Exploring the Limits of Crop Productivity: Beyond the Limits of Tipburn in Lettuce

Horticulturists have long sought to maximize yield and quality of all crop plants. Three physiological determinants govern biomass yield in all plants: light capture, photosynthetic efficiency, and respiration. By manipulating the environment, one can maximize these determinants of yield.

Lettuce is typically grown in low temperatures and low light. The main reason for these growth conditions is to minimize a calcium disorder called tipburn (Figure 1). High light increases growth rates, which increases the need for Ca^{2+} in the meristem and increases tipburn. There are other factors which increase tipburn as well, such as low day-time humidity, high humidity, and salinity. Other conditions can also play a role in tipburn.

Figure 1. Closeups of the growing tips in 'Buttercrunch' (A and B) and 'Waldmann's Green' with and without the calcium disorder called tipburn. By blowing air onto the meristem, tipburn could be completely eliminated in some lettuce varieties.

We found that yield continues to increase if warmer than typical temperatures (optimum = 28C) and light of ½ full sun for 16-h days are used. Tipburn was still a problem however, so additional controls were needed.

Another study was conducted to determine the effect of aeration on tipburn in two different cultivars. Meristem aeration through small tubes directed at the growing center eliminated tipburn in 'Waldmann's Green' and almost eliminated it in 'Buttercrunch'. Previous studies done on aeration were done at low light intensities, but this study was done at very high light intensities. Without aeration, tipburn symptoms initially appeared on about day 14 for 'Buttercrunch' and about day 16 for 'Waldmann's Green', suggesting that 'Waldmann's Green' is more resistant to tipburn than 'Buttercunch ' The treatments differed greatly in quality. Aerated plants had minimal tipburn and good quality (Figure 1).

Fresh mass was greater in aerated plants, but there was no difference in dry mass because of a difference in the amount of water held by aerated plants (Figure 2).

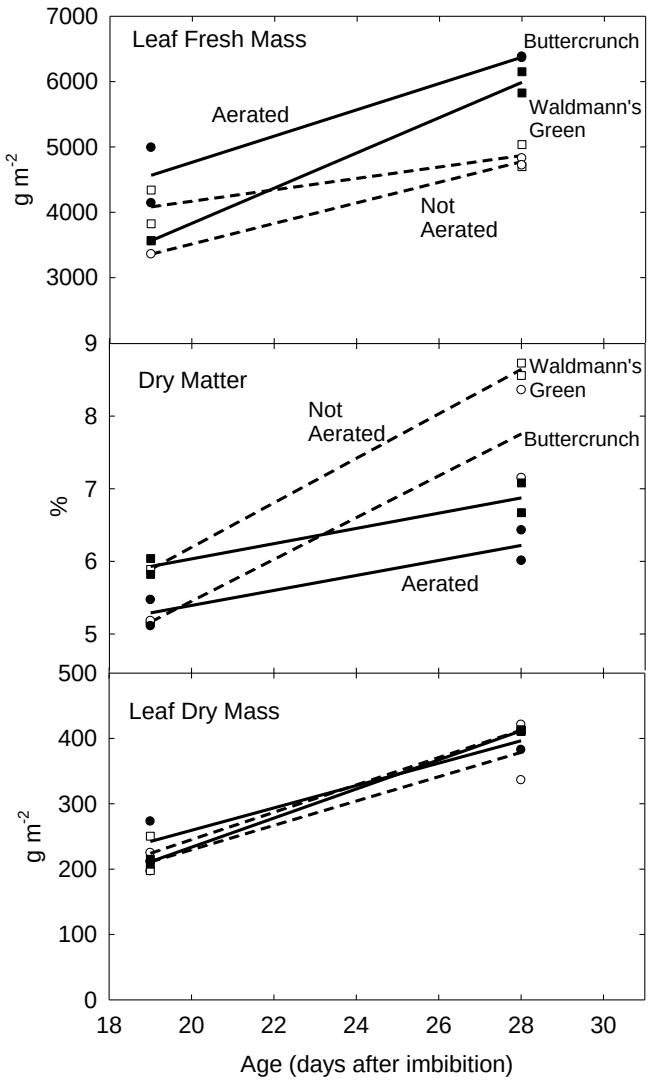

Figure 2. Yield components of aerated and non-aerated lettuce plants.

For more information, contact: Jonathan Frantz, jonathanfrantz319@gmail.com. Dr. Frantz now works for Dupont Pioneer.

Frantz, J. M., Ritchie, G., Cometti, N. N., Robinson, J., and Bugbee, B. 2004. Exploring the limits of crop productivity: beyond the limits of tipburn in lettuce. J. Amer. Soc. Hort. Sci. 129:331-338.