Stanford
SCHOOL OF EARTH, ENERGY & ENVIRONMENTAL SCIENCES

A Study Into the Effects of Various Compost-Potting Soil Mixes in An Effort to Heighten Bio-Productivity and Lower Farm Expenses

Erin Lence[1], Jennifer Saltzman Ph.D.[1], Krishna Ammini[1], Johnny Ho[1], Darren Lo[1], Sonia Mahajan[1], Claire Valva[1], Adrienne Zhang[1]

Introduction

The O'Donohue Family Stanford University Educational Farm is a small, sustainably run farm that prioritizes producing high-quality crops in an environmentally sustainable way. As many organic farms do, The O'Donohue Family farm is attempting to find a balance between bio-productivity and both economic and environmental cost.

This experiment, conducted by agricultural interns at Stanford University, focuses on the soil used to germinate and cultivate crops in a controlled greenhouse environment.

It attempts to determine which ratio of compost to potting mix is most favorable in terms of both cost and biological productivity. Currently, the O'Donohue Family farm uses VermiSoil premium potting soil — which costs approximately $149.50 per cubic yard and $0.23 per pound — for germination purposes. This potting soil was compared to the compost used on the farm, Z-Best Organic Compost, which costs $24 per cubic yard and $0.029 per pound. Therefore, the higher percentage of compost, the more economically favorable the combination would be.

Three different crops--an Indonesian cultivar of Cosmos flowers (Cosmos sp.), a heritage American Corn cultivar (Zea mays) and Ojo de Cabra beans (Phaseolus vulgaris)--were grown in five different soil-to-compost ratios. Measurements were taken twice weekly to determine the ratio in which the plants grew best.

In order the mirror the variety of cultivated plants and polyculture methods used on the farm, three plant varieties were tested with, relatively different soil needs. Corn performs best with a complete fertilizer when planted, but also requires additional nitrogen to produce optimum yields. Similarly, beans germinate best with a complete compost, but, as legumes fix nitrogen with the mutualistic *Rhizobium* bacteria. Later application of nitrogen can result in delayed flowering and over-stimulated leaf growth. However, cosmos flowers generally prefer poor and slightly alkaline soil. The diversity of plant needs help the results more closely reflects the range of soil type preferences for crops on the O'Donohue Family Stanford University Educational Farm.

Procedure

In order to find which ratio of compost to potting mix is most effective for plant germination and early plant growth, 5 ratios of compost to potting mix were created: 100 percent compost, 75 percent compost and 25 percent potting mix, 50 percent compost and 50 percent potting mix, 25 percent compost and 75 percent potting mix, and finally 100 percent potting mix.

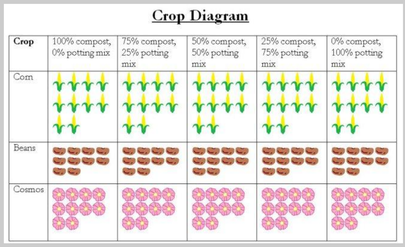


Figure 1: Diagram of organization method

Ten pots each of an Indonesian cultivar of Cosmos flowers (Cosmos sp.), a heritage American Corn cultivar (Zea mays), and Ojo de Cabra beans (Phaseolus vulgaris) were planted using each of the 5 soil ratios, for a total of 150 pots. Each pot of beans and corn contained one seed, while each pot of cosmos contained 2 seeds.

The 150 pots were placed in the controlled environment of the O'Donohue Family Stanford University Educational Farm Greenhouse for 18 days. All plants received equal amounts of water and sunlight. For recording purposes, the plants in 100 percent compost were labeled purple, the 75 percent/25 percent compost/potting mix plants were labeled blue, the 50 percent/50 percent mix plants were labeled green, the 25 percent/75 percent compost/potting mix blend were labeled orange, and the 100 percent potting mix plants were labeled red.

The germination of each plant variety was recorded twice a week, beginning on July 16, 2015. One week into the experiment, upward growth calculations began–this was done by measuring bi-weekly the height of highest point of the plant. After 11 days into the experiment, the outward growth of the plants was measured by counting the number of full leaves on each plant.

References

1. Blashfield, J. F. (2014). Composting. In K. L. Lerner & B. W. Lerner (Eds.), The Gale Encyclopedia of Science (5th ed.). Farmington Hills, MI: Gale.
2. What is Sustainable Agriculture? (2015). Retrieved 2015.
3. Drost, Dan, and Sheriden Hansen. "Cosmos in the Garden (Beans, Corn)." *Horticulture/Vegetables*. Utah State University, 2013. Web. <http://extension.usu.edu/files/publications/publication/Horticulture_Vegetables_2013-01c.pdf>.

	Corn (*Zea mays*)	Beans (*Phaseolus vulgaris*)	Cosmos (*Cosmos sp.*)
0% compost/100% potting mix	90%	90%	90%
25% compost/75% potting mix	90%	90%	100%
50% compost/50% potting mix	90%	80%	95%
75% compost/25% potting mix	90%	40%	90%
100% compost/0% potting mix	90%	80%	100%

Figure 2: Germination rates by percentage

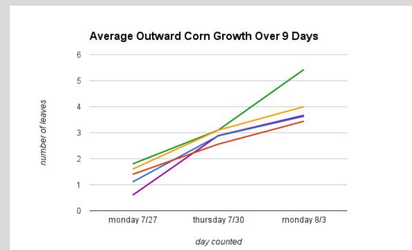


Figure 3: Average corn outward growth (number of full leaves) in relation to time

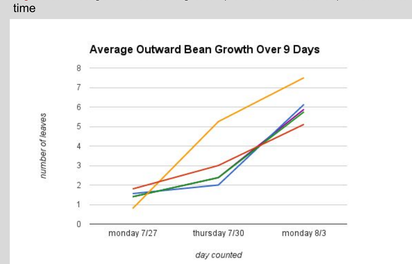


Figure 4: Average bean outward growth (number of full leaves) in relation to time

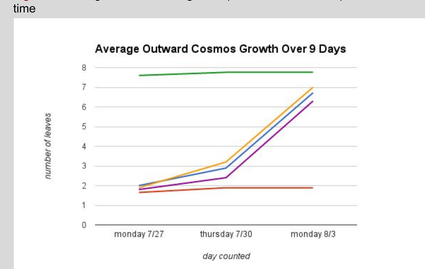


Figure 5: Average cosmos outward growth (number of full leaves) in relation to time

Germination and Growth

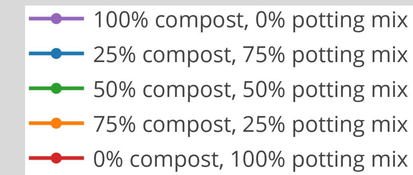
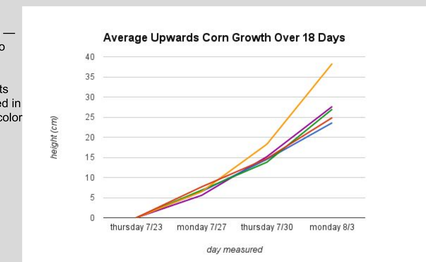


Figure 6: Diagram of organization method

Figure 7: Average upwards corn growth — height — in relation to time
Figure 8: Final corn height — 9 data points for each mix — plotted in comparison to each color



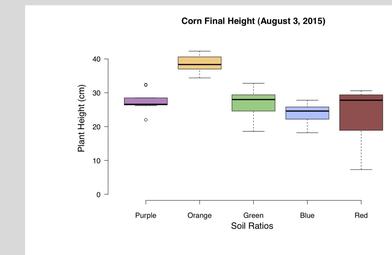
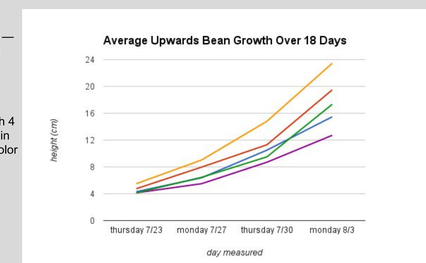


Figure 9: Average upwards bean growth — height — in relation to time
Figure 10: Final bean height — 8 or 9 data points for each mix except for orange, with 4 data points — plotted in comparison to each color



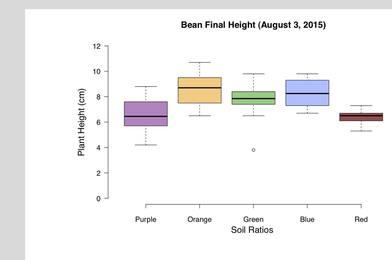
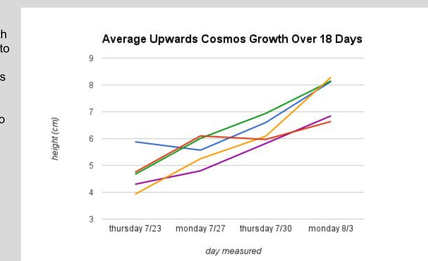
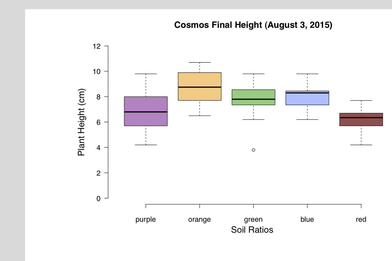


Figure 11: Average upwards cosmos growth — height — in relation to time
Figure 12: Final cosmos height — 18 to 20 data points for each mix — plotted in comparison to each color





Results

Generally, the crops had higher germination rates when planted in the mixes with more even blends potting soil and compost. In 75 percent compost/25 percent potting mix blend, labeled orange, there were the highest overall germination rates, but the higher rates of compost were more conducive to faster germination in the case of the beans. This was most notable within the first five days, where the two higher compost blends only had 3 germinated seeds in comparison to the full potting soil blend with 9 germinations. However, once established (approximately two weeks after germination), the plants' vertical growth was better in mixes with more compost, such as the 100 percent compost and the 75 percent compost/25 percent potting mix. All three varieties grew upwards best in the mixes with more compost once established. The beans grew best with 100 percent compost, while both the corn and the cosmos grew best with the 75 percent compost/25 percent potting mix.

In terms of outward growth — which was measured by number of leaves — the 100% potting soil mix (or red) was the least productive. Both the cosmos and the corn had the most outward growth in the 50% potting soil, 50% compost mix, and the beans grew best in 75% compost. These results suggest, although the 100% compost was not optimal, that higher ratios of compost produce more full leaves soon after germination.

As compost is cheaper to obtain than potting mix for the O'Donohue Family Stanford University Educational Farm, this suggests a preferable conclusion. However, due to the small number of seeds used in the sample, the rate of germination may not be consistent for repeated experiments.

Contact Information:
[1]Stanford University, Stanford, CA, stanfordfarminterns@gmail.com or stanfordfarminterns.wordpress.com
The complete data set can be found here: https://goo.gl/huOHG7