



**CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY**

Name(s) Grace Deng	Project Number S1901
Project Title The Characterization of Accelerated Growth of Helianthus annus L Due to Fertilization	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals We studied the growth and development of an ornamental sunflower, <i>Helianthus annus L</i>, in a statistically controlled experiment. The factor was the topical application of a liquid fertilizer at three levels. The goal was to produce high-quality statistical data that could be modeled mathematically and statistically over the plant's growth cycle to maturity. Of special interest was the acceleration of growth during the rapid growth phase. Also of interest were the comparative effects of the fertilizer in the two treatment groups relative to the control group.</p> <p>Methods/Materials A completely randomized experimental design consisting of a control group and two treatment groups each containing five plants was used. The plants were germinated in soil in a structured garden plot. When plants were seedlings of a height of 7 cm, they were randomly allocated to the groups. The fertilizer was applied weekly to leaves, stems, and the stem-soil interface. Daily observations were made of the plants growth and development, and weekly measurements of the plants height were taken in cm to the nearest 0.1 cm. Observations and measurements were recorded in the laboratory notebook and measurements were recorded on a master data sheet.</p> <p>Results The growth in the height of the plant over time forms a sigmoid curve. The data represent a latent time series, height vs. time index, with five plant heights at each index. The time series for each plant were averaged and analyzed as a univariate time series. The raw data and the univariate time series were analyzed using EDA procedures (summary statistics; boxplots; scatter diagrams; one-sigma confidence intervals). Four hypotheses were tested using CDA procedures (hypothesis tests). The scatter diagrams showed sigmoid curves in their proper relationship when shadow outliers were removed. The Richards empirical growth curve was successfully fitted to the scatter diagrams of the control group and the two treatment groups.</p> <p>Conclusions/Discussion The experimental design produced data enabling modeling of the accelerated growth of the plants. Treatment was effective against the control. Treatments had a higher rate of growth than control and higher overall growth. The Richards empirical growth curve adequately models the statistical data characterizing the plants sigmoid growth curve. The structured use of mathematics and statistics allows for deeper insight into plant science experiments.</p>	
Summary Statement Statistical experimental designs can produce high-quality data enabling deeper insight into plant growth and development.	
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