Plant Hormone Addition on Mutant Millets

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INTRODUCTION

- Gibberellin is a plant hormone responsible for seed germination and plant growth and development. Plants produce gibberellin naturally, but it can also be manually added by applying a gibberellic acid solution to plant leaves and stems to stimulate plant growth.
- Millet plants come in various strains that can be classified into different groups: normal wild-type and shorter dwarf types. Dwarf types exist because they either don't naturally produce gibberellin, or they do produce it and are non-responsive; this means that there are two different groups of dwarf types.
- We developed an experimental design to test the effects of addition of synthetic gibberellic acid introduction to both wild-type and dwarf strains, and to determine which type each mutant dwarf strain was.

METHODS

Six pots were set up, each containing:
- 30 seeds
- Soil
- 1 divider

Plant care:
- Plants were given 20mL of water every Monday, Wednesday, and Friday
- Gibberellic acid was applied on one side of each divider, leaving one half of each pot untreated
- 0.1 g/mL of gibberellic acid was applied every Monday and Friday
- Plants were kept in greenhouse conditions
- For each seed type, 1 pot contained pre-soaked seeds and 1 pot contained dry seeds

Seed types
- Setara viridus = wild type
- Setara viridus dwarf = 00256m3 (dwarf m3)
- Setara viridus dwarf = 11842m4 (dwarf m4)

REFERENCES

Janowska, B., & Andrzejak, R. (2022). Cytokinins and Gibberellins stimulate the flowering and post-harvest longevity of flowers and leaves of calla lilies (Zantedeschia Spreng.) with colourful inflorescence spathes. Agronomy, 12(8), 1859. https://doi.org/10.3390/agronomy12081859

Li, L., Wang, J., Chen, J., Wang, Z., Qaseem, M. F., Li, H., & Wu, A. (2022). Physiological and transcriptomic responses of growth in Neolamarckia Cadamba stimulated by exogenous gibberellins. International Journal of Molecular Sciences, 23(19), 11842. https://doi.org/10.3390/ijms231911842

Ordonio, R. L., Ito, Y., Hatakeyama, A., Ohmae-Shinohara, K., Kasuga, S., Tokunaga, T., Mizuno, H., Kitano, H., Matsuoka, M., & Sazuka, T. (2014). Gibberellin deficiency pleiotropically induces culm bending in sorghum: An insight into sorghum semi-dwarf breeding. Scientific Reports, 4(1). https://doi.org/10.1038/srep05287

Phinney, B. O. (1956). Growth response of single-gene dwarf mutants in maize to gibberellic acid. Proceedings of the National Academy of Sciences, 42(4), 185–189. https://doi.org/10.1073/pnas.42.4.185

Figure 1: Millets at end of experiment

RESULTS

- Dwarf m3 plants showed more growth when treated with gibberellic acid.
- Dwarf m4 plants did not show additional growth when treated with gibberellic acid.
- Wild-type plants, when treated with gibberellic acid, showed some growth, but not as much as dwarf m3 plants.

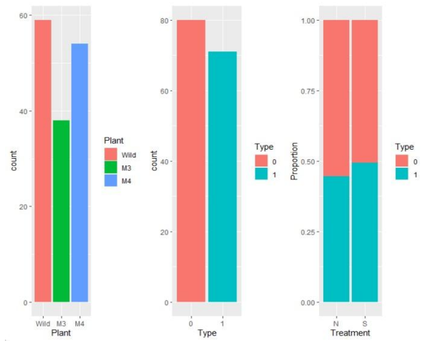

Figure 2: Distribution of the plants and type variables

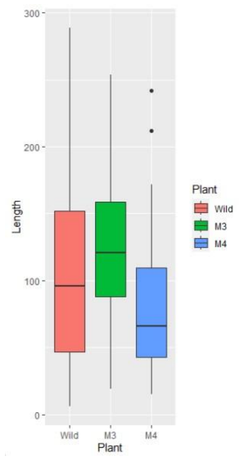

Figure 3: Differences between the plants and the length

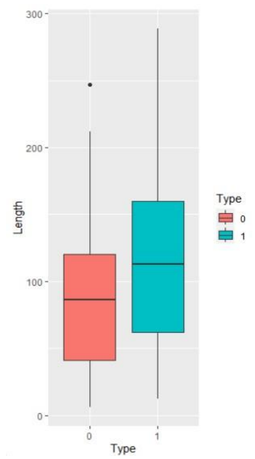

Figure 4: Differences between the control group and gibberellic groups based on their lengths

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Analysis of Variance Table

Model 1: Length ~ Weeks + Plant + Type + Treatment
Model 2: Length ~ Weeks + Plant * Type + Treatment
Model 3: Length ~ Weeks * Type + Plant + Treatment
Model 4: Length ~ Weeks + Plant + Type * Treatment
Model 5: Length ~ Weeks * Type + Plant * Type + Treatment * Type
  Res.Df    RSS Df Sum of Sq      F  Pr(>F)
1    145 415390
2    143 404074  2   11316.4 1.9796 0.14194
3    144 413824 -1   -9750.2 3.4112 0.06685 .
4    144 415390  0   -1566.2
5    141 403014  3   12375.8 1.4433 0.23280
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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
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Most significant and has the lowest p-value

Figure 5: ANOVA test based on different fitted models

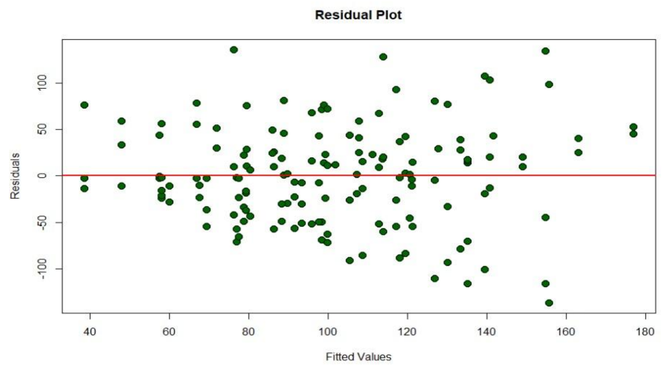

Figure 6: Scatter plot

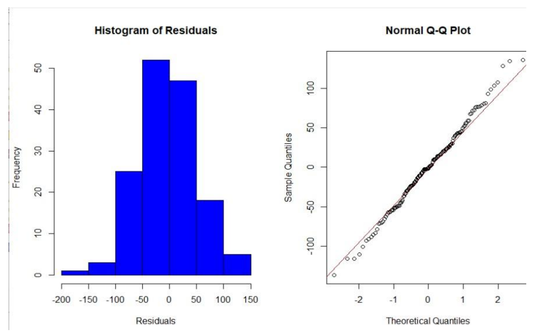

Figure 7: Histogram and Q-Q Plot

VARIABLES

- Length - length of each plant (mm)
- Weeks - week each plant was measured

Type:
- 0 - control group
- 1 - gibberellic acid

Treatment:
- N - seeds planted without being soaked
- S - seeds soaked for 24 hours prior to planting

CONCLUSIONS

- Based on these results, it was concluded that the dwarf m3 strain did not produce gibberellins naturally.
- Dwarf m4 was unresponsive to treatment.
- The wild type showed a lower response level than the dwarf m3 strain, but a higher response than the m4 strain.