Exploration of effects of *Azospirillum brasilense* application on root characteristics in giant pumpkin

Joe Ailts, Spring 2019

Summary: *Azospirillum brasilense* (azo) is one of the most well studied plant growth promoting bacteria (PGPB), known primarily for its ability to fix nitrogen as well as its production of various plant growth hormones. This study explored measurable differences in root morphology in giant pumpkin when drenched with a commercial preparation of water soluble azo concentrate. In agreement with published work, the treatment group showed increased elongation of the main root, increased lateral root density, and increased root hair density.

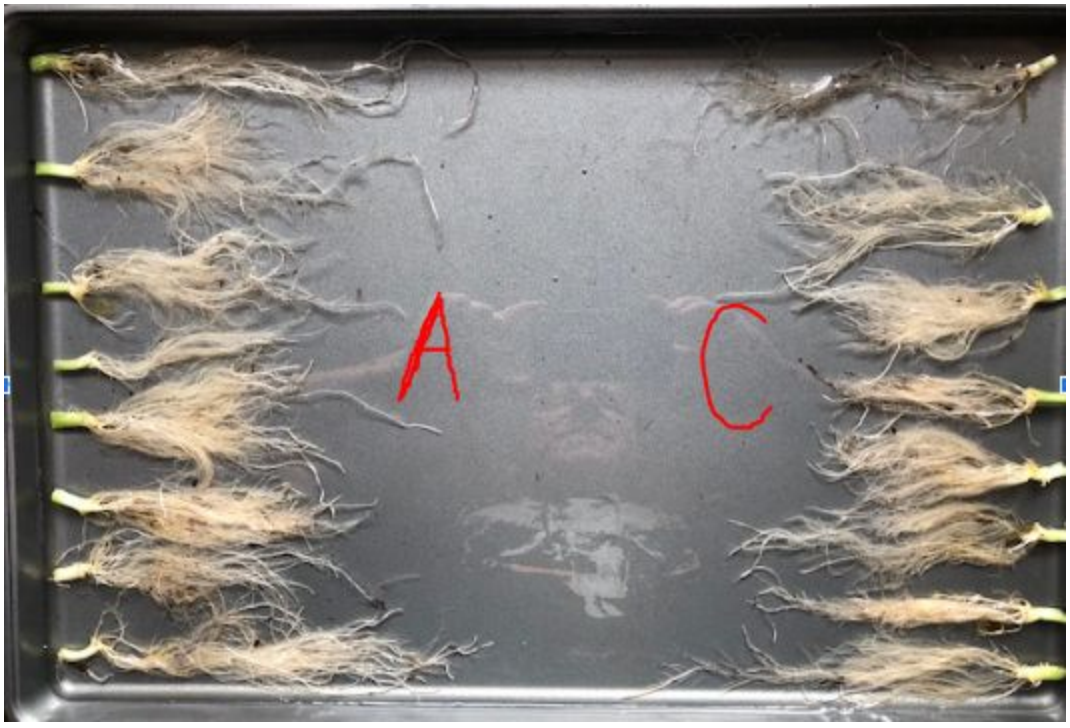
Introduction: In the pursuit of growing the largest giant pumpkin, gardeners are presented with a seemingly unending list of products purported to have plant growth benefits. Identifying which products have the greatest, if any, impact for a giant pumpkin enthusiast is a challenge, as very little research showing value exists. However, due to its widespread and long history of academic & commercial interest, the use of azo as an additive to giant pumpkin cultivation programs bears consideration. Of particular interest is azo's documented ability to synthesize and exude plant growth hormones, including giberellins, indole acetic acid, and cytokinin-like substances (Tien, et al, 1979). All three of these chemical messengers have known impacts on root growth habit when applied directly in experimental settings, including increased production of lateral roots, increased root hair formation, and increased elongation of the taproot. Studies have shown that in the presence of azo, similar changes in root growth habits/morphology occur, suggesting that azo bacteria release of these chemicals in plant root zone is producing similar effects as direct application of hormones. An assumption made here is that more roots confers benefit to the goal of the giant pumpkin grower...a bigger pumpkin.

Materials & Methods: Sixteen giant pumpkin (*Cucurbita maxima*) seeds were planted in 3 inch pots containing standard seed starting mix. Pots were evenly watered every 3 days for a three week period. The sixteen pots were divided into a control and treatment group. A commercial preparation of azo (Azos, Xtreme Gardening) was applied as a drench on day 4 and day 11 after planting to the treatment group. Product application rate was per package instructions, adjusted for the volume of water needed for the treatment group. Control group received an equivalent volume of water as the treatment group, minus the azo treatment to ensure water equivalence between the groups. The experiment was stopped on day 21 to perform root morphology analysis, including visual comparison of root density while contained in media, visual comparison following root wash, taproot maximum length measurement, and total root dry matter comparison.

Results & Discussion:
Upon removing the plants from their containers, a visual inspection of root mass density was made. In the graphic below, “C” group on the left represents the control group, “A” group on the right represents the treatment group. Increased root density appears to manifest in the treatment group.

Cytokinins are plant growth hormones shown to stimulate root hair formation and increase main root elongation. Azo is well studied for its ability to release cytokinin hormones into the root zone. The next measurement aimed to determine if there was a difference in taproot maximum length between the groups. While the sample set is small, there was a ~15% difference in average taproot length. See table below.

Average Taproot Length (inches)	
Azos Treatment Group	Control Group
10.0	7.5
9.0	6.25
7.0	5.5
5.5	4.75
7.5	7.25
6.0	6.5
8.0	6.0
8.75	8.0
Average: 7.7”	**Average: 6.5”**



The final measurement explored differences in total dry root mass. Roots from each treatment group were severed from the plant stem and washed gently to remove rooting media. Roots were then dried to remove any water influence on the outcome. The treatment group had 12.7% more dry root mass than the control group.

Conclusion: While the sample set was small, notable differences in various aspects of root morphology were observed in concordance with published science regarding the impact of azo on plant growth promotion, including increased root mass and increased taproot elongation. It would be a stretch to conclude that the use of azo as part of a giant pumpkin program leads to better performance come harvest, however, if the product is indeed providing enhanced root growth throughout the season, its use should be considered when exploring the various amendments to include in your giant pumpkin program.

Disclosure: the author has no conflict of interest, financial or otherwise, with the manufacturer of the azo product used in this investigation.

References:

1. T. M. Tien, M. H. Gaskins, D. H. Hubbell., Plant Growth Substances Produced by *Azospirillum brasilense* and Their Effect on the Growth of Pearl Millet (*Pennisetum americanum* L.).Appl. Environ. Microbiol. May 1979, 37 (5) 1016-1024.