The Effects of Gibberellin on Dwarfism in *Setaria Viridis*

DONALD DANFORTH PLANT SCIENCE CENTER
DISCOVERY | COMMUNITY | IMPACT

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Introduction

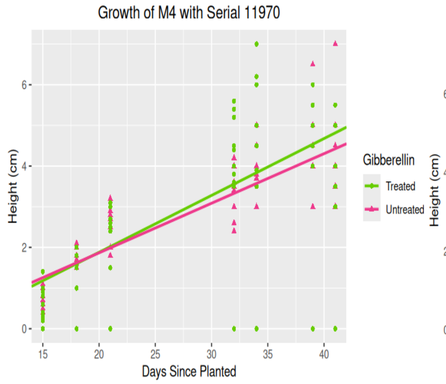
Gibberellin is a hormone effecting growth of stems and leaves by stimulating cell division and elongation. Gibberellin is often used in dilute solutions for agricultural purposes. It has been shown to increase the size of fruits produced and cause more rapid germination. Dwarfism can be caused by lack of production of gibberellin or lack of ability to process it. Therefore, it can be assumed if adding gibberellin to a dwarf strain results in a normal growth rate the dwarf was affected by production ability. If adding gibberellin to a dwarf strain result in a reduced growth rate the dwarf was affected by processing ability. Therefore, This information allowed us to hypothesize that adding gibberellin to two differently mutated dwarf strands would let us identify the causes of the dwarfism in each strain.

Methods and Materials

- An original mixture of potting soil, perlite, and dry substrate was created and poured in equal measure into each of the twelve prepared pots.
- Four pots were designated for each strain – wild type, M4, and M6 – so that there could be two pots undergoing treatment while two remain for control purposes.
- Five of each seeds of their respective strain were planted in the pots.
- Pots were kept together in a controlled environment for growth and observation. This was done to maintain conditions as closely as possible for all subjects.
- Water was given as needed and treatment was withheld before germination on suspected effects the seeds would experience.
- After germination, the treatment was applied by spray bottle twice a week to each designated pot under observation. A solution of 2% gibberellin stock was created by dissolving 20 mL of solid gibberellin in a liter of water. This started February 1st and ended March 1st.
- Measurements were regularly taken throughout the growing period from the base of the plant starting at the soil to the apical meristem of the shoot.
- Data was given to math group for analysis through the program R.

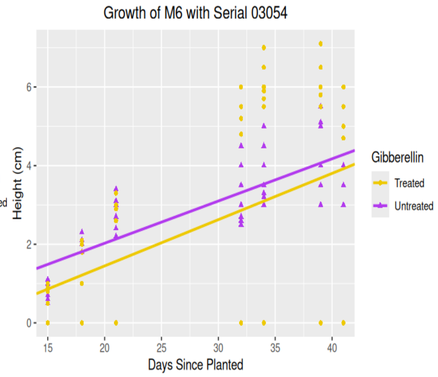
Objective: Learn about the genetic relationship between plant organ elongation and the usage of plant growth regulator gibberellin.

Figure 1. Mutant strain 4 of *Setaria Viridis* Foxtail Millet treated vs untreated growth.



Both the treated and untreated strains of the Mutatation 4 Sertaria Viridis plants are expressed above. The average height of M4 treated is 4.5cm while the untreated average height is 4.2cm. The small 0.3cm difference between M4 treated and M4 untreated strains indicate that the strain treated with gibberellin had accelerated growth.

Figure 2. Mutant strain 6 of *Setaria Viridis* Foxtail Millet treated vs untreated growth.

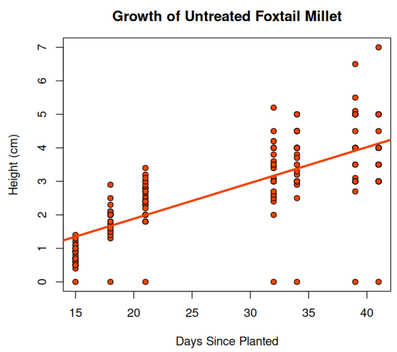


Both the treated and untreated strains of the Mutation 6 Sertaria Viridis plants are depicted above. The average height of M6 treated is 4cm while the untreated average height is 4.2cm.The 0.2cm difference between M6 treated and M6 untreated strains expose that the strain not treated with gibberellin has more growth.

Figure 3. *Setaria Viridis* Foxtail Millet Wild type treated vs untreated growth.

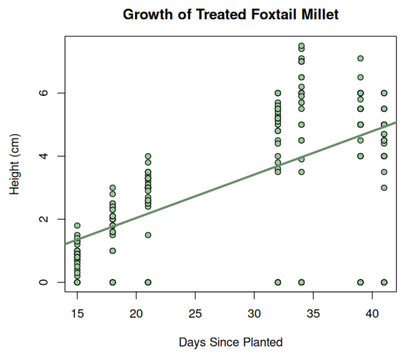
Both the treated and untreated Wild type/ Normal strains of the Setaria Viridis Fox Millet plants are represented above. This plant was used as a control variable to test wheatear or not gibberellin affected growth. The treated strain's average height was 6.1cm while the untreated strain's average height was 3.9cm. Therefore, The significant difference in plant height of 2.2cm indicates that gibberellin does affect plant organ elongation.

Figure 4. The comparison of untreated growth between M4, M6, and the Wild Type strain of *Setaria Viridis* Foxtail Millet .



The average height of all the Foxmillet strains that were not treated with gibberellin are depicted above. The scattered points indicate how tall a plant grew based on the number of days since planted. The average height of the untreated strains was 4cm.

Figure 5. The comparison of treated growth between M4, M6, and the Wild Type strain of *Setaria Viridis* Foxtail Millet.



The average height of all the Foxmillet strains that were treated with gibberellin are depicted above. The scattered points indicate how tall a plant grew based on the number of days since treatment started after germination. The average height of the treated strains was 5cm.

Figure 6. Contaminated potting soil error.

Irregular mushroom development within the potting soil was one of the most intriguing sources of error. After watering the plants for two weeks and treating them with gibberellin for just one week, the mushrooms along with small houseflies emerged in the soil.

Results and Discussion

Control Variable:
Setaria Viridis Wild type was both treated and not treated with gibberellin to understand the organ affect.
Test Variable(s):
M4:Mutant strain 4 was treated and not treated with gibberellin. This dwarfism strain contains the genetic abilities to grow like normal when treated with a plant growth regulator.
M6: Mutant strain 6 was treated and not treated with gibberellin. This dwarfism strain contains genetic inhibitors that do not allow a plant to surpass a certain height.

In each of the charts depicted all of the strains used for the experiment were closely related in height except for the Wild type. The Wild-Type was used as a control variable to understand if gibberellin had an effect on plant height in which it did. Gibberellin in the Wild type strain showed the most growth of 1.6cm more compared to treated M4 and M6. While all strains of the untreated averaged about 4 cm in height which is still less than the treated average results of a bout 5cm.However, Even though most of the numbers show that the treated strains result in a taller height we did not collect enough data to solidify that gibberellin actually affected plant organ elongation.

Errors

Based on comparisons with different experimentations (genetics) conducted with the same wild type millet, the overall growth rate of even our control subjects can be ruled as stunted. On average, our seedlings' germination took an additional week compared to those with normal growth rates. This could be attributed to a variety of reasons.
For instance, our experimentation lacked grow lights and the premade soil that the other successful experiments contained. As well as, on other occasions we experienced the growth of unknown mushrooms within all our pots as well as gnats (houseflies), neither of which had been present in the successful genetics experiments. Time also presented a challenge. Foxtail millet requires an average of fifteen weeks to reach full maturity. Due to constraints of the semester timeline and the deadline of the showcase we were only able to allow the plants a growth period of around six weeks, less than half of the average time necessary. Therefore, our hypothesis could not be backed with credible results, and needs to undergo further experimentation in order to have reliable evidence.

Sources:

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- Gupta RK, Chakrabarty S. Gibberellic acid in plant. Plant Signaling & Behavior. 8(9):e25504. https://doi.org/10.4161/psb.25504.doi:10.4161/psb.25504
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