Phosphorous nutrient deficiency

Phosphorous Nutrient Deficiency of Sunflowers, Helianthus annuus

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Abstract: The objective of this experiment was to determine whether or not a complete nutrient solution would have increased stem width, height, and leaf length compared to 25% phosphorous. My hypothesis was that sunflowers with a complete solution of nutrients would have the same growth compared to sunflowers with 25% phosphorous deficiency. The experiment was conducted by setting up two groups of sunflower seeds, control and treatment. Each group contained five seeds. The nutrients were added when the seeds had germinated. The controls were treated with a complete nutrient solution, whereas the treatment was treated with 25% phosphorous deficiency. Both groups were watered regularly with the nutrient solutions until harvest time. The measurements of both groups were taken periodically. During harvest time, the healthiest plant in each pot was measured for stem width (mm), height (cm), and leaf length (mm). The results indicated that there was no significant change in the controls and treatments because the p-values of all three types of measurements were greater than 0. 05. Therefore, the null hypothesis was accepted. Despite the insignificant results, observations and measurements of growth in both groups of sunflowers in terms of stem widths, lengths, and leaf lengths suggested that the presence or absence of phosphorous did influence the plant growths.

Introduction: The objective of this experiment was to determine the effects of nutrient deficiency in sunflower, H. annuus. My null hypothesis was that sunflower plants that were treated with a complete nutrient solution would be the same as plants that were 25% deficient in phosphorous. My alternate hypothesis was that sunflower plants with a complete nutrient treatment would have increased growth compared to plants with phosphorous deficiency with respect to stem height, width, and leaf length. Phosphorous is an essential nutrient for root formation, flowering, fruiting and ripening (Gayle et al. 2001). Ten elements that are required for normal growth in plants are carbon, hydrogen, oxygen, potassium, calcium, magnesium, nitrogen, phosphorus, sulfur, and iron. The absence of any one of these elements causes plants to display characteristic abnormalities of growth known as deficiency symptoms. Often such plants do not reproduce normally (Raven et al. 1999). One reason why phosphorous is essential in plants is because it is responsible for the general health and vigor of all plants. Some specific growth factors that have been associated with phosphorus are: stimulated root development, increased stalk and stem strength, improved flower formation and seed production, more uniform and earlier crop maturity, increased nitrogen N-fixing capacity of legumes, improvements in crop quality, and increased resistance to plant diseases (Webb 2002). One reason why sunflowers were chosen in the experiment was because sunflowers are easy to grow, the only single flower that grows as high as three meters at a rate of about 30 centimeters a week, and are really the most beautiful flowers in the world (Webb 2002). A study of nutrient deficiency was done by a group of two scientists to determine the effect on dwarf sunflowers.

Materials and Method: The sunflower deficiency experiments began on February 19, 2002 in the Cal State Fullerton green house and were harvested on May 3, 2002. Two groups of plants were made, the control and treatment. Each group contained five sunflower seeds. A complete nutrient solution of Ca(NO3)2, KNO3, KH2P04, MgSO4, Fe, and Micros was used in the control group to compare the differences with the treatment plants that were twenty-five percent phosphorus deficiency. Both groups were watered regularly (every 2 days) and the nutrient solutions were made four times throughout the experiment. The table below showed how the control and treatment solutions were done. The plants were checked periodically. Measurement of the longest leaf in (mm), stem in (mm), and height of each plant in (cm) were inserted into the Mann Whitney test to obtain the p-value of the nutrient deficiency experiment.

Table 1. Nutrient Experiment Deficiency of 25% phosphorous in Sunflower plants

ControlTreatment of 25% phosphorous deficiency

Ca(NO3)2= KNO3= KH3PO4= MgSO4= Fe= Micros= Fill in half regular water in milk jar tank, and for every liter of water of the other half of the tank, five milliliter of each nutrient was added5 x 3. 78 = 18. 918. 9 x 5 (number of nutrients) +18. 9 = 113. 4 a complete nutrient solutionCa(NO3)2= KNO3= KH3PO4= MgSO4= Fe= Micros= P= 25%Fill in half regular water in milk jar tank, and for every liter of water of the other half of the tank, five milliliter of each nutrient was added excluding phosphorous. 5 x 3. 78 = 18. 918. 9 x 5= 94. 9 + (5 x 3. 78 x . 25%) = 99. 26

Results: As a result of the experiment, my null hypothesis accepted. Sunflower plants that were treated with a complete nutrient solution did not exhibit a significant increase in growth compared to the 25% phosphorous nutrient deficiency plants. The mean and variance in a complete solution for leaf lengths were 5. 07 and 1. 08 compared to 6. 62 and 3. 38 for the 25% phosphorous deficiency (Figure 2); mean and variance in a complete solution for stem widths were 0. 35 and 0. 01 compared to 0. 33 and 0. 01 for the 25% phosphorous deficiency (Figure 1); mean and variance in complete solution for stem heights were 7. 80 and 0. 27 compared to 12. 9 and 0. 24 for the 25% phosphorous deficiency (Figure 3). It was determined that there was not a significant change between a complete and 25% of phosphorus nutrient deficiency solution because the p-values for stem width, height, and leaf length were 0. 44, 3. 97, and 0. 11 respectively, which were greater than 0. 05.

Discussion: The results of the experiment showed that there was not a significant difference between the two groups of sunflower plants, a complete solution group (control) and, a 25% of phosphorous nutrient deficiency group (treatment), because the p-values of stem width, height, and leaf length were all greater than 0. 05. In a complete solution, the stems were shorter and thinner compared to the treatment plants. Excess phosphorous may result in micronutrient deficiencies in iron and zinc (Webb 2002). One of the symptoms resulting from nutrient deficiency is chlorosis, which shows up first in young leaves, and is also reduced in size. Leaves are often closely spaced, forming a rosette and may be malformed (Gayle et al 2001). As such, chlorosis in iron deficient plants begins at the top of the plant and works its way down with leaves turning yellow but retaining some chloroplast. One reason why the control plants appeared to have dead spots, and stems were structurally weak is because in a warm room, the water evaporated quickly, with no nutrient remained in the soil to help the plants keep up with high heat, their leaves became dry and wilted. Thus phosphorus is essential for the general health and vigor of all plants. Some specific growth factors that have been associated with phosphorus are: stimulated root development, increased stalk and stem strength, improved flower formation and seed production, more uniform and earlier crop maturity, increased nitrogen N-fixing capacity of legumes, improvements in crop quality, and increased resistance to plant diseases (Scheffel 1999, 78). Phosphorus deficiency is more difficult to diagnose than a deficiency of nitrogen or potassium (Scheffel 1999, 83). Plants usually display no obvious symptoms of phosphorus deficiency other than a general stunting of the plant during early growth. By the time a visual deficiency is recognized it may be too late to correct in annual crops. The sunflower plants in this experiment demonstrated different leaf colors: light yellow, green, and some brown. Some crops, such as corn, tend to show an abnormal discoloration when phosphorus is deficient. As a plant matures, phosphorus is trans-located into the fruiting areas of the plant where high-energy requirements are needed for the formation of seeds and fruit (Scheffel 1999, 87). Phosphorus deficiencies late in the growing season affect both seed development and normal crop maturity (Scheffel 1999, 81-2). . The percentage of the total amount of each nutrient taken up is higher for phosphorus late in the growing season than for either nitrogen or potassium. When I compared my results with my group members, I found that Jamaica's

(50% phosphorous deficiency) and Bill's (0% phosphorous deficiency) experiments germinated were significant p-values in all three measurements. Bill's p-values were 0. 007 for leaf length, 0. 048 for stem width, and 0. 0005 for stem heights. Jamaica's p-values were 0. 04 for stem height, 0. 048 for stem width, and 0. 048 for leaf length. One reason why Jamaica and Bill's p-values were significantly different than mine was because I started my nutrients three weeks late such that if plants were grown longer, I would have seen significant differences between two groups since P-value is required late in development. In addition, I did not water the plants as regularly as they did. My plants were watered every two days and occasionally three days. Another possibility was that Bill's sunflowers did not have any phosphorous in them, but they might have every nutrient excluded phosphorous. Gina's results for stem width, height, and leaf length were insignificant because she started her nutrient deficiency late. Her p-values were 0. 5 for stem width, 0. 28 for stem height, and 0. 31 for leaf length. Similar experiments were conducted by a group of scientists who tested analyzed the water relations in standard height and dwarf sunflower cultivars. Angadi and Entz discussed that the sunflower cultivars demonstrated similar results as semi-dwarf cereals such as wheat. They found out that the affect of plant stature on osmoregulation had not been investigated for quite a time (Angadi and Entz 2002). Their results indicate that plant statute has a significant effect on water status in dwarf species because the dwarf sunflowers initiated osmotic adjustment early such that the standard height of the dwarf was higher. The reason why there was such a significant difference might be because the dwarf sunflower had to deal with limited soil moisture, the primary factor of limiting productivity. Our plants were water stress as well; perhaps this influenced our results. Randel conducted one experiment, and his objective was to see how seed oils optimize the total energy stores in a seed and the radar energy production during germination. Seeds that are at a cool temperature have a higher proportion of unsaturated oils and may germinate earlier than seeds that are higher in saturated fatty acid (Rendal 2000). Randel's experiment revealed that temperature also plays an important role in the germination of sunflower seeds, regardless of the nutrients available. His experiment indicated that seeds will grow faster if they live in an " extreme" hot or humid environment where there is enough sunlight to allow them to photosynthesize. The study of nutrient deficiency in plants is important because it gives ordinary people a better idea of how much of a nutrient they should use for their plants. Certain plants require certain types as well as certain amount of nutrients. A complete nutrient solution might not ensure successful growth, as was in the Phosphorous Nutrient Deficiency experiment on Sunflowers. In addition, with the nutrition deficiency knowledge in mind, farmers could grow their crops more effectively, less time consuming, and effortlessly.

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