

Statistics, Science, and Dahlias
Jerry Moreno, John Carroll University

moreno@jcu.edu

Most people would consider it time to retire and relax after having worked two or three quite successful, and quite different, careers - no more stress, no demanding responsibilities, no deadlines – "been there, done that" many times over. But that's not for an absolutely marvelous woman by the name of Roberta "Granny" Paolo. Although gardening was not a part of any of her career paths, it has been a part of her life since childhood. Bypassing the rocking chair, she instead went to the Loveland, Ohio, School Board a couple years ago expressing "Our children in primary and elementary school should be gardening as part of their science curriculum." Fortunately for the children of Loveland, the School Board agreed and therein began yet another career for her - "Granny's Garden School." See www.grannysgardenschool.com . Her vision was not to have a couple petunias here, a sunflower there, a manicured landscape bed around the schools' entrances. No indeed. Multitudes of flowers and vegetables and plants and whatever are growing on practically every square foot of the land around the elementary and primary schools in beds, buckets, containers of all sorts – a long semicircular hoop frame has morning glories growing over it which serves as an outdoor reading room for children! And it is the children who plant, the children who pick, the children who harvest, while school is in session as well as over the summer (with the help of their parents). Throughout it all Granny has a wonderful group of Granny's Gardeners who volunteer their time and talent to help her manage this colossal, awe-inspiring educational project.

So what does this have to do with dahlias, you no doubt are asking. Well, dahlias are one of the children's favorite blooms. They grow dahlias along a couple hundred foot fence. Roberta obtains as many donations as she can for everything. And so I, as president of the Dahlia Society of Ohio, as well as the rest of the 16 or so presidents of the American Dahlia Society Midwest Conference received emails from Roberta asking if we might be able to donate a few dahlia roots. I thought DSO could do that I replied, thinking that to be the end of it. A couple days later, I received another email from Roberta, thanking me for the reply but also mentioning that she had been surfing the web and found that I am a professor of statistics, a member of a school board, and that I have given workshops for teachers and students in data analysis. She asked if I might be interested in possibly incorporating statistics as part of the third or fourth grade science curriculum. "Would I ever," I replied, thinking I had died and gone to heaven!

After having thought for a considerable amount of time on what we might be able to do to tie the scientific method, statistics, and dahlias together for third/fourth graders, I suggested that the science question to answer would be "Does compost matter?" Granny allows no fertilizers to be used, only compost. I met with four classes last April to discuss scientific protocol and elementary statistics. We discussed what measurements they thought should be taken to answer the question. We decided to plant 16 plants of a certain variety called Baron Katie; eight would be planted in

composted soil and the other eight in non-composted soil. The students suggested several variables to measure: weekly heights of the plants, time of first bloom, size of bloom, number of blooms per plant. Their knowledge of statistical measures from their math class focused on the median. To get an idea of what the dahlia experiment would look like, I introduced dotplot and scatterplot graphs with them by having them measure 16 daisies since dahlias weren't available in April. (We used Tukey's Quick Test to compare.)

Since it is over a four-hour drive from Cleveland to Loveland, I wasn't able to observe the actual planting of the two experimental beds, nor supervise the measurements over the summer. As it turned out, only height measurements were taken in this first year. I thank Paula Carlsen, one of Granny's Gardeners, and her children for being so diligent in recording the heights of all 16 plants for each of nine consecutive weeks over the summer.

In October, I visited one of the classes of fourth grade science teacher Brandi Carter. As these were not the students I had talked with last April, I had to go over the experiment with them. The experimental plots were outside their window so we viewed them from the classroom. We discussed the design of the experiment and the height data, and decided to calculate and compare the median heights of the eight composted plants with the median heights of the eight non-composted plants for each of the nine weeks. A couple students suggested that we use the mean but not all of the students had learned the mean yet. There was another reason not to use the mean. One of the non-composted plants died in the fifth week. Calling its height zero did not cause any problem using the median but using the mean would have introduced a statistical difficulty. We then plotted the nine paired medians by date on a scatterplot with the non-composted scale from 10 inches to 40 inches on the horizontal and a similar composted scale on the vertical.

The paired data by week were:

Date	6/22	6/29	7/6	7/13	7/20	7/27	8/3	8/10	8/17
Non-composted	11.25	13	15.5	16.5	19.75	27	28.5	29.25	31.5
Composted	12.5	14.5	17.5	19	22.75	24.75	29.5	30.5	31.0

Although I learned from the fourth grade mathematics teacher that the students were just beginning to learn the coordinate system in two-dimensional graphs, I banked on their having played Battleship since "youngsters" and forged ahead to plot the data in a scatterplot. In three words, they were terrific! Each drew a scatterplot by first labeling the horizontal and vertical axes as mentioned above. Then they drew a diagonal line that they called the "compost doesn't matter line" indicating that compost height = non-composted height. They analyzed the graph by observing that the first five data points were above the diagonal line indicating that the composted heights were taller than the

non-composted ones, then the sixth week produced a data point below the line that prompted one of the students to respond "the non-composted plants had a growth spurt!" The next two weeks were in favor of the composted plants once again with the last week practically a tie. The students concluded that for most of the summer compost seemed to matter a little bit but at the end there was no difference.

We didn't have time to discuss the results in depth. I learned from Paula who supervised the summer data collection that the plants could have been tied a bit better. Also, it wasn't clear to me that the only difference in the soil was the presence or absence of compost. So, I am looking forward to trying the experiment again next year with tighter control of the scientific protocol and experimental conditions.

So, a class of fourth grade students began to understand the synergy between the scientific method and statistics, for just as with the scientific method, statistics is an investigative process that begins with a question, collects data to answer the question, organizes the data, analyzes the data by measures and graphs, and interprets the results. And the dahlia is being used in a real gardening experience to enhance the children's science, mathematics and language arts skills in the spirit of Ohio's curricular standards.

Thanks to Roberta Paolo, Brandi Carter, Paula Carlsen and her children, and a terrific Loveland Elementary fourth grade science class for a wonderful pilot study in a program that I hope will continue and improve for a very long period of time. Also I extend thanks to members of the Cincinnati Dahlia Society who have expressed an interest in helping the dahlia part of the exercise – Carol Hartman, Bob and Anna Moynahan, and John Devine.

Jerry Moreno
Dahlia Society of Ohio
Cleveland Chapter, American Statistical Association
Dept. Mathematics and Computer Science, John Carroll University