. https://www.teagasc.ie/publications/2021/prunus-laurocerasus---a-crop-walkers-guide-to-pests-and-diseases.php Prunus (Laurel) Factsheet 4/21. https://www.teagasc.ie/media/website/crops/horticulture/cut-foliage/420-Prunus-Laurel-(003).pdf (Other factsheets on (1) Shothole disease of Prunus lauroceasus and (2) Key pests of Prunus Laurocerasus are in progress). These outputs, along with technical articles in popular magazines. help to raise awareness and knowledge of the cut foliage sector to a wide audience of agriculturally and horticulturally minded individuals.
Identify any knowledge transfer activities executed within the project.	The workshops & seminars listed under the Dissemination headings above were also knowledge transfer activities as defined by the EPA report. These events have attracted both established and potential growers in both Northern Ireland and Ireland. Similarly the training events at UCD in Academic output would be knowledge transfer activities and would inform Agricultural students of the this type of enterprise as a potential option for farm diversification.
List any impacts resulting from the knowledge transferred during the project.	These activities along with technical articles in popular magazines, help to raise awareness and knowledge of the cut foliage sector to a wide audience of agriculturally and horticulturally minded individuals and have provided them with expert knowledge and advice. Andy Whelton, Teagasc cut foliage advisor has seen an increase in new contacts from growers interested in establishing cut foliage plantations in both Northern Ireland and Ireland

Section 3 – Leveraging, Future Strategies & Reference

Leveraging Metrics

Type of Funding Resource	Funding €	Summary
Exchequer National Funding	€270,100.00	NDP funding has supported expansion in the cut foliage sector over the years. This expansion has been driven by the activities of the Teagasc Cut Foliage advisor who has been strongly supported by having the New Leaves research project-staff and outputs to draw on. The €270,100 figure quoted refers to the 2021 NDP scheme allocation (40% of costs)
Non Exchequer National Funding	€405,150.00	This represents the 60% matching funds invested by the cut foliage sector in response to the the 2021 NDP awards.

Future Strategies

As outlined above, this research has made several excellent advances in cut-foliage research that supports the future development and expansion of the sector. There is limited research in this area and, as a result, this research has made a major contribution, generating new knowledge, developing new plant clones with unique traits and new micropropagation protocols of direct relevance to the future of the sector. It has increased the out-plantings of Eucalyptus and Hebe in demonstration plots for the sector at both Teagasc, Kildalton and Teagasc, Ashtown. The project team has explored avenues for future research funding both nationally and with stakeholder companies but with limited success. The opinion of the commercial sector is that further externally-funded research is still needed to validate potential novel plant clones to demonstrate that they have good potential at a commercial level. At that point, the commercial sector could be willing to contribute towards research that gets the products to market. In the meantime the PI continues to search for potential research funding opportunities. One new small collaboration with the sector has been initiated to continue on the development of propagation methods for Eucalyptus, which were initiated as part of the New Leaves project.

Project Publications

1. Afroze, F, Douglas, G, Grogan, H. (2021). A comparative study on seed physiology and germination requirements for 15 species of Eucalyptus. Theor. Exp. Plant Physiol., 33, 411-425,

2. Smith, L., Gibriel, H.A.Y., Brennan, C., del Pino de Elias, M., Twamley, A., Doohan, F., Grogan, H. and Feechan, A. (2020). First report of sot hole disease on cherry laurel (Prunus laurocerasus) caused by Micrococcus aloeverae in Ireland. Plant Disease,104 (10): 2722.

3. Smith, L. 2019. The epidemiology of Pseudomonas syringae pv. syringae (Pss) on Prunus laurocerasus. MSc thesis. University College Dublin, Dublin 4, Ireland

4. Grogan, H., Smith, L., McGuiness, B., Feechan. 2020. A. Spot the difference on cherry laurel https://www.teagasc.ie/publications/2020/tresearch-summer-2020.php T-research Jul 2020

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6. Afroze, F., Douglas, G., Whelton, A., Grogan, H. Eucalyptus: a favoured filler. TResearch 17:1 Spring 2022. Pp 8-9.

7. Afroze, F., Douglas, G., Whelton, A., Grogan, H. Hebe 2.0. TResearch 17:2 Summer 2022. Pp 26-27.

8. Afroze, F., Douglas, G., Whelton, A., Grogan, H. Eucalyptus: a favoured filler. Horticulture Connected 9(2): Summer 2022. Pp 40-41.

9. Whelton, A., McGuiness, B., Grogan, H., Baars, JR. 2021. Prunus laurocerasus, a crop walkers guide to pests and diseases. Teagasc, 2021. https://www.teagasc.ie/publications/2021/prunus-laurocerasus---a-crop-walkers-guide-to-pests-and-diseases.php

10. Whelton, A. 2021. Prunus (Laurel) Factsheet 4/21. https://www.teagasc.ie/media/website/crops/horticulture/cut-foliage/420-Prunus-Laurel-(003).pdf