

Progress Report - February 2007

Development of protocols for optimization of branching and flower counts in cut-flower Gerbera production

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This intermediate progress report covers various areas of the project where progress can be reported. The specific experiments described in the original proposal are not repeated here.

Experiment A: Heat-Unit Time-line

The flower production of many horticultural crops, such as rose, is usually a function of temperature and can generally be described as in relation to accumulated heat units. The purpose of this experiment was to determine a production time-line based upon heat units for gerbera flower production. We were seeking this so as to be able to identify seasonal patterns in productivity. We found that the plants have a much greater response to varying light levels than they do for temperature. This was noticed in our production setting because there was a significant fluctuation of flower production while the average daily temperature remained relatively consistent. The levels of ambient light, however, did change dramatically with the change of the seasons, and the production of flowers was reflected by this change in light. From the data collected in this experiment we can not completely rule out the effects of temperature on flower production. This is because the plants were only grown at one consistent temperature and not at varying temperatures. There may indeed be an interaction between temperature and light, but from the information gathered under the original experimental design we were not able to deduce what this might be. In addition, since no supplementary lights were used, we cannot determine which aspect of lighting (photoperiod versus light intensity or light integral) had a greater influence on gerbera flower production. The various characteristics of light need to be studied to understand their role in the regulation of flower production, also the developmental activities of the plants need to be monitored at various temperatures to determine the impact that temperature has on flower development. Preliminary indications are that photoperiod is a driving force, but it is not known how. Thus we need to do additional experiments to see if we can identify this.

Experiment B: Development of a Leaf Area Model

A model to estimate leaf area in situ was developed for both 'Maya' and 'Passion'. The length and width of all the leaves from two 'Maya' plants and four 'Passion' plants were measured, then removed from the plant. Each was measured with a Licor LI-3100C leaf area meter. Each leaf was sent through three times and the average area was recorded. A regression analysis was run to determine what measurable trait would best estimate the area of the leaf. The results of the regression analysis indicated that both length and width measurements were required in order accurately estimate the area of each leaf. From this a prototype tool was developed which could closely estimate the area of each leaf without physically measuring the length and width of each leaf. The tool incorporates various curves created from a mathematical equation derived from

the results of the regression analysis. The various curves of the tool indicate various leaf areas, so by placing the leaf on top of this leaf area tool, the leaf area can quickly be estimated by visually determining where along the curve the leaf fits. This tool will allow for the leaf area of each plant to be monitored nondestructively. The LAI of each variety can then be monitored and manipulated.

Experiment C: Efficacy screening of various chemical materials on flower production

This experiment made up the majority of the work and involved a number of tests involving plant growth regulators (PGRs) and nutrient manipulation.

PGR screening:

The plants within five PGR treatments, in addition to those of the control group, were monitored on a daily basis starting from the beginning of September. Each day the plants were observed, to determine the number of new flower buds developed and the number of flowers to be harvested. Because flower initiation is not observable through non-destructive methods, the first recorded stage of flower development was when a new flower bud was first discernable from a new leaf, generally when the flower bud was about one centimeter in diameter. This stage was labeled "VB" (visible bud) (Fig. 1), was marked on the plant with the date on a plastic tag, and recorded. The date at which VB occurred was recorded. The flowers were considered ready to harvest once pollen development was exhibited by the first row of disk florets (Fig. 2). The flowers were then harvested and the date at which this occurred was also recorded. The harvested inflorescences were then measured for various quality characteristics such as, fresh weight, scape length, and capitulum diameter. These five observations were taken for every flower of every plant over the course of the entire experimental period. This information provided us with data indicating the average number of flower buds produced per plant per week, the average number of flowers harvested per plant per week, cumulative production values, as well as continuous quality traits. By incorporating environmental data, PAR and temperature, we were able to quantify the rate of flower development, not only by number of days, but by a light integral and temperature integral.



Figure 1 Visible Bud



Figure 2 Harvestable Flower

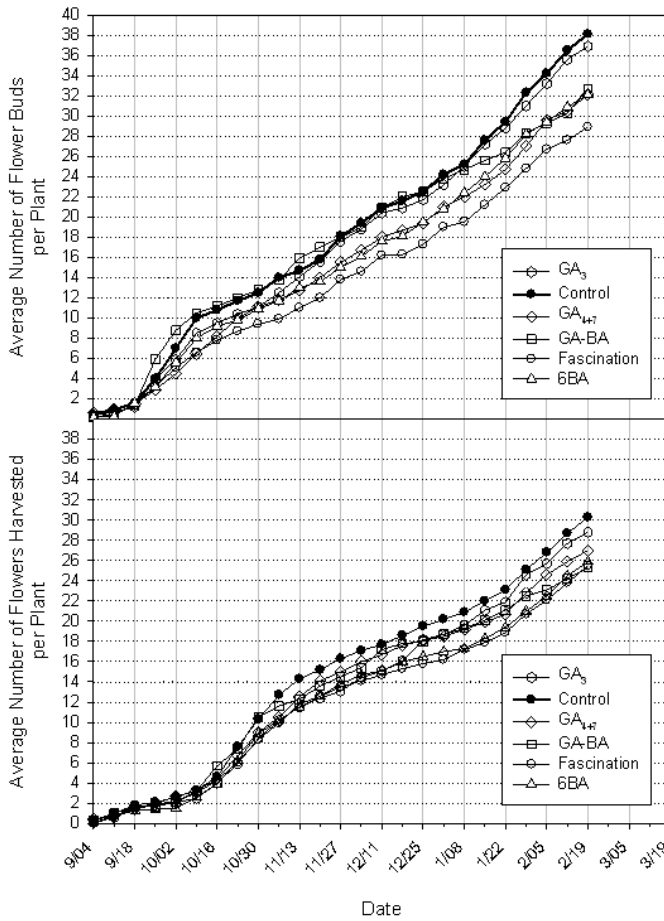


Figure 3 Average cumulative production counts for Maya

These integrals were the accumulated amount of either PAR (micromols m^{-2}) or temperature (degrees). All of this information was tracked for all of the plants to determine the effect of the treatments on flower production.

In general, there was a lot of variation among the plants of each treatment and the plant responses to the treatment applications were minimal. The PGRs used in this experiment had no apparent positive effect on the flower production of 'Maya', and in some cases actually reduced production levels. When the cumulative production values of the treatments were compared to those of the control there was a reduction of 1.2 to 9.2 flower buds per plant over the course of the experiment. This reduction will most likely also be manifested in the final cumulative harvest yields (Fig. 3).

Therefore, the PGRs used in this evaluation should not be used in further

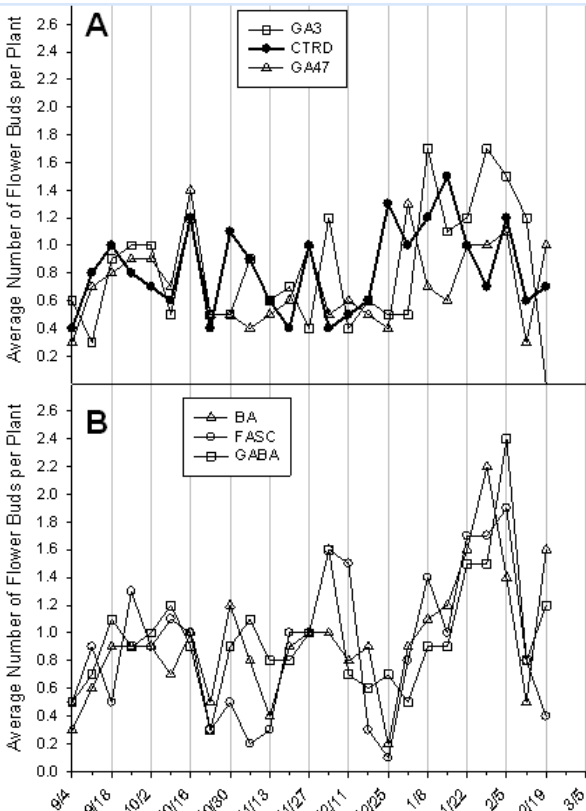


Figure 4: Average weekly number of 'Passion' flower buds (Passion)

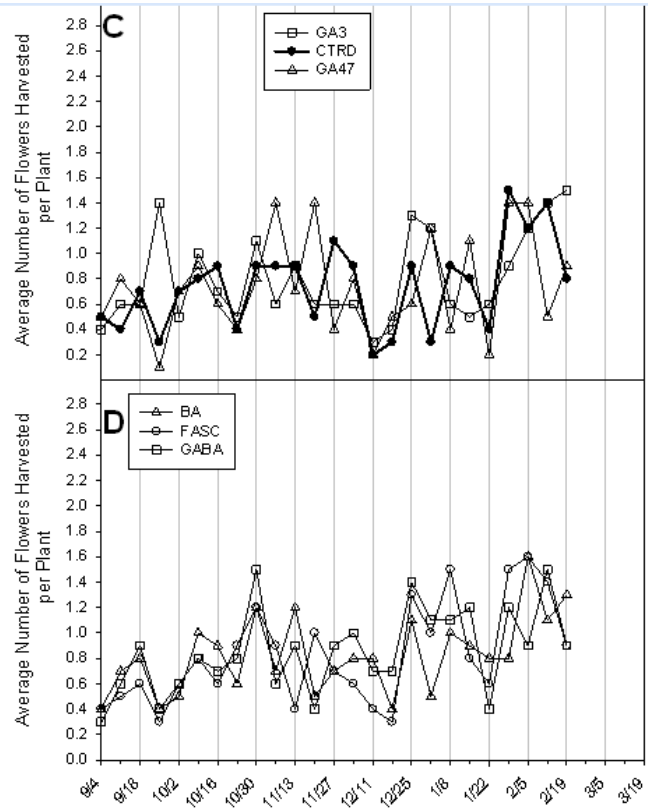


Figure 5 Harvested weekly flowers over time

production protocols for 'Maya'. Even though there were no statistically significant differences between the cumulative production values of the treatments, any reduction in flower count is, of course, deleterious.

Due to the large amount of variation which occurred on a weekly basis for both flower bud production and the number of flowers harvested (Figs. 4 and 5), there were only a few weeks during the experimental period where significant differences occurred between the treatment means of 'Passion'. However, when comparing the similar groups of treatments, the treatments which included BA alone or associated with GA₄₊₇ seemed to both increase the production of flower buds and harvestable flowers for 'Passion' (Fig. 6). There was an increase of about 12% (2.3 flower buds per plant) of the cumulative flower buds produced by the plants in BA treatments than those of the control, which was determined from the production values at the beginning of September 2005 until the middle of February. This increase in flower bud production will surely result in an increase in the final amounts of cumulative flowers harvested. Although the applications of BA on 'Passion' seemed to increase flower bud productions, because of the large amount of plant to plant variation, the values were not statistically significantly different at the 5% level. Thus it is possible that additional trials with a larger number of replicates or possibly increased treatment concentrations could result in significant differences.

There were no statistically significant differences in the flower quality attributes as a result of the treatment applications. Therefore, the quality of the flowers was not jeopardized by an increase in the production. In addition to no differences in flower quality, there were no significant differences among the treatment means of rates of development.

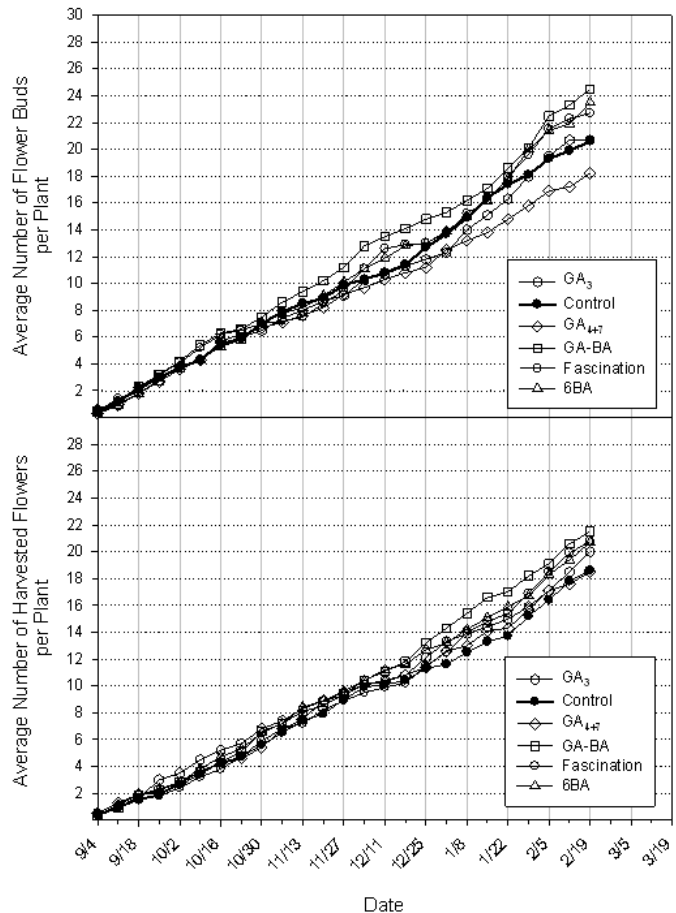


Figure 6 Average cumulative production counts per plant for cultivar 'Passion'

From this experiment we can conclude that none of the PGRs that were tested on 'Maya' were at all effective. These materials should be abandoned from any other work as they did not seem to benefit the flower production of this cultivar. In fact, some of these chemicals actually seemed to reduce the flower production. However, there does seem to be potential with some of the materials tested on 'Passion'. Those chemical treatments which included BA alone or with GA₄₊₇ seemed to have a positive effect on flower production. Therefore, it would be beneficial to

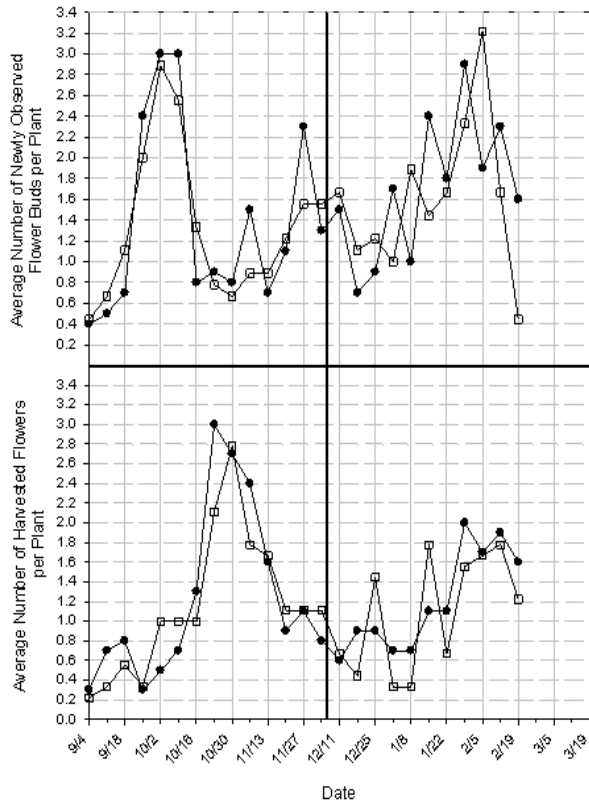


Figure 7: Average cumulative flower bud production and flowers harvested per plant per week for 'Maya'

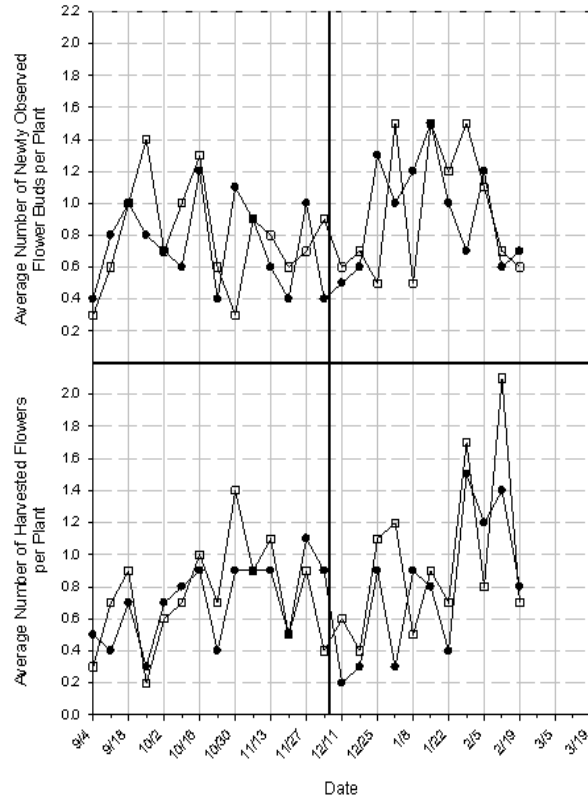
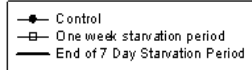
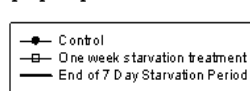


Figure 8: Average cumulative flower bud production and flowers harvested per plant per week for 'Passion'



repeat the study of these materials in another trial. Future work should involve greater concentrations in order to stimulate potentially greater differences. Because of the large amount of variation that occurred within treatments and between treatments on a weekly basis, it would be beneficial to use a greater number of replicates.

Nutrient starvation evaluation:

The nutrient starvation treatment is used by some growers to induce a flush of flowers on the plants. By removing the source of nutrients to the plants, a shift in the production of flower buds could occur. A shift in the production of flowers seemed to have occurred for the variety 'Passion', but not 'Maya' in this experiment. Again, it is difficult to make solid conclusions because of the large amount of variation that occurred on a weekly basis (Figs. 7 and 8). In addition to no obvious shift in flower production, there is no difference present in the cumulative amount of new flower buds produced or the cumulative number of flowers harvested for 'Maya' (Fig. 9). Though not obvious, there seems to have been a shift in the flower production of 'Passion'. This shift in production of 'Passion' is somewhat exhibited in the cumulative number of flowers harvested per plant after the starvation treatment had ended (Fig. 10). It will have to be determined at a later point if there are any significant differences in the final cumulative production values.

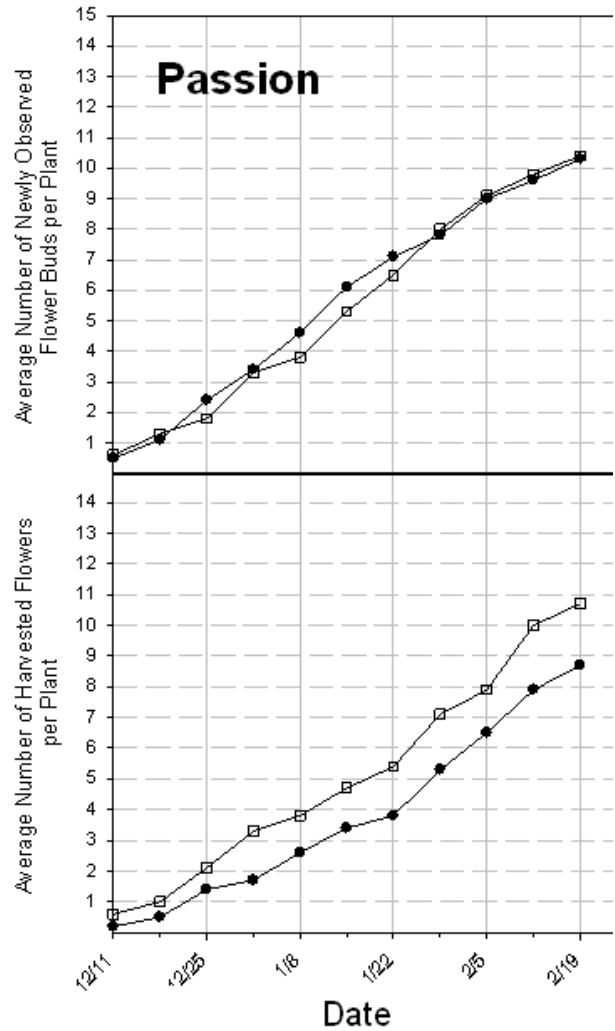
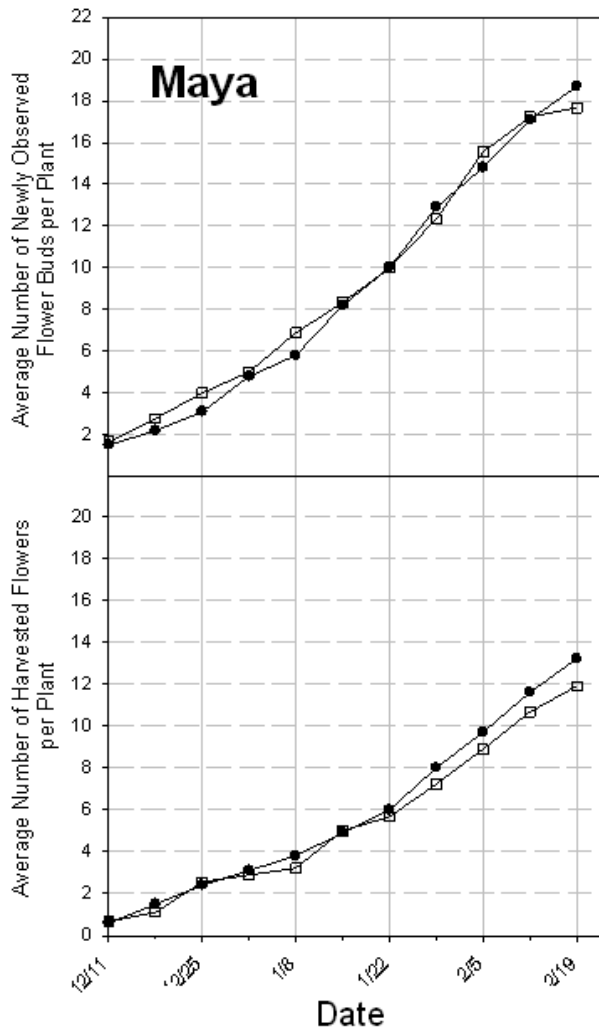


Figure 9 and 10 Average cumulative flower bud production and flowers harvested per plant after the end of the starvation period

Any sort of shift in flower production, whether new flower buds or harvestable flowers, caused by a nutrient starvation treatment, seems to be masked by the large amount of weekly variation. This trial should be repeated with an additional two week starvation treatment. A longer starvation treatment should make any related shift in production more pronounced. In addition to an additional treatment, more replicates should be used to attempt to reduce the amount of plant-to-plant variation that was obviously present in this trial. It is important for this trial to be repeated in order to make a final conclusion about the efficacy of this tool used by some growers. If this can indeed alter the timing of the crop, than it could be a potentially powerful tool in cut flower production.