JOURNAL OF INTERDISCIPLINARY PERSPECTIVES

ISSN Print: 2984-8288, ISSN Online: 2984-8385
Vol. 3 No. 8, 839-844, August 2025

Breaking Dormancy Barriers: Harnessing Fermented Plant Juice (FPJ) for Enhanced Germination and Early Seedling Growth in Lettuce (*Lactuca sativa* L.)

Angelica Joy G. Fronda*, Manolo T. Valdez
Nueva Vizcaya State University, Bayombong, Nueva Vizcaya, Philippines

*Corresponding Author Email: frondaangelicajoy09@gmail.com

Date received: May 10, 2025
Date revised: July 7, 2025
Date accepted: July 25, 2025

Originality: 96%
Grammarly Score: 99%
Similarity: 4%

Recommended citation:
Fronda, A.J., & Valdez, M. (2025). Breaking dormancy barriers: Harnessing Fermented Plant Juice (FPJ) for enhanced germination and early seedling growth in lettuce (Lactuca sativa L.). *Journal of Interdisciplinary Perspectives*, *3*(8), 839-844. https://doi.org/10.69569/jip.2025.382

Abstract. Lettuce (*Lactuca sativa* L.) is a widely cultivated leafy vegetable, but seed dormancy and slow, uneven germination often limit crop uniformity and yield. Finding natural, sustainable methods to improve seed germination and early seedling growth is essential for enhancing lettuce production. The study investigated the effect of Fermented Plant Juice (FPJ), a bio-stimulant made from natural plant extracts, on lettuce seed germination and seedling development. Four treatments were tested: a control with no treatment, and FPJ solutions at 2%, 5%, and 10% concentrations. Seeds were monitored for 8 days to assess germination rates and then for an additional 12 days to evaluate seedling emergence and growth vigor. The highest germination rate of 98.67% was observed with the 10% FPJ treatment by Day 7, with seedling emergence reaching 100% by Day 11, starting from 17.67% on Day 3. The 5% FPJ treatment also significantly improved germination and emergence, approaching full seedling development by Day 12. The 2% FPJ treatment showed moderate improvement compared to the control, which had the slowest germination and poorest seedling growth. These findings demonstrate that FPJ can effectively break seed dormancy, accelerate germination, and promote uniform and vigorous seedling growth. Using FPJ as a natural seed treatment provides a cost-effective and eco-friendly alternative to chemical stimulants, supporting sustainable agricultural practices. The application of FPJ can contribute to higher crop yields and better-quality lettuce seedlings, making it a promising tool for farmers and researchers aiming to improve lettuce production naturally.

Keywords: Fermented plant juice (FPJ); Lettuce (*Lactuca sativa*); Seed dormancy; Seed germination; Seedling vigor.

1.0 Introduction

Lettuce (*Lactuca sativa* L.) is a globally important crop, valued for its fresh, nutritious leaves, often used as a salad base (Poliquit et al., 2021). It is a vital, cost-effective staple that is easy to prepare and usually cultivated in urban areas, contributing to the sustainability of local food systems (Meneghelli et al., 2021). However, the challenge of seed dormancy, a phenomenon not yet fully understood, poses a significant barrier to optimal cultivation. (Chandel et al., 2024). Studies have shown that high storage temperatures can induce dormancy by altering physiological and enzymatic processes (Catão et al., 2018). While methods such as seed stratification and chemical treatments are commonly employed to address dormancy, they are often expensive and labor-intensive (Bewley et al., 2013; Finch-Savage & Leubner-Metzger, 2006; Gornik et al., 2023). This highlights the urgent need for innovative, eco-friendly strategies to enhance lettuce seed germination and ensure sustainable production.

Fermented Plant Juice (FPJ) is widely used as a liquid fertilizer in organic farms (Denona et al., 2020). It is particularly valued for its ability to stimulate plant growth and improve photosynthesis through its enzyme-rich composition (Sulok et al., 2021). Additionally, FPJ is widely applied in seed and soil treatments to boost plant nutrition and overall health (Diamante et al., 2022; Miller et al., 2013). Research indicates that the nutrients and bioactive compounds in FPJ enhance seedling growth, improving their resilience against stresses such as drought and pest attacks (Mambuay et al., 2024). However, there is limited research specifically examining the effects of FPJ on lettuce seed germination and early growth. Most existing studies focus on other crops or general applications, leaving the benefits of FPJ for lettuce seeds still largely unexplored. This study aims to fill this gap by testing how FPJ affects lettuce seed germination and early seedling growth. Improving these stages is crucial for enhanced crop growth, higher yields, and environmentally friendly farming practices. The results will help show if FPJ can be a safe, affordable, and natural way to improve lettuce farming.

2.0 Methodology

2.1 Research Design

The study utilized a completely randomized design (CRD) with four treatments, each replicated three times: T1 (Control – no treatment), T2 (seed soaking with 2% fermented plant juice), T3 (seed soaking with 5% fermented plant juice), and T4 (seed soaking with 10% fermented plant juice).

2.2 Research Locale

The study was conducted in Camanacsacan, San Jose City, Nueva Ecija, from April to May 2024. The experiment utilized seeds of Green Wave lettuce, which can be grown year-round and typically reach maturity 30-45 days after transplanting.

2.3 Data Gathering Procedure

Materials

Green Wave lettuce seeds were used in the experiment, selected for their year-round growth potential and typical maturity period of 30-45 days post-transplantation. For planting, a plastic container was designated for Set A, while a seedling tray was used for Set B.

Seed Sowing Preparation

This study followed a simple process for preparing and planting seeds. Each treatment, except for the control (Treatment 1), underwent soaking in fermented plant juice at a designated concentration before being sown in a plastic container for SET A and a seedling tray for SET B. Germination was observed, and signs of dormancy breaking, like the appearance of roots or shoots, were recorded.

2.4. Data Analysis

Data analysis was conducted using Analysis of Variance (ANOVA) in STAR software, while mean comparisons were performed using the Least Significant Difference (LSD) Test at a 5% significance level. Significant results were thoroughly examined to identify meaningful variations, providing a clear and accurate interpretation of the findings.

Mean germination time (T50, h). The mean germination time was computed using the formula:

$$T_{50} = t_i + \left[\frac{\frac{N+1}{2} - n_i}{n_j - n_i}\right] \cdot (t_j - t_i) \qquad \text{Equation 1}$$

where: N = final number of germinants

n_i ; n_j = total number of germinants by adjacent counts at t_i and t_j

where: $n_i < (N + 1)/2 < n_j$

Mean spread of germination time (T_{90} -T_{10}, h). This was obtained by using the following formula:

$$T_{10} = t_i + \left[\frac{\frac{N+1}{10} - n_i}{n_j - n_i}\right] \cdot (t_j - t_i) \qquad \text{Equation 2}$$

where: $n_i < (N+1/10) < n_j$

$$T_{90} = t_i + \left[\frac{\frac{9(N+1)}{10} - n_i}{n_j - n_i}\right] \cdot (t_j - t_i) \qquad \text{Equation 3}$$

where: $n_i < 9(N+1)/10 < n_j$

Mean emergence time (T50, h). The mean emergence time was computed using the formula:

$$T_{50} = t_i + \left[\frac{\frac{(N+1)}{2} - n_i}{n_j - n_i}\right] \cdot (t_j - t_i) \qquad \text{Equation 4}$$

where: N = final number of seedlings emerged
n_i; n_j = total number of seedlings emerged by adjacent counts at t_i and t_j
where: $n_i < (N + 1)/2 < n_j$

3.0 Results and Discussion

3.1. Set-up A. Seed Germination Test

This experiment investigated the germination performance of seeds exposed to four different treatments over an eight-day period (see Table 1). Among the treatments, Treatment 4 consistently had significantly higher germination percentage, starting at 73.33% on Day 1 and reaching 98.67% by Day 8. In contrast, Treatments 2 and 3 showed moderate germination progress, while Treatment 1 consistently lagged, beginning with no germination and ending at just 79%.

Table 1. *Summary of the result of percent seed germination in lettuce as influenced by soaking at different concentrations of fermented plant juice*

Treatment	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
1	0.00 c	1.67 c	36.67 c	50.67 c	55.00 c	67.33 c	78.67 c	79.00 c
2	54.00 b	55.33 b	70.33 b	80.33 ab	85.33 b	87.67 b	88.00 b	89.33 b
3	56.33 b	57.67 b	73.00 ab	75.00 b	88.67 ab	88.67 b	92.00 ab	93.67 ab
4	73.33 a	78.00 a	84.00 a	87.00 a	91.00 a	97.33 a	98.67 a	98.67 a

Means with the same letter are not significantly different at the 5%level of probability.

Statistical analysis confirmed that Treatment 4 surpassed the others at nearly every stage, particularly in the early days, indicating enhanced seed vigor and faster activation of germination processes. Treatments 2 and 3 exhibited similar trends, with steady improvement, but remained significantly lower than Treatment 4 in final germination percentages. These findings highlight the effectiveness of bioactive treatments, particularly those derived from Fermented Plant Juice (FPJ), in enhancing germination. Plant-based biostimulants, including FPJ, provide sustainable solutions for improving crop growth and seed germination, with seed priming emerging as an eco-friendly alternative to conventional practices (Wazeer et al., 2024). This aligns with previous studies that emphasize the critical role of organic biostimulants in promoting uniform germination and robust early seedling development (Alam, 2021). Figure 1 compares the average germination times of seeds under four treatments. Treatment 1 (Control) had the longest average germination time at 78.19 hours with high variability. In contrast, Treatments 2, 3, and 4 significantly reduced germination time, with Treatment 4 being the most effective and consistent at 16.32 hours, followed by Treatment 3 (20.21 hours) and Treatment 2 (24.04 hours). The smaller error bars for T2–T4 indicate more uniform germination compared to the untreated control.

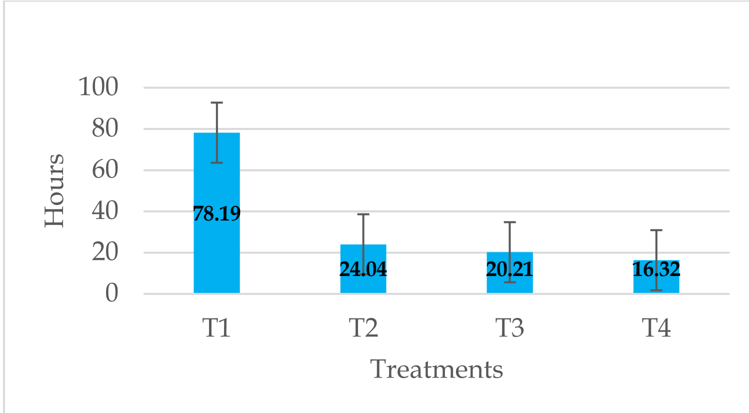

Figure 1. *Rate of germination of lettuce seeds as influenced by soaking at different concentrations of fermented plant juice (FPJ).*

Figure 2 presents the uniformity of germination (in hours) across four treatments. Treatment 4 exhibited more uniform germination with an average of 26.11 hours, closely followed by Treatment 3 at 32.33 hours. In contrast, Treatment 2 had a wider spread of germination, with a duration of 36.65 hours, compared to Treatment 4. Treatment 1 (Control) showed uneven germination at 48.46 hours.

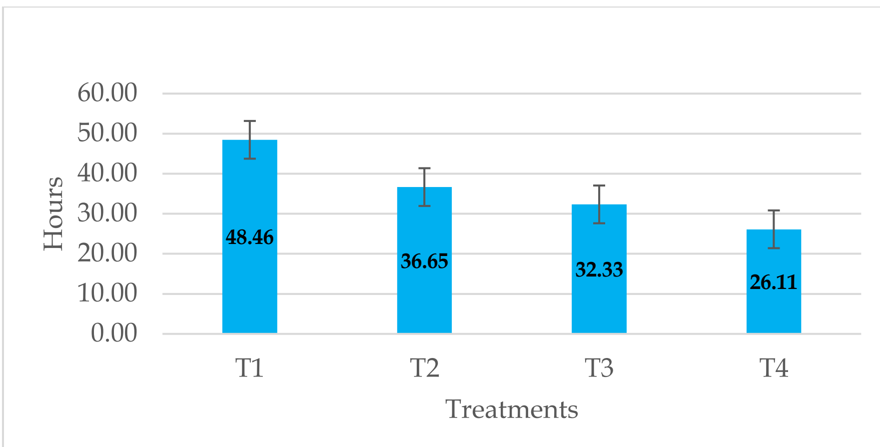

Figure 2. *Uniformity of germination of lettuce seeds as influenced by soaking at different concentrations of fermented plant juice (FPJ).*

These results suggest that Treatments 3 and 4 effectively promoted more uniform and predictable germination, which is important for synchronized seedling development and improved crop management.

3.2. Set-up B. Seedling Emergence Test

Table 2 shows the percentages of seedling emergence over 12 days for seeds treated with four different concentrations of FPJ. Treatment 1 showed the lowest % seedling emergence, starting at 1.0% on Day 3 and reaching 75.0% by Day 11. Treatment 2 began at 3.0% and increased to 94.0% by Day 12. Treatment 3 started at 9.33% and reached 98.0% by Day 12. Treatment 4 was the most effective, achieving 100% seedling emergence by Day 11 and maintaining it through Day 12. By Day 12, Treatments 2, 3, and 4 all showed high seedling emergence percentages, with no significant difference among them, while Treatment 1 remained significantly lower. Treatment 4 was the most effective in promoting rapid and complete germination.

Table 2. *Summary of the result of % seedling emergence of lettuce as influenced by soaking at different concentrations of fermented plant juice (FPJ)*

Treatment	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12
1	0	0	1.00c	3.00c	11.67c	17.00c	20.67d	79.00c	46.33d	63.33c	75.00c	75.00b
2	0	0	3.00c	11.67bc	13.67c	24.00c	37.33c	89.33b	71.00c	88.00b	91.67b	94.00a
3	0	0	9.33b	17.00b	36.00b	46.67b	57.67b	93.67ab	76.00b	87.33b	93.33b	98.00a
4	0	0	17.67a	48.67a	57.00a	68.67°	78.67a	98.67a	95.67a	99.33°	100.00 a	100.00 a

Means with the same letter are not significantly different at the 5%level of probability.

These findings align with Cejalvo and Mercado (2018), who reported that FPJ treatments significantly improved germination, vigor, and seedling growth in crops. Similarly, the study of Butay et al. (2018) revealed that plants treated with FPJ exhibited significant improvements in seedling production, promoting vigorous growth and healthier development.

Figure 3 presents the mean emergence time (in hours) for seeds treated with four different FPJ concentrations (T1, T2, T3, and T4). Treatment T2 exhibited the longest emergence time, with an average of 208.72 hours, followed by Treatment T1 at 176.16 hours. In contrast, Treatments T3 and T4 showed a faster emergence rate, with means of 124.75 hours and 110.33 hours, respectively. The error bars indicate variability in emergence times, with T2 and T1 demonstrating higher variability compared to the more consistent T3 and T4 treatments.

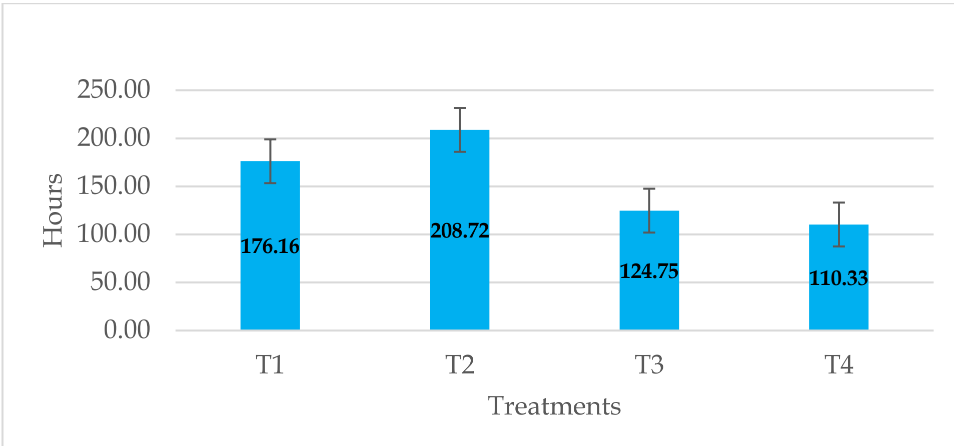

Figure 3. *Seedling emergence rate of lettuce as influenced by soaking at different concentrations of fermented plant juice (FPJ).*

Overall, the data reveal significant differences in the mean rate of emergence, with T3 and T4 being the most effective, as they exhibit shorter times required to reach 50% seedling emergence.

Figure 4 compares the seedling emergence times (in hours) for lettuce seeds under four different treatments (T1, T2, T3, and T4). Treatment 2 exhibited the unevenness of seedling emergence at 194.43 hours, followed by Treatment T1 at 193.54 hours. In contrast, Treatment T3 and Treatment T4 had significantly shorter times for some seedlings to emerge, with a mean of 149.4 hours and 97.6 hours, respectively.

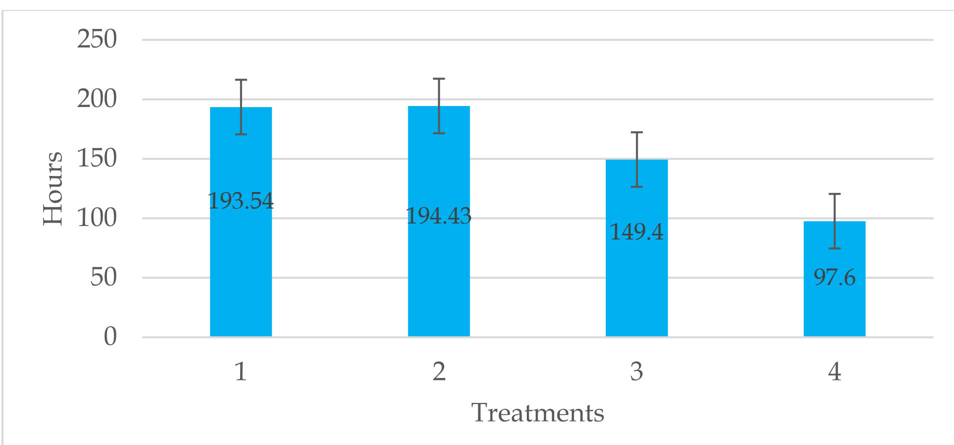

Figure 4. *Uniformity of emergence of lettuce seedlings as influenced by soaking at different concentrations of fermented plant juice (FPJ).*

The error bars in the figure indicate the variability of seedling emergence times for each treatment. T2 displayed the highest variability, suggesting a less uniform emergence compared to the other treatments. T1 also showed considerable variability, while T3 and T4 had smaller error bars, reflecting more consistent and more uniform seedling emergence.

4.0 Conclusion

The study highlighted the promising potential of FPJ in improving seed germination and seedling growth. The data from the 8-day germination and 12-day seedling emergence periods clearly showed the effectiveness of FPJ treatments in enhancing seed performance. Among the treatments, Treatment 4 recorded the highest germination percentage, which is consistent with the result in the percentage of seedling emergence, achieving 100% emergence by Day 11 after starting at 17.67% on Day 3. Treatment 3 also demonstrated significant results, nearing complete germination by Day 12. Treatment 2 showed moderate progress, while Treatment 1 had the slowest germination and the least effective results. These findings support the FPJ's role in overcoming dormancy barriers, speeding up germination, and promoting uniform seedling growth. The results confirm that FPJ is a highly effective and eco-friendly solution for enhancing lettuce seed germination and early growth, providing a sustainable alternative to traditional seed treatment methods.

5.0 Contribution of Authors

Fronda A.J. designed the study, conducted the experiments, analyzed the data, and wrote the manuscript. Valdez M. supervised the research and assisted with the final version of the manuscript. Both authors provided valuable feedback and contributed to the development of the research, analysis, and manuscript.

6.0 Funding

The authors would like to acknowledge the generous support of the Department of Science and Technology-Science Education Institute (DOST-SEI) for funding this research.

7.0 Conflict of Interest

Authors declare that there is no conflict of interest.

8.0 Acknowledgment

The authors extend their deepest gratitude to the Philippine Government's Department of Science and Technology - Science Education Institute (DOST-SEI) for funding this research, as well as to the College of Agriculture, Nueva Vizcaya State University, Bayombong, Nueva Vizcaya, for providing technical support for this experiment.

9.0 References

Alam, E. A. (2021). Lettuce grown in the open field and protected culture applied with different fermented plant juices. Lukad: An Online Journal of Pedagogy, 1(2), 109–120.

Bewley, J.D., Bradford, K.J., Hilhorst, H.W.M. & Nonogaki, H. (2013). Seeds: Physiology of development, germination and dormancy 3rd Edition, Springer, New York. http://dx.doi.org/10.1007/978-1-4614-4693-4

Butay, J., Trinidad, L., & Diagan, N. (2018). Yield performance of bell pepper (*Capsicum annum*) as influenced by different plant extracts. Asia Pacific Journal of Multidisciplinary Research, 6(4).

Catao, H.C.R., Gomes, L., Guimaraes, R.M., Fonseca, P.H.F., Caixeta, F., & Galvao, A.G. (2018). Physiological and biochemical changes in lettuce seeds during storage at different temperatures. Horticultura Brasileira, 36, 118–125. http://dx.doi.org/10.1590/S0102-053620180120

Cejalvo, R., & Mercado, M.F.O. (2018). Presoaking treatment of soybean (*Glycine max* L. Merrill) seeds using fermented plant extracts and commercial liquid fertilizer. JPAIR Multidisciplinary Research. 34(1), 40–56. https://doi.org/10.7719/jpair.v34i1.628

Chandel, N.S., Tripathi, V., Singh, H.B. & Vaishnav, A. (2024). Breaking seed dormancy for sustainable food production: revisiting seed priming techniques and prospects. Biocatalysis and Agricultural Biotechnology, 55. https://doi.org/10.1016/j.bcab.2023.102976

Denona, M., Baladjay, A. & Turnos, N. (2020). Enhancing leaf mustard (*Brassica juncea* L.) productivity using nitrogen-based fermented plant juice (FPJ). Journal of Agricultural Research, Development, Extension, and Technology, 2(1), 31–39. https://doi.org/10.5281/zenodo.8248046

Diamante, R., Banca, N., Almarza, A., Espina, K., & Alipe, J.R. (2022). Performance and growth of pechay using fermented plant juice. United International Journal for Research & Technology, 4(2).

Finch-Savage, W. & Leubner-Metzger, G. (2006). Seed dormancy and the control of germination. New Phytologist. https://doi.org/10.1111/j.1469-8137.2006.01787.x

Gornik, K., Sas-Paszt, L., Seliga, L., Pluta, S., Derkowska, E., Głuszek, S., Sumorok, B. & Mosa, W. (2023). The effect of different stratification and scarification treatments on breaking the dormancy of saskatoon berry seeds. Agronomy, 13, 520. https://doi.org/10.3390/agronomy13020520

Mambuay, S.,Amba, O., Escomen, E., Jambaro, G. & Masnar, A. (2024). Response of lettuce (*Lactuca sativa* L.) to different fermented plant juices as foliar organic plant supplements. International Journal of Current Research and Applied Studies, 3(5). https://doi.org/10.61646/IJCRAS.vol.3.issue5.90

Meneghelli, C.M., Fontes, P.C.R., Milagres, C.C., Silva, J.M. & Junior, E.G. (2021). Zinc-biofortified lettuce in aeroponic system. Journal of Plant Nutrition. https://doi.org/10.1080/01904167.2021.1889587

Miller, S., Ikeda, D., Weinert, Jr. E., Chang, K., McGinn, J., Keliihoomalu, C., & DuPonte, M. (2013). Natural farming: fermented plant Juice. Sustainable Agriculture.

Poliquit, D., Horca, L., Gamusa, E., & Jamin, N. (2021). Banana peel, A. pintoi, and T. gigantea on fermented plant juice (fpj) extracts and coco-water as growth and yield (*Lactuca sativa* L.) grown in hydroponic systems. Journal of the Austrian Society of Agricultural Economics (JASAE), (pp. 651–659) 17(8).

Sulok , K.M.T., Ahmed, O.H., Khew, C.Y., Zehnder, J.A.M., Jalloh, M.B., Musah, A.A., & Abdu, A. (2021). Chemical and biological characteristics of organic amendments produced from selected agro-wastes with potential for sustaining soil health: a laboratory assessment. Sustainability 13, 4919. https://doi.org/10.3390/su13094919

Wazeer, H., Gaonkar, S., Doria, A., Pagano, A., Balestrazzi, B., & Macovei, A. (2024). Plant-based biostimulants for seeds in the context of circular economy and sustainability. Plants 13, 1004. https://doi.org/10.3390/plants13071004