

# Evaluation of the Effect of Cytokinin Products on Yield of Head Lettuce

Jorge Fonseca

The University of Arizona – Yuma Agricultural Center, Yuma AZ

## Abstract

*A series of replicated trials were conducted during the winter season of 2003 and 2004 to investigate the effect of pre-harvest applications of cytokinins on yield and postharvest quality of intact and fresh-cut lettuce. We report here only those results obtained at harvest. Cytokinins products were applied at different frequency and rates. The crops in the different trials were under different cultivation programs, including different nitrogen fertilization rates. Figures showing the performance of each individual cytokinin product versus the corresponding untreated controls are provided. Results obtained are mixed even for the same cytokinin product, however, some trends were observed. With the exception of products that also contain other plant growth regulators in their formula, high rates (or multiple applications) of the cytokinin products resulted in no effect or even in negative results. For example applications of Cytokin® did not improve yields as was the case with Cytoplex®, from the same manufacturer, under different conditions. The results from this study suggest that lettuce plants can respond to cytokinin applications, but factors to enhance positive response still need to be studied further. Single applications appear to be the most effective program for products containing only cytokinins, while products such as Cytoplex® can increase yield with multiple applications. A discussion addressing the different results obtained with nitrogen rates and the cytokinin products in yield and quality is included.*

## Introduction

Lettuce is currently a crop that brings high economical return to growers. Efforts to increase yields have been done, notably, by investigating different fertilization and crop protection programs, but very little has been done on understanding the effect of biostimulants and plant growth regulators on vegetable production. In fact, the use of these products is scarce in vegetable production. An interesting fact is that in-vitro studies have shown that the different growth regulators have a high impact on the growth of plants, but in commercial fields this effect often is not observed.

In an early work conducted at the Yuma Agricultural Center with HappyGro®, a cytokinin (kinetin) product, we observed increased yields when the product was applied twice after head formation, which warranted further evaluations with different commercial products. Thus, it was the object of this work to evaluate the effect of products such as Cytokin®, Cytoplex®, both supplied by Plant Biotech, Inc., Maxcel® (Valent BioSciences), Millerplex® (Miller Chemical), HappyGro® (LT Biosyn) on lettuce yield volumes. A parallel objective was to determine whether there is any interaction of the effect of cytokinins products and nitrogen fertilization, as nitrogen availability in the soil could be one of the factors affecting the final effect of cytokinins.

## Materials and Methods

Separate trials were conducted to investigate the effect of products individually and at different doses. Each product was evaluated in at least two trials. We report here trials evaluated during the 2003-2004 seasons. Harvest was conducted in early (with harvest in January) and late season (harvest in March). The experiments were conducted on Iceberg lettuce cv Red Coach 74, cultivated following commercial practices at the Yuma Agricultural Center, Yuma, Arizona. The planting date for the first series of experiments was October 18, 2004 and December 13<sup>th</sup> for the second series of experiments. The selected concentration of the products was as recommended by the manufacturers. In some trials the product were evaluated in crops fertilized with a “low Nitrogen rate” which ranged from 30 to 50 gal CAN-17/ac and a “high Nitrogen rate” which ranged from 140 to 160 gal CAN-17/ac. The application volume for all the cytokinin products was 50 gallons/acre. The temperatures during applications were 55-70 °F and wind speed was <5 mph. Cytokinin products evaluated in the experiments included Cytokin® (zeatin), Cytoplex® (zeatin), Maxcel® (6-BA), Millerplex® (Kelp with zeatin activity), HappyGro® (kinetin) on yield volumes. Concentrations are provided in figures 1-4.

At harvest, 60 feet per treatment (15 ft each replicate) were selected and all the lettuce was evaluated for head weight and diameter. Ten lettuce were selected per replicate to also measure for weight, including outer leaves. Although not shown in this report, lettuces were also evaluated at harvest for color, water content and postharvest quality evaluations.

The experimental design for all the experiments was a randomized complete block with 5 replicates. Data were subjected to analysis of variance (ANOVA) at  $p \leq 0.05$  to determine statistical significance. Mean comparisons were conducted using Duncan’s Multiple Range Test at  $p \leq 0.05$  (SAS Institute, Cary, NC).

## Results and Discussion

Results of head weight were diverse with the different cytokinin products. In most cases no positive effect was observed. Interestingly, application of MaxCel, a 6-BA product used at higher concentration than the other products, reduced the weight at harvest (Figure 1). Results obtained in the January harvest showed that the higher the concentration of MaxCel the more negative the results. In the March harvest the pattern was not similar but still the MaxCel applications reduced head weight with the exception of the high concentration applied on a field managed with low nitrogen rate. In this late season harvest Cytoplex showed an increase in weight (Figure 2), and similar increase of more than 7% was observed in plant weight for both the January and March harvests (Figure 3 and 4).

The results, although mixed, showed that the lettuce plant respond to cytokinin products under conditions that need to be elucidated. Different nitrogen rates were considered in these evaluations given the fact that all the cytokinin chemical structure contains nitrogen and this could play a role in the metabolism of the plant. Cytokinin has been reported to enhance uptake of this nutrient. On the other hand, lack of nitrogen limit growth and mobilization of water to young leaves, the via of transportation of natural cytokinin in the plant. The results with MaxCel are interesting because showed negative results under high nitrogen rates but improved yields of lettuce receiving high nitrogen rates. This product has proven very effective for other applications, especially in tree fruit production, and has not been evaluated for vegetables. It is very likely that the doses and frequency of application in our studies were extremely high for lettuce. Moreover, the results obtained with low rates of nitrogen may have some use for our growers when rain frequency is high during the growth of the plant, which subsequently limits fertilization, as was the case in Yuma during the past winter. More studies are needed to determine any benefit of MaxCel under “normal” to high nitrogen rates. High doses of nitrogen however, resulted in lower postharvest quality (data not shown) which has also been observed in other crops.

Results with HappyGro have not been consistent, ranging from no effect to an increase of near 5% of weight. In the initial trial in 2003 the application of this product increased yields (data not shown) of a lettuce field with low nitrogen rates, but subsequent trials have yielded diverse results. It resulted in significantly higher plant weight in the January harvest but head weight was not significantly affected. For the March harvest we also applied HappyGro on plants that had outer leaves covered with paper, attempting to determine whether the effect of this product was influenced by any activity of the adult leaves. However, in the March harvest no effect was observed in either group of plants, uncovered or covered.

The results with Millerplex did not show any statistical difference, however, the trend showed that the single application of this product tended to yield larger weight than the control in both trials which could indicate a consistent increase of yield if a correlation test is conducted when more data is available. Similarly to MaxCel results, the single application of Millerplex could be more effective than multiple applications, but this needs to be verified with more trials.

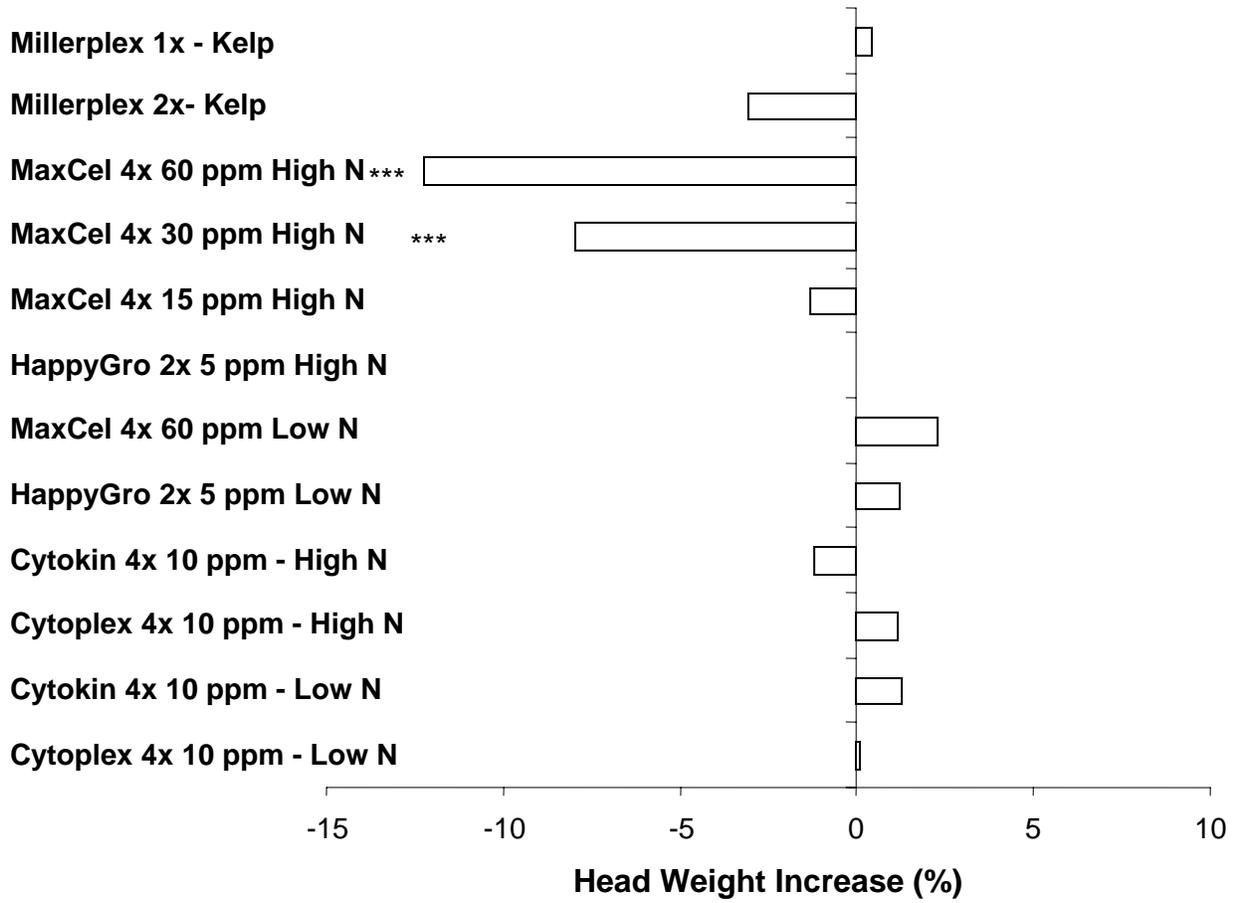
The results with Cytokin and Cytoplex showed that multiple application of a product containing only cytokinin (Cytokin) can be ineffective. Cytoplex also contains gibberellins and auxins which could explain the more positive results with this product. Under the conditions of our trials, with some exceptions Cytoplex was the only product that increased head size, improved quality at harvest (data not shown) and increased weight. More studies are needed to determine the effect of cytokinin applied fewer times or at different concentrations.

In summary, it is clear that the application of growth regulators is influenced by “external” factors that are still not well elucidated, which may explain why many growers often lose confidence in this type of product. In more than a dozen trials that have been conducted to evaluate cytokinin on lettuce yield in Yuma, the maximum increase of weight has been 7%, which may or may not be sufficient margin depending on the number of applications needed to obtain this result. The results obtained do show that products with only cytokinin may only need a single application to trigger a response, if any is possible under the prevailing conditions. On the other hand, products like Cytoplex can yield more consistent results with multiple applications, perhaps due to a more balanced formula containing gibberellins and auxins.

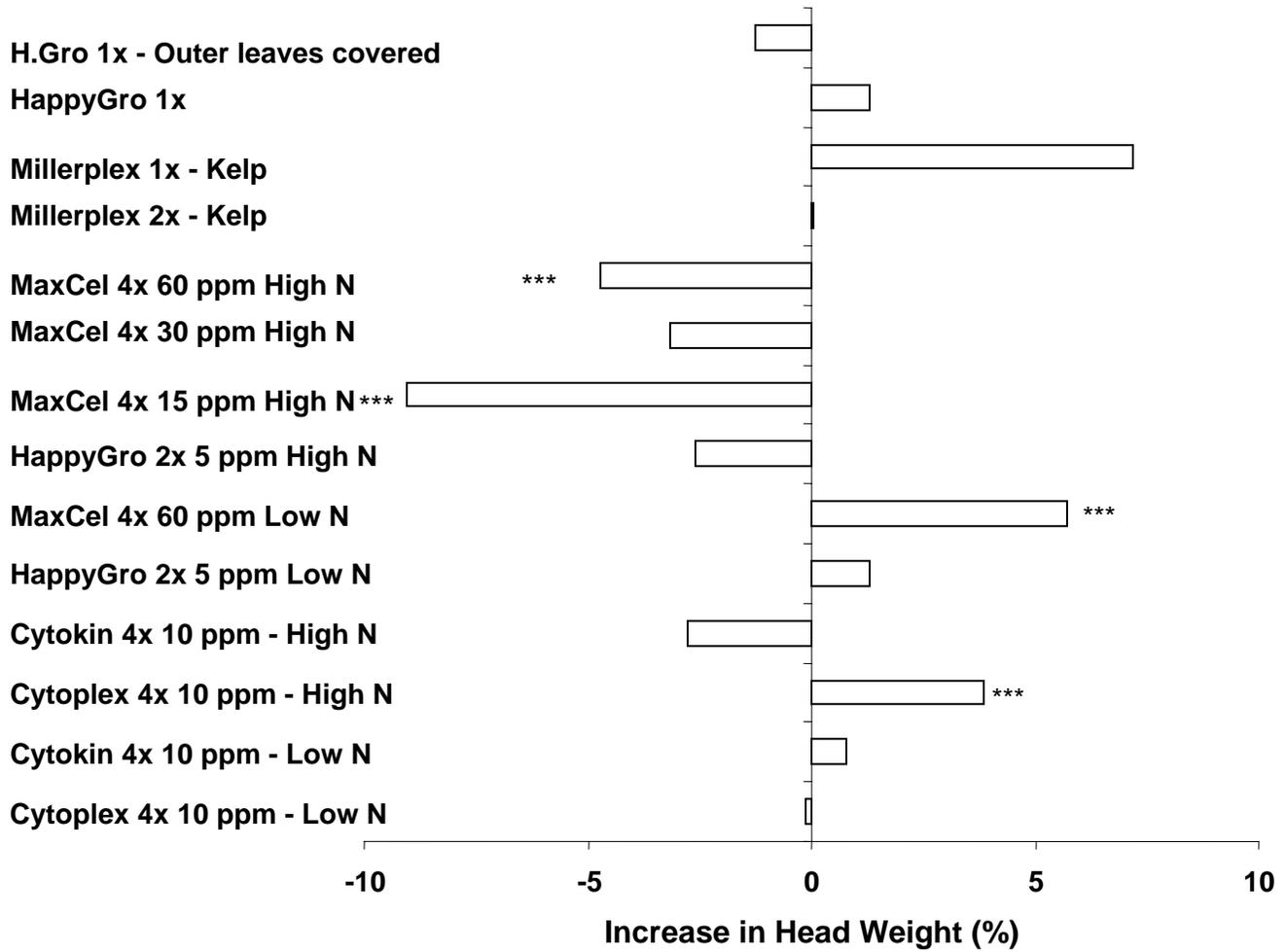
### **Acknowledgments**

Funding and support for this work was provided by Plant Biotech Inc., Miller Chemical, Valent BioSciences and L.T. Biosyn. Special thanks to Ramiro Galvez for his assistance to all the trials.

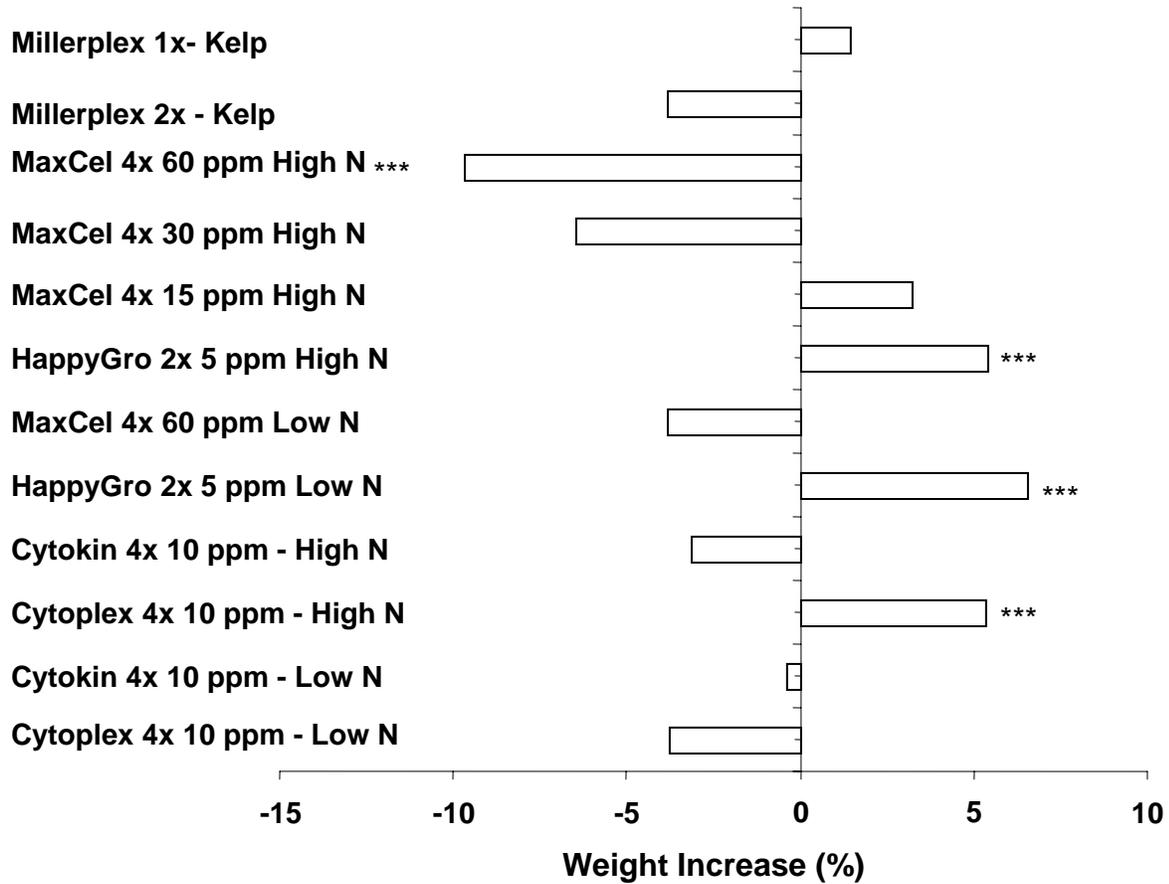
**Figure 1. Effect of cytokinin products on weight of head lettuce harvested during January 2004-2005.**



**Figure 2. Effect of cytokinin products on weight of head lettuce harvested during March 2004-2005.**



**Figure 3. Effect of cytokinin products on weight whole plants of lettuce harvested during January 2004-2005.**



**Figure 4. Effect of cytokinin products on weight of whole plants of lettuce harvested during March 2004-2005.**

