IT Tralee Masters by Research Programme Details

Title of Project: *Investigating commercial Ascophyllum Nodosum extracts ability to increase Nitrogen Use Efficiency in Spring and Winter Oil-Seed Rape*

Name of Principle Supervisor: Mr Patrick Quille

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Brief Biography of Principle Supervisor:

Mr Quille received his Degree in Chemistry of Pharmaceutical Compounds from University College Cork in 2007. He has since completed an M.Sc in Biotechnology in the Shannon ABC laboratories at IT Tralee on a project entitled: The preparation of an alginate with a hydrophobic moiety that retains its biocompatibility and immunosuppressive properties while remaining suitable for cellular encapsulation. He has previously worked in Astellas as a Process Technician and in Shannon ABC as a Biochemical Technician. He currently holds the role of Research Scientist with Shannon ABC. Previous projects include developing a commercial focus to the use of bioassays in the assessment of different components of seaweed and the impact of seasonality. He has worked on the FP7 funded project NatuCrop where he oversaw extensive tomato growth room, glasshouse and field trials. Results of his work have been presented at a number of conferences all over Europe and in Brazil. He is currently working on a Horizon 2020 project.

Recent Research Publications:

Journals:

- Goñi, Oscar; Fort, Antoine; Quille, Patrick; McKeown, Peter; Spillane, Charles; O'Connell, Shane **Journal of Agriculture and Food Chemistry.** Ascophyllum Nodosum extract biostimulants for crop yield enhancement: Same seaweed but different: A transcriptome analysis. 64(14) · March 2016
- Goñi, O., Quille, P., & O'Connell, S. (2016). Production of chitosan oligosaccharides for inclusion in a plant biostimulant. **Pure and Applied Chemistry**, *88*(9), 881-889.

Edited conference proceedings

- Goñi O., Quille, P., O'Connell, S. 2015. Impact of biostimulants on plant growth and stress tolerance. Irish Plant Scientists' Association Meeting (IPSAM), Maynooth, Ireland (ORAL PRESENTATION).

- Goñi O., Quille, P., O'Connell, S. 2015. Production of chitosan oligosaccharides for inclusion in a plant biostimulant. 12th International Conference of the European Chitin Society/ 13th International Conference on Chitin and Chitosan (ICCC/EUCHIS), Münster, Germany (ORAL PRESENTATION).

- O'Connell, S., Goñi O., Quille, P. 2015. The impact of *Ascophyllum nodosum* biostimulant compositional variation on performance in drought stressed tomato. 2nd World Congress on the use of Biostimulants in Agriculture, Florence, Italy (POSTER)

- Quille, P., Goñi O., O'Connell, S. 2015. Investigating the use of a high throughput screening tool in order to evaluate a range of biostimulants. 2nd World Congress on the use of Biostimulants in Agriculture, Florence, Italy (POSTER)

Research Project Abstract

Crop productivity relies heavily on nitrogen fertilisation which in itself requires huge amounts of energy to produce. Also excess applications of nitrogen to the land is detrimental to the environment therefore increasing plant nitrogen use efficiency (NUE) is essential in the promotion of sustainable agriculture.
The use of seaweed and seaweed extracts in agriculture is well documented. The most popular and well researched type of seaweed extract commercially available is an *Ascophyllum Nodosum* extract (ANE). *Ascophyllum* is a brown seaweed that is native to the waters of Ireland as it grows best in the North Atlantic basin. Seaweed extracts have been described to enhance seed germination and establishment, improve plant growth, yield, flower set and fruit production, increase resistance to biotic and abiotic stresses, and improve postharvest shelf life. Previously a seaweed extract when combined with a fertiliser regime increased the productivity and oil content and accelerated maturation (colour and firmness) of the olive fruits from olive trees.
Oil-Seed Rape (OSR; Brassica *napus*) is a member of the Brassicaceae family that is grown for its oil content. It requires extensive nitrogen fertilisation, however it has a poor N-harvest index meaning a lot of nitrogen is lost in the straw rather than transported to the pod.
The aim or our study is to apply 4 commercially available ANE's to winter and spring crops of OSR (different varieties) in a controlled growth room and glasshouse and finally in a field setting under different fertiliser regimes. Treatments will be assessed by comparing fresh weight, dry weight, and seed/oil yield and oil quality. Plant tissue will also be saved in order to assess other parameters such as flavonol accumulation, nitrate reductase, gene expression (*NRT2*) and photosynthetic parameters.

Research Context (Technical Merit & Impact)

600,000 Ha of OSR is planted in the UK and Ireland alone every year, recommended input of nitrogen is 200 kg (0.2 tonnes) per Ha meaning 120,000 tonnes of nitrogen every year. As OSR only has an N-harvest index of 0.6, representing 48,000 tonnes lost, which is a massive financial loss as well as potentially environmentally detrimental.

In determining the effect of ANE's on NUE current research focuses on the outcome, i.e. is yield increased, rather than investigate the method by which the yield has increased. This research is aimed a filling some void of knowledge here by linking phenotypic differences to biochemical and genetic data of treated plants in order to assign a potential mode of action.

Research Methodology

While ANE's have been shown to increase nitrogen assimilation, extensive growth trials, especially in economically important crops (such as OSR) which investigate their role in affecting NUE are scarce and are only seemingly becoming popular in recent years. However considering the increased price of nitrogen, the additional interest in biostimulants (ANE's in particular), the need to feed a growing population and coupled to the environmental damage of excess nitrogen this can be considered a 'hot topic'.

Plant (glasshouse and field setting) trials will be conducted and analysed for phenotypic data (photosynthetic measurements, yield). Materials from these plant trials must then be harvested, extracted and saved for biochemical and genetic determination.
Lab-based techniques employed include protein extraction, western blotting and spectrophotometry, RT-PCR and HPLC.

This 3 pronged approach from assessing phenotype to the biochemical level and finally to the gene level will provide evidence on mode of action of the ANE's potential impact on NUE in OSR.

PROJECT SCHEDULE – GANTT CHART

WP	M1	M3	M6	M9	M12	M15	M18
1							
2							
3							
4							

WP1: Literature Review

WP2: Plant Trials

WP3: Analysis of Plant Material

WP4: Write Up