Grower Summary

FV 421

Field evaluation of rhizobacterial inoculants for enhancing lettuce production

Final 2014

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Before using all pesticides check the approval status and conditions of use.

Read the label before use: use pesticides safely.

Further information

If you would like a copy of the full report, please email the HDC office (hdc@hdc.ahdb.org.uk), quoting your HDC number, alternatively contact the HDC at the address below.

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Project Title:	Field evaluation of rhizobacterial inoculants for enhancing lettuce production
Project Leader:	Dr Ian Dodd
Contractor:	Lancaster University
Industry Representative:	David Norman, FPC
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Headline

The application of the rhizobacteria *HDC P003* to lettuce plants in propagation or in the field increased lettuce head weight by up to 19% in 4 out of 6 cultivars. However, the development of this organism as a commercial product is at the “proof of concept” stage.

Background and Expected Deliverables

In the UK, lettuce comprises the majority of the salad leaf industry worth £566 million a year, with lettuce being bought by 92% of consumers (Ceres 2012). Over recent years, there has been increasing demand for more cultivars, with salad bags and bowls often containing a mixture of varieties. Due to this high demand, lettuce needs to be grown all year around (either abroad or in greenhouses during winter) and thus may be exposed to environmental stresses that limit productivity.

Environmental stresses such as drought stimulate the production of the growth inhibitory phytohormone ethylene (Belimov *et al.*, 2009). There is considerable horticultural interest in decreasing the production of ethylene, or antagonising its effects. One method to achieve this is soil inoculation with rhizobacteria containing the enzyme 1-aminocyclopropane-1-carboxylate (ACC) deaminase (ACCd), which hydrolyses the precursor of ethylene, ACC, into α-ketobutyrate and ammonia (Honma and Shimomura 1978). Previous work (within HDC Studentship CP 54) has shown that rhizobacteria that modify crop hormone status (*V. paradoxus* 5C-2, *Bacillus subtilis* IR-15) increased lettuce head weight of crops grown under both well-watered and drying soil conditions in both pot experiments and small-scale (6 m^2 cropping area per treatment) polytunnel experiments.

This project explored the use of *HDC P003* (a very similar ACCd-containing rhizobacterium) as an inoculant for lettuce grown under commercial cropping conditions. Suitable propagation and inoculation techniques for large-scale inoculum production using both commercially available (*Bacillus subtilis* QST713, marketed as Serenade by AgraQuest) and experimental inoculants (available at Lancaster University) were determined. Consequently, the deliverables of the project are:

- the development of suitable inoculation techniques for several different rhizobacterial inocula intended for field lettuce production
- the documentation of data showing the effects of two different rhizobacterial inoculants on rhizobacterial colonisation of the root zone, and the incidence of plant disease and crop productivity

Summary of the project and main conclusions

Field trials were conducted using the summer outdoor lettuce cultivars Iceberg, Endive, Red Salanova and Red Coral (August-October) and winter indoor lettuce Green Oak Leaf (Cook) and Apollo (Exact) (November-January) at different sites with plants grown in field soil. When applied according to the manufacturer's instructions, the commercially available product Serenade (*Bacillus subtilis* QST713) had no effect on lettuce head weight (presumably since disease incidence in the crop was low). When applied at the same bacterial concentration, *HDC P003* increased yield by up to 19% according to site and cultivar (in 4 of 6 cultivars tested). Adding rhizobacteria directly to plants in the field generally resulted in more consistent effects on crop yield than inoculation in the nursery.

Although variability in crop response to PGPR may be caused by variation in rhizobacterial colonisation of the root system, there is currently no method to quantify *HDC P003* colonisation of the root system. Consequently, molecular work aimed to provide a sensitive DNA-based technique by sequencing the 16S gene of *HDC P003.* However, there was no difference in probe detection when root systems were recovered from inoculated or uninoculated plants. Greater primer specificity needs to be achieved, and work (still ongoing) aims to achieve this, by using the ACCd gene.

Greenhouse-based pot trials conducted during winter aimed to select appropriate inocula and inoculation techniques for field experiments. *HDC P003* increased head weight, leaf area and water use efficiency of iceberg lettuce grown in soil from the field, similar to its effects in field trials.

Financial Benefits

Assuming a 20% increase in lettuce head weight, and a wholesale value of 33 pence per head for butterhead lettuce (Gov.uk 2014) or Little Gem (Horticulture Week 2014) lettuce, this would represent additional earnings if price was based on weight. Alternatively, should the crop achieve the desired minimum harvestable head weight 2 weeks earlier, this may allow an additional crop in each season.

Action points for growers

To note that *HDC P003* can be applied during propagation or post-planting and stimulates lettuce growth. However, it should be stressed that development of this organism as a commercial inoculant is at "proof of concept" stage, and there is currently no commercially available product.