The Effects of Exogenous Gibberellin Exposure on Dwarf Mutant Millet Plants

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Introduction

Mutations are a significant topic in the field of Agriculture due to their effects on crop yield (Evert and Eichhorn 2013). Plant growth hormones are widely used in the agricultural industry to manipulate the growth of crops. Wildtype variants exhibit typical stem elongation and are most common in populations. Dwarf mutant variants have been found to have a variety of mutations that inhibit the synthesis and metabolism of gibberellin, a major plant growth hormone (Phinney 1956). The mutation of certain dwarf variants results in the inactivation of gibberellins, due to immediate bonding of a hydroxyl group to the second carbon (Bilova et al. 2016). Other variants have a mutation that results in insufficient production of gibberellins. These mutants would be responsive to exogenous gibberellin exposure.

Determining the mutation that is resulting in dwarf mutant types will assist in proper usage of plant growth hormones in the field of agriculture. Mutant types that do not produce any or enough gibberellin can be treated during growth to increase stem elongation. This will also prevent farmers from wasting money applying plant growth hormones to mutant types that will immediately inactivate it.

Methods

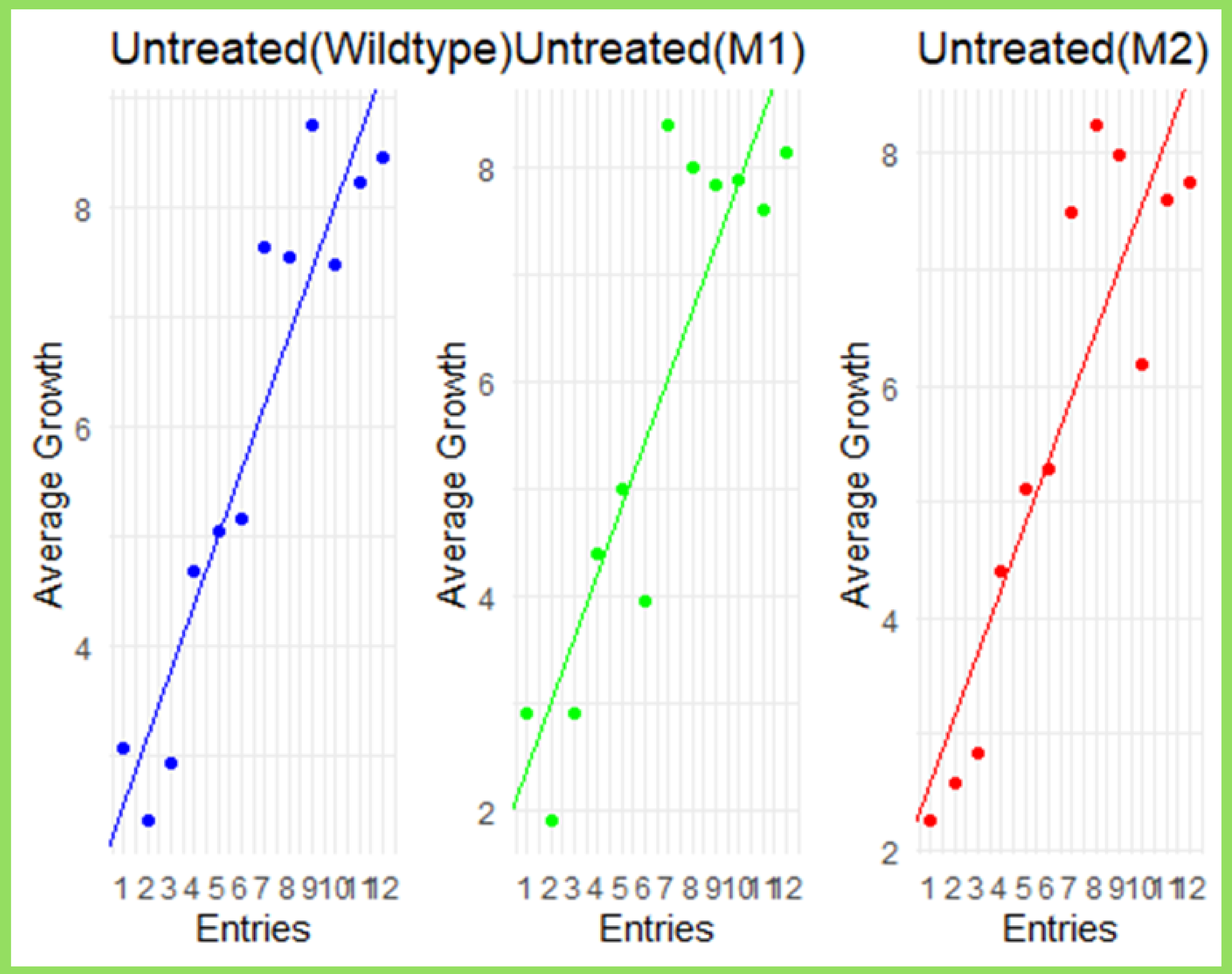
Three replicate pots of the following were planted in random order:

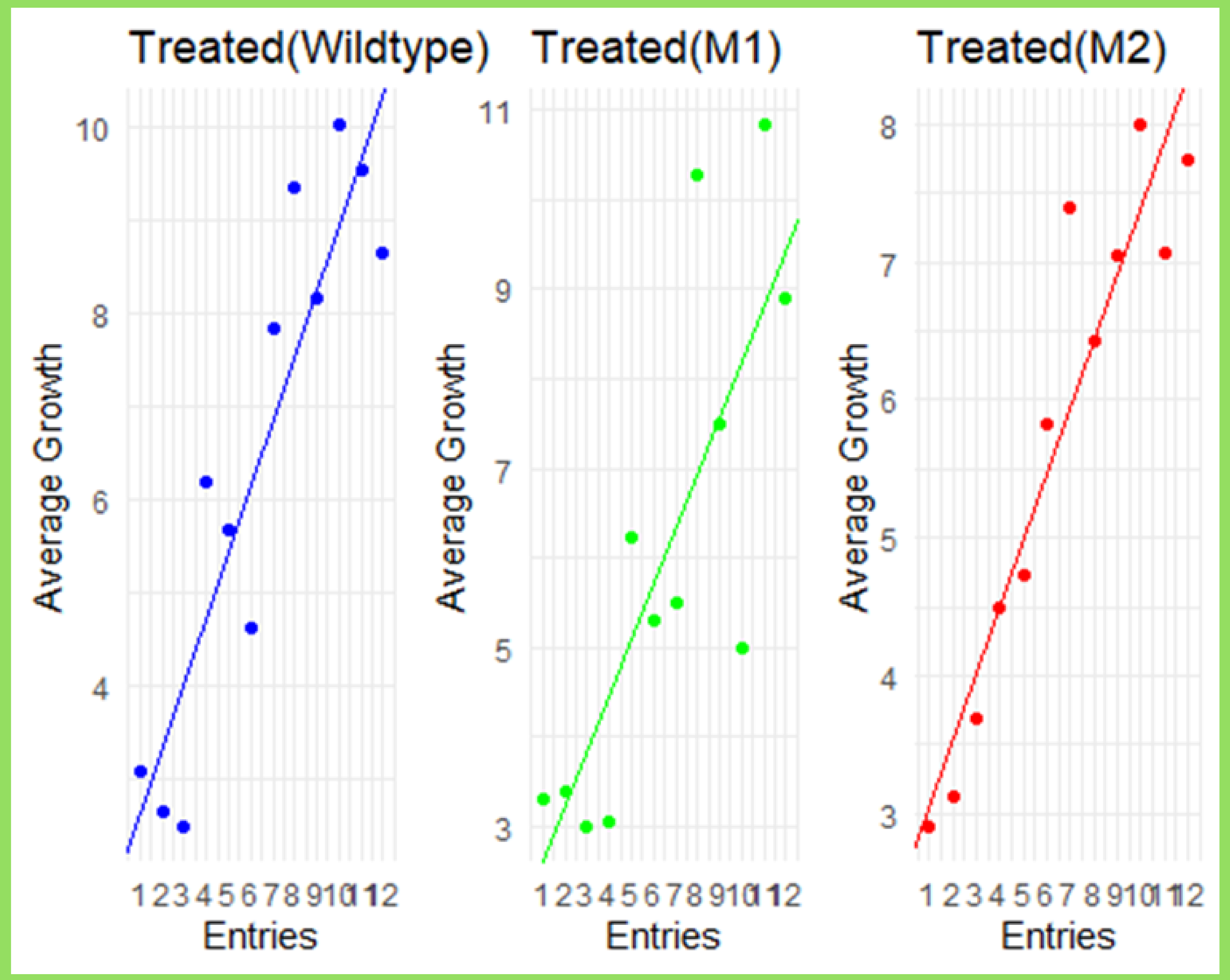
- Treated/Untreated Wildtype
- Treated/Untreated Mutant 1 (M1)
- Treated/Untreated Mutant 2 (M2)

A gibberellic acid solution with a concentration of 450 ppm was created (Phinney 1956). 1 mL of the gibberellin solution was applied to each seedling in the treated pots immediately after germination and again after two weeks. Stem length was measured weekly for four consecutive weeks.

A regression analysis of the data was conducted using R^2 tests to explain the variance in growth across treatment levels.

Results





Untreated	Treated
Wildtype: R^2 value (.8675) Fitted Model : Growth = 2.00758 + 0.60601(Entries)	Wildtype: R^2 value (.7967) Fitted Model : Growth = 1.9906 + 0.6977(Entries)
M1: R^2 value (.777) Fitted Model : Growth = 1.77530 + 0.61098(Entries)	M1: R^2 value (.6033) Fitted Model : Growth = 1.9995 + 0.6189(Entries)
M2: R^2 value (.7795) Fitted Model : Growth = 2.04515 + 0.55357(Entries)	M2: R^2 value (.8816) Fitted Model : Growth = 2.55697 + 0.48406(Entries)

Discussion

The untreated Wildtype had the greatest R^2 value of 0.8675, suggesting that the model explains 86.75% of the variation in growth during untreated circumstances. In comparison, untreated Mutants 1 and 2 had significantly lower R^2 values. This reinforces that variants with mutations impacting gibberellin production or metabolism result in slightly decreased growth patterns.

The treated Mutant 2 plants exhibited the greatest R^2 value of 0.8816, meaning that 88.16% of the variation in growth for this particular mutant type under treated circumstances can be explained by the model. The R^2 value of untreated samples was significantly lower, which indicates that Mutant 2 most likely possesses the mutation that inhibits sufficient gibberellin production. Treated Mutant 1 plants had a noticeably lower R^2 value than the untreated samples. The lack of growth response from the untreated plants indicates that the mutation responsible for its dwarfism is inactivating the gibberellins it encounters or produces. The treated Wildtype had a R^2 value of 0.7967, demonstrating a high degree of growth predictability under treatment. This decreased growth in treated plants may indicate that an excess of gibberellin can negatively impact stem elongation.

References

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Acknowledgements

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