

**Título:** "EFFECT OF AERATION OF THE NUTRIENT SOLUTION AND USE OF PGPR ON THE PRODUCTION AND QUALITY OF VEGETABLES BABY LEAF GROWN IN FLOATING SYSTEM".

**Nombre:** NIÑIROLA CAMPOY, DIANA

**Universidad:** Universidad Politécnica de Cartagena

**Departamento:** Producción vegetal

**Fecha de lectura:** 09/04/2015

**Mención a doctor europeo:** concedido

**Programa de doctorado:** TECNICAS AVANZADAS EN INVESTIGACIÓN Y DESARROLLO AGRARIO Y ALIMENTARIO

**Dirección:**

> **Director:** JUAN ANTONIO FERNÁNDEZ HERNANDEZ

> **Codirector:** CATALINA EGEA GILABERT

**Tribunal:**

> **presidente:** SEBASTIAN BAÑÓN ARIAS

> **secretario:** JOSEFA LÓPEZ MARIN

> **vocal:** FRANCESCO ORSINI

**Descriptor:**

> PRODUCCION DE CULTIVOS

> TECNICAS DE CULTIVO

> PLANTAS ORNAMENTALES

**El fichero de tesis** ya ha sido incorporado al sistema

> <http://hdl.handle.net/10317/6801>

**Localización:** REPOSITORIO DIGITAL DE LA UPCT

**Resumen:** Resumen de la tesis:

The floating system is one of the easiest and cheapest hydroponic methods used to produce baby leaf vegetables, a product which has grown in popularity in recent years as a ready-to-eat vegetable included in salads or as a single products.

The aim of this thesis was to assess the influence of three levels of aeration of the nutrient solution, the growing cycle or the application of plant growth promoting rhizobacteria (PGPR) on yield, on quality and on shelf life as a fresh-cut product of different species of baby leaf vegetables.

In the experiments of aeration of the nutrient solution, three levels [no aeration (NA), low aeration (LA) or high aeration (HA)] were studied in three different species (purslane, watercress and lettuce).

The study of three levels of aeration of the nutrient solution on the growth and quality of two cultivars of purslane

(*Portulaca oleracea* L.) over four crop cycles showed that purslane exhibited little sensitivity to oxygen depletion in the rooting medium, since it was able to adapt to a gradual reduction in oxygen content. Under such conditions, purslane plants created an aerenchyma tissue that helped to maintain growth. Under conditions in which no aeration was provided, there was a slight decrease in plant growth. The final quality of the product was improved because leaf nitrate concentrations were reduced compared with the high aeration treatment, and the content of functional phytochemicals and chlorophyll contents were increased.

The study of the effects of nutrient solution aeration and growing cycle (spring vs. winter) on yield, quality and on shelf life as a fresh-cut product of watercress (*Nasturtium officinale* R. Br.) showed that in the spring cycle, the plants had significantly higher yield and antioxidant capacity and lower specific leaf area, total root length, root diameter, length of 0 to 0.5 mm diameter root, and oxalate content than in the winter cycle. The absence of aeration increased the antioxidant capacity and vitamin C content in both cycles. Several adventitious roots developed exogenously from the watercress stem at the nodes as a morphological adaptation to oxygen depletion, particularly in NA conditions. The nitrate, oxalate, Ca<sup>2+</sup>, K<sup>+</sup> contents, and microbial populations were affected by both the cycle and the aeration conditions. Hue angle of the leaves was affected by both the cycle and storage time, and chromaticity and lightness were affected by the three factors (cycle, aeration, and storage time). The global quality was significantly higher (7.8 over 9 points hedonic scale) in the spring cycle than in winter, the score reflecting their marketable value (7.0 over 9 points). The mild dehydration problems observed in the winter cycle that led to a slightly lower overall product quality that could be the result of the development of thinner leaves and also the differences in the respiration rates compared with the spring cycle. In general, the spring cycle led to higher productivity, antioxidant capacity, and Ca<sup>2+</sup> and K<sup>+</sup> contents and lower oxalate content. Aeration slightly affected the quality of the final product, the plants grown in non-aerated conditions being richer in vitamin C and antioxidants and with lower nitrate content.

The study of the effects of nutrient solution aeration and growing cycle (autumn, winter and summer) on yield, quality, and on shelf life as a fresh-cut product of a red lettuce (*Lactuca sativa* L.) showed that the specific leaf area was lowest in winter. Yield was affected only by the growing cycle, showing the highest value in autumn. Lack of aeration produced shorter total root length but did not affect the root diameter. The percentage of dry matter and the nitrate content were affected by growing cycle and aeration, total phenolics and mesophilic microorganism by both aeration and storage time, hue angle and chromacity by growing cycle and storage time, and antioxidant capacity, vitamin C, lightness and psychrophilic microorganisms were affected by all three factors. NA conditions increased the antioxidant capacity in summer and vitamin C content in winter. After 7 days of storage at 5 °C, the antioxidant capacity, total phenolics, vitamin C and nitrate content decreased. The leaves were redder (higher Hue angle) in autumn and winter. The lowest mesophilic and psychrophilic count was observed in autumn.

The last two chapters relate to the use of plant growth promoting rhizobacteria (PGPR) to improve the quality and yield of baby leaf vegetables grown in floating system.

Regarding to the effect of application of two PGPR (*Bacillus subtilis* and *Bacillus velezensis*) and two concentrations of nitrogen (4 and 12 mM) in the nutrient solution on yield, quality and nitrate content of two baby leaf lettuce cultivars the results showed that in both cultivars and crop cycles plant height was affected by the level of N and the PGPR application, while leaf area, fresh and dry weight were only affected by the level of N. The use of the nutrient solution containing 12 mM of nitrogen increased the accumulation of nitrate in leaves. The application of *B. velezensis* in the nutrient solution provoked a decrease of nitrate content in red lettuce leaves respect to control. Finally, root growth was not affected by neither nutritive solution nor bacterial inoculants in both cultivars.

Finally, the study of the effect of applying a PGPR (*Bacillus subtilis*) on the yield, quality and safety of watercress considering two factors: substrate disinfection and inoculation with *B. subtilis* showed that substrate disinfection had a positive effect on plant development because it increased the shoot antioxidant capacity and general plant growth and decreased the colony-forming units of moulds. In turn, inoculation with *B. subtilis* increased the antioxidant capacity but decreased the chlorophyll a, chlorophyll b and carotenoid contents and did not affect the rest of parameters measured.

<http://repositorio.bib.upct.es/dspace/>