Microbial Quality of Iceberg Lettuce is Affected by Moisture at Harvest – 2nd Year Evaluation

Jorge M. Fonseca
The University of Arizona - Yuma Agricultural Center

Abstract

In a continuing work, the effect of moisture conditions on yield and microbial quality of Iceberg lettuce was investigated. Iceberg lettuce cv. Sahara grown at the University of Arizona Yuma Agricultural Center was evaluated for yield, microbial population and postharvest quality either following different irrigation termination schedules or before/after a rainfall event. We report here microbial population data with treatments including early (16 days before harvest), middle (8 days before harvest) and late (4 days before harvest) irrigation termination. Lettuce receiving the last irrigation 4 days before harvest showed increased weight but had higher microbial population than other treatments. The effect of moisture prior to harvest on quality was further evaluated with lettuce harvested before and after a rainfall event. Increased aerobic bacteria population of over 1 log CFU/g for outer leaves and over 2 log CFU/g for head leaves was observed after rain. The results from this study suggest that managing moisture conditions at harvest is important to enhance quality of lettuce.

Introduction

Understanding the dynamic of the microbial population of lettuce is extremely important for growers to deliver safe food to consumers. Water used for irrigation in Yuma County, for example, is not treated and likely contains high amounts of microbial counts. Prolonged exposure of water to lettuce can trigger proliferation of microbial population, including pathogenic bacteria if contamination has previously occurred. To minimize this, Good Agricultural Practices (GAP) has been recommended by Federal authorities, but still there are practices that need to be studied further to determine the actual impact. Along this line, it is thought that the longer the term between last irrigation and harvest, the lower the microbial population in the harvested product. The concern is, however, that early irrigation termination potentially causes weight loss and affects grower profits. Moreover, the impact of rainfall on microbial quality of lettuce has not been reported in our area. The results from the previous year, which are shown in the 2004 Arizona Vegetable Report, indicated that excess moisture at harvest affects microbial and visual quality of lettuce, and also showed that excessively late irrigation is not necessary to obtain maximum yields. This year the goal was to confirm these findings. The objectives of this study were: a) to evaluate different schedules of last irrigation on microbial population of fresh Iceberg lettuce; b) to determine the effect of timing of irrigation termination on yield and visual quality of fresh Iceberg lettuce (not reported); c) to determine the impact of rainfall a few days before harvest on microbial quality of Iceberg lettuce.

Material and Methods

Lettuce plants were grown at the UA Yuma Agricultural Center conducting agronomical practices as currently applied in commercial settings. For the irrigation termination trial the treatments were: 1) last irrigation scheduled 16 days prior to harvest; 2) last irrigation scheduled 8 days prior to harvest; 3) last irrigation scheduled 4 days prior to harvest. Harvest was conducted on the same day for all treatments. Additionally, we monitored lettuce from commercial fields before and after harvest, and evaluated for mesophilic bacteria count and coliform population (data not shown).

This is a part of the University of Arizona College of Agriculture and Life Sciences 2005 Vegetable Report, index at http://cals.arizona.edu/pubs/crops/az1382/

Microbial analysis was performed on the day of harvest. For the irrigation termination evaluation six heads per replicate were taken. Samples (7 g) of head leaves were diluted in 70 mL of water according to the film manufacturer's recommendation, and submitted to gentle agitation for 90 seconds using a stomacher.

Aliquots were taken from the solution and diluted to 10^{-1} to 10^{-7}. Aliquots of the diluted solutions were placed onto 3M-Petrifilm™ and incubated at 32 °C for 48 hours. The inoculation of the samples was conducted in duplicate. The bacterial analysis was conducted at the Vegetable Quality Lab of the Yuma Agricultural Center.

The lettuce were stored at 34-38 °F. Quality was evaluated on days 0, 5 and 10 (data not reported). The irrigation termination experiment was arranged in a completely randomized design and each treatment consisted of 3 replicates. Sampling of lettuce before and after rainfall was conducted at random in a ½ acre field, using 5 plants per each of four replicates. Data were subjected to analysis of variance (ANOVA) at $p \leq 0.05$ to determine statistical significance. Mean comparisons were conducted using Fisher's Protected LSD Method at $p \leq 0.05$.

Results and Discussion

The results from this second year of evaluation confirmed those obtained the previous year. The trend observed then, where the closer the irrigation termination to harvest the larger the microbial population, was also observed in this 2nd year trial. Lettuce receiving early irrigation termination showed the lowest microbial population, while lettuce receiving the late irrigation termination showed higher microbial count. Notably, lettuce receiving overhead sprinkle irrigation 4 days before harvest showed larger microbial population than lettuce irrigated the same day, but with furrow irrigation. Head leaves consistently had higher mesophilic bacteria (Figure 1) and coliform population (data not shown).

The results obtained from monitoring microbial population before and after rain support the hypothesis that high moisture at harvest results in high microbial population. We observed that microbial population increased to over 1 Log on outer leaves and over 2 Log CFU/g on head leaves 48 hours after rainfall (Figure 2).

Undoubtedly, an extreme early irrigation termination can result in lower yields, but the results from yield, quality (data not shown) and microbial population suggest that extremely late irrigation termination is not necessary to maximize weight at harvest. The main point to learn from the results obtained in this 2-year study is that wet conditions at harvest results in increased microbial population. This means that if for any reason a pathogenic bacteria reaches the surface of lettuce, wet conditions at harvest will result in higher proliferation of the pathogen. The survival of a pathogen is minimized if a dry period is allowed prior to harvest, but clearly, this cannot be achieved in times of frequent rainfall events. When wet conditions are inevitable, other practices may help in reducing the microbial growth rate, such as treating with sanitizers at harvest. On-going studies are conducted to determine how efficient the approved sanitizing systems are in reducing microbial population on lettuce.

Acknowledgements

I gratefully acknowledge the excellent assistance of Ramiro Galvez and Kristin Little from the Yuma Agricultural Center.

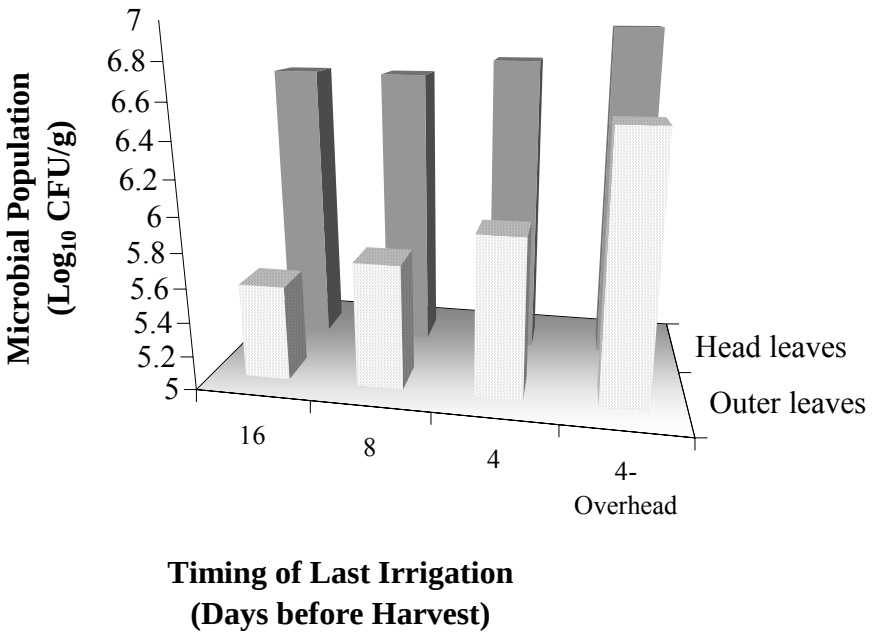

Figure 1. Effect of time of last irrigation on microbial population of head lettuce. Lettuce was watered through furrow irrigation with exception of one treatment that was irrigated with overhead sprinklers.

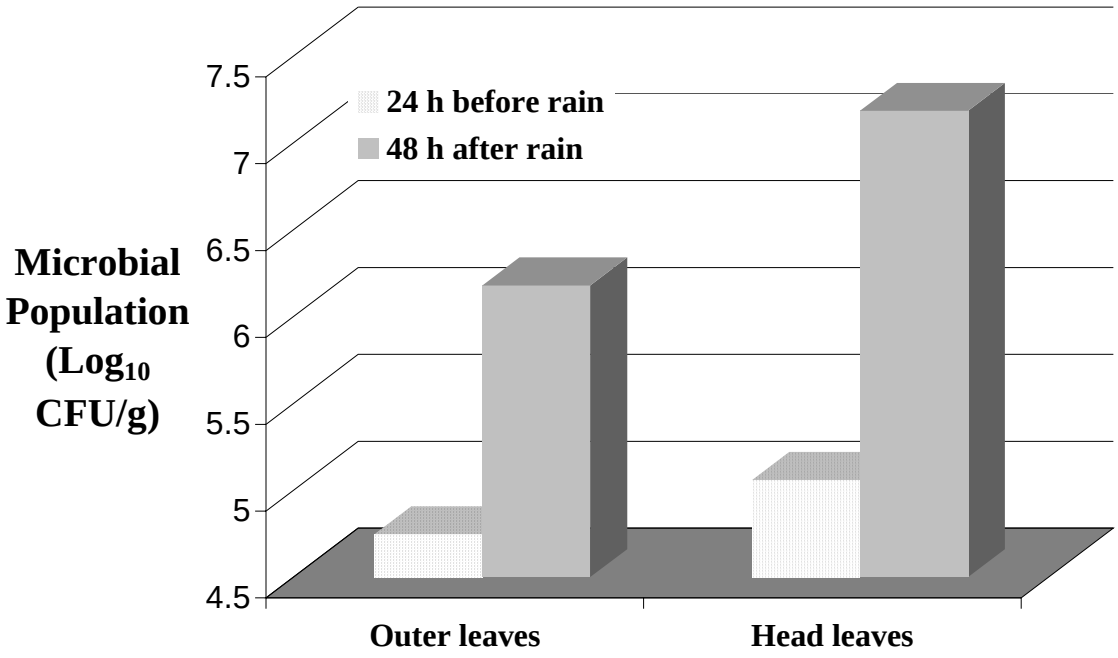

Figure 2. Microbial population of lettuce before and after a rainfall event.