Effects of Gibberellin on Mutant Dwarf *Setaria viridis* Height

Purpose

Gibberellic acid is a plant hormone that plays a crucial role in plant growth. Gibberellins promote cell elongation and cell division throughout the plant body and are required for a plant to grow to its expected height(Minier, T.C. & Lord, E.M., 1983). Without gibberellin plants will be unable to grow to their normal height and instead will express a form of dwarfism. Gibberellin related dwarfism is often due to 2 options. The first being that the plant is unable to produce its own gibberellin resulting in the dwarf phenotype. The second being that the plant has no gibberellin receptors and even with gibberellin present will not be able to respond to it. The goal of this project is to determine the mechanism of dwarfism in each of the mutant genotypes provided. Using the gibberellin treatment, we will be able to determine whether the cause of the dwarfism is due to a production issue or a reception issue.

Results

Summary:

day	plant_type	growth_measurement
Min. :1.0	Length:216	Min. : 1.00
1st Qu.:2.0	Class :character	1st Qu.: 7.05
Median :3.5	Mode :character	Median :14.00
Mean :3.5		Mean :16.06
3rd Qu.:5.0		3rd Qu.:22.55
Max. :6.0		Max. :45.00
		NA's :49

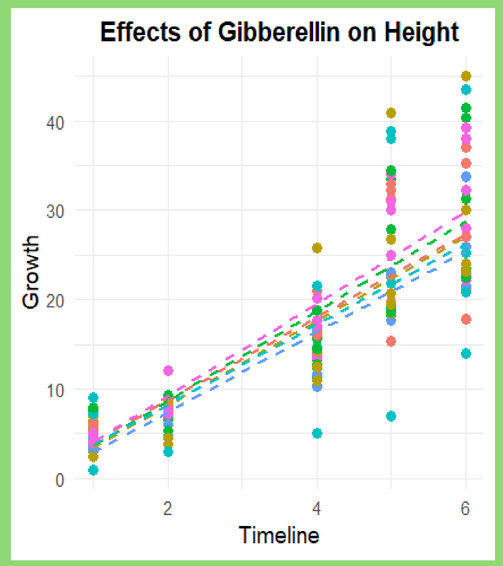
Adjusted R-squared: 0.6968
F-statistic: 35.67
p-value: < 2.2e-16

Error Analysis

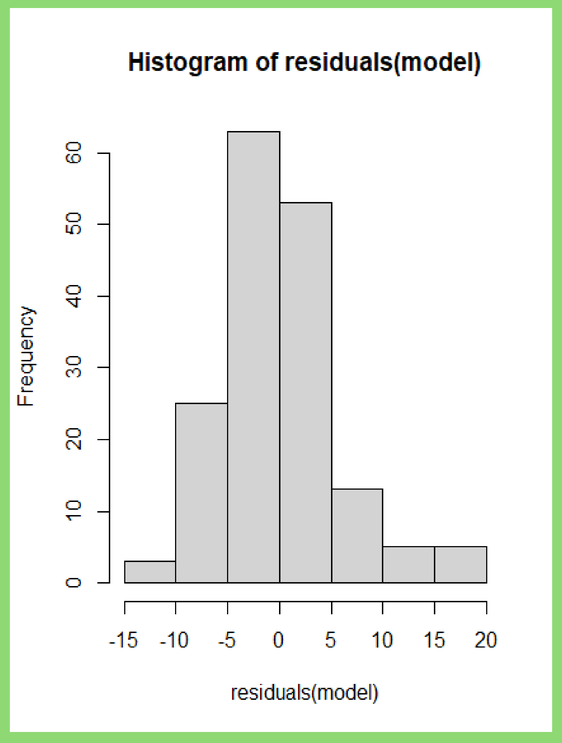
The reference paper used in this experiment used a concentration of 100 micro-M while this experiment used 100 mM. This may be the cause of the plants treated with gibberelic acid having little structural support. As gibberelic acid is not very soluble in water, applying the same amount to each plant was difficult. All plant pots contained holes for water drainage into the arrays. This means that all plants in a single array were subjected to what one plant was given. Each plant pot did not contain the same amount of plants as some seeds did not germinate causing possible fluctuations in average height. Lastly, due to inclement weather causing Lindenwood University to close for two days, there was a day gap in the experimental data.

Discussion

The results show that the relationship between the predictors (plant type, treatment) and plant growth is statistically significant, with a p-value of 2.2e-16, which is much smaller than the typical threshold of 0.05. This indicates that the effects observed are not due to random chance. The F-statistic of 35.67 suggests that the model fits the data well, explaining a substantial portion of the variability in plant growth. The adjusted R-squared value of 0.6968 means that approximately 70% of the variation in plant growth can be explained by the variables included in the model. These results suggest that our treatment (e.g., gibberellin) and plant type have a meaningful impact on plant growth.



Key:
Mutant1 Control Group: Red
Mutant1 Gibberellin: Yellow
Mutant2 Control Group: Green
Mutant2 Gibberellin: Light Blue
Wild Control Group: Dark Blue
Wild Gibberellin: Pink



Methods

To complete this experiment, we will use a greenhouse and UV lights to produce a consistent growing environment for all plants as well as the same opportunity for sunlight. We will have two separate arrays of plants, in which there will be 6 separate pots of each species of millet seeds. The first array will receive approximately 10ml of water and will be treated as the control group for the species Wild Type, M3, and M4. For the second array, there will be an identical number of pots with the same amount of seeds as the first array. The only discrepancy between the 2 arrays will be that during the watering process, the second array will receive 10ml of a 100-millimole solution. This concentration was compared to the 60 μg of gibberellin applied to the fully grown test plants in our reference article (Phinney 4). We will measure and treat each of the plants twice a week and develop a spreadsheet of the final measurements to compare the heights and growth rates. Using the final information in the spreadsheet, we will be able to answer the initial research question to identify which dwarf species can and cannot make gibberellic acid or can and cannot receive the acid. The independent variable in this project will be the array receiving the gibberellin treatment and the dependent variable will be the height recorded as a result of the extra growth from the treatment.

References

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