POST-HARVEST PHYSIOLOGY OF MELONS AS AFFECTED BY SOIL PHOSPHORUS AVAILABILITY AND APPLICATION TIMING.

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Annotation: *This study investigates the influence of soil phosphorus availability and the timing of its application on the post-harvest physiology of late-ripening melon (Cucumis melo L.) cultivated in light gray soils of the Samarkand region. The experiment was designed to assess how different phosphorus levels (deficient, optimal, and excessive) and application stages (pre-sowing vs. vegetative phase) affect melon fruit quality indicators such as firmness retention, weight loss, sugar content (Brix%), and spoilage rate during a 60-day storage period. Results demonstrated that optimal phosphorus application (100 kg/ha P_2O_5) applied during early vegetative growth significantly enhanced fruit biochemical stability and shelf life, with 72.5% firmness retained and only 12% spoilage. Delayed or excessive phosphorus application resulted in lower storability and nutritional quality. These findings suggest that precise phosphorus management—both in dosage and timing—plays a critical role in post-harvest performance of melons and can inform more sustainable melon production strategies in phosphorus-deficient soils.*

Keywords: *melon, phosphorus availability, application timing, post-harvest physiology, fruit firmness, shelf life, storage quality.*

Introduction: Melon (Cucumis melo L.) is one of the most economically significant horticultural crops in arid and semi-arid regions, including Uzbekistan. Late-ripening varieties are particularly valued for their extended shelf life and potential for long-distance transport. However, the post-harvest quality of melons—such as fruit firmness, sugar content, and resistance to spoilage—largely depends on pre-harvest agronomic practices, especially nutrient management. Among macronutrients, phosphorus plays a pivotal role in fruit development, carbohydrate metabolism, and membrane stability, all of which directly influence post-harvest physiology.

In phosphorus-deficient soils, such as the light gray soils of the Samarkand region, the availability and timing of phosphorus application are critical factors that determine not only yield but also the storability of harvested fruits. Previous research has primarily focused on the effect of phosphorus on melon yield and flowering; however, fewer studies have examined its influence on post-harvest behavior. Moreover, the timing of phosphorus application—whether during pre-sowing or at early vegetative stages—may significantly alter nutrient uptake efficiency and physiological responses in fruits.

This study aims to investigate how varying phosphorus availability levels and application timing affect the post-harvest physiological properties of late-ripening melons, with particular attention to storage-related indicators such as firmness retention, soluble solids content, and spoilage rate. The outcomes of this research will contribute to optimizing phosphorus management strategies that enhance both productivity and market quality of melons in arid agroecosystems.

Literature review: The influence of mineral nutrition on post-harvest quality of horticultural crops has been widely studied, with phosphorus recognized as a key element in enhancing metabolic stability and storability of fruits. Phosphorus is essential for ATP synthesis, membrane integrity, and enzyme activation, all of which are vital for prolonging fruit shelf life (Marschner, 2012). In melons, phosphorus deficiency during the growth phase can lead to impaired sugar accumulation, poor rind development, and reduced post-harvest resistance to microbial spoilage (Turan et al., 2010).

Buriev and Dosmuratova (2000) emphasized the need for early-stage phosphorus application to ensure proper root development and fruit set in cucurbits. Their work suggested that phosphorus applied during pre-sowing stages improved nutrient uptake efficiency, whereas delayed applications had limited benefit in low-phosphorus soils. Similarly, Karimov et al. (2018) reported that phosphorus availability in light gray soils of Central Asia is restricted by high pH and calcium carbonate content, which affects solubility and plant uptake.

Recent research by Yildirim et al. (2021) highlighted that the timing of phosphorus fertilization can significantly affect post-harvest fruit firmness, especially in crops like melon and watermelon. Early phosphorus application was associated with thicker rind structure and higher cell wall stability, leading to better storability. Furthermore, studies in post-harvest physiology indicate that phosphorus contributes to the maintenance of soluble sugars and vitamin C content during storage, which are critical indicators of fruit quality (FAO, 2017).

Despite these findings, comprehensive field-based studies that evaluate both phosphorus levels and application timing in relation to melon post-harvest physiology are still limited, especially in the agroecological context of Uzbekistan. This research addresses this gap by analyzing the dual impact of phosphorus dose and timing on the storage quality of late-ripening melon cultivated in the phosphorus-deficient light gray soils of Samarkand.

Methodology: The field experiment was conducted in the light gray soils of the Samarkand region, characterized by low phosphorus availability, neutral to alkaline pH (7.7–8.3), and moderate calcium carbonate content. The aim of the study was to assess the effects of different phosphorus doses and their application timing on the post-harvest physiological behavior of late-ripening melon (Cucumis melo L.).

A randomized complete block design (RCBD) was used with a factorial arrangement: three phosphorus doses (50, 100, and 150 kg/ha P_2O_5) and two application timings (pre-sowing and early vegetative stage). Each treatment was replicated three times. A uniform background dose of 100 kg/ha nitrogen (as ammonium nitrate) and 50 kg/ha potassium (as potassium chloride) was applied to all plots to eliminate macronutrient variability.

Phosphorus was supplied in the form of 19% superphosphate. In pre-sowing treatments, the entire phosphorus dose was incorporated into the soil during primary tillage. In early vegetative treatments, phosphorus was applied at the 3–4 leaf stage by shallow band placement between rows.

The melon variety used was "Qora po'choq," known for its long storage potential. Seeds were sown on May 20, with a row spacing of 270 cm and intra-row spacing of 60 cm. Standard agronomic practices—thinning, hoeing, and irrigation at 65–70% field capacity—were followed uniformly.

Fruits were harvested at full maturity (October 15) and stored under ambient conditions (20–25°C, 60–70% RH). Post-harvest evaluations were conducted at 15-day intervals over a 60-day period. Parameters measured included fruit firmness (penetrometer), weight loss (%), soluble solids content (°Brix), ascorbic acid content (mg/100g), and spoilage rate (%). Statistical analysis was performed using two-way ANOVA, and mean differences were compared using LSD at a 5% significance level.

Results: The experimental data revealed that both the **dose and timing** of phosphorus application significantly influenced post-harvest physiological traits of late-ripening melon fruits. Notably, melons grown with 100 kg/ha P_2O_5 applied during the early vegetative stage exhibited the best overall post-harvest performance across all measured indicators.

Table 1: Effect of phosphorus dose and application timing on melon fruit firmness during storage:

№	Treatment	Firmness at harvest (N)	Firmness after 30 days (%)	Firmness after 60 days (%)
1	P50 – Pre-sowing	14.8	70.3	59.1
2	P100 – Pre-sowing	15.4	74.5	63.8
3	P150 – Pre-sowing	15.3	73.2	62.4
4	P50 – Vegetative stage	15.1	73.8	61.5
5	P100 – Vegetative stage	16.2	78.6	67.2
6	P150 – Vegetative stage	16.0	76.4	65.0

The highest retention of firmness after 60 days was observed in the P100-VS (vegetative stage) treatment, indicating enhanced cell wall stability.

Table 2: Post-harvest sugar content and ascorbic acid in melon fruits (average of 60 days):

№	**Treatment**	**Soluble solids (°Brix)**	**Ascorbic acid (mg/100g)**
1	P50 – Pre-sowing	8.7	14.9
2	P100 – Pre-sowing	9.6	16.3
3	P150 – Pre-sowing	9.9	16.5
4	P50 – Vegetative stage	9.2	15.7
5	P100 – Vegetative stage	10.4	17.1
6	P150 – Vegetative stage	10.5	17.0

Vegetative-stage phosphorus application improved sugar and vitamin C accumulation, with peak values at 100–150 kg/ha doses.

Table 3: Spoilage rate and weight loss in melon fruits during storage:

№	Treatment	Weight loss after 60 days (%)	Spoilage rate (%)
1	P50 – Pre-sowing	15.2	19.3
2	P100 – Pre-sowing	13.5	15.8
3	P150 – Pre-sowing	13.3	15.4
4	P50 – Vegetative stage	13.9	17.0
5	P100 – Vegetative stage	11.8	12.4
6	P150 – Vegetative stage	12.0	13.1

The lowest spoilage and weight loss occurred in melons treated with 100 kg/ha phosphorus at the vegetative stage, suggesting better physiological and structural resilience.

Both phosphorus dose and timing significantly affect post-harvest melon quality. The P100-VS (100 kg/ha at vegetative stage) treatment was the most effective, improving firmness, reducing spoilage, and enhancing sugar and vitamin C levels. Higher doses (150 kg/ha) showed marginal gains compared to 100 kg/ha, indicating a physiological plateau.

Discussion: The results of the experiment clearly demonstrate that both the quantity and timing of phosphorus application significantly affect the post-harvest physiology of late-ripening melons grown in phosphorus-deficient light gray soils of the Samarkand region. Among the tested treatments, applying 100 kg/ha of P_2O_5 during the early vegetative stage (P100-VS) provided the most favorable outcomes in terms of firmness retention, biochemical quality, and storability.

Phosphorus plays a fundamental role in energy metabolism, cell division, and sugar transport, which are critical not only for fruit growth but also for maintaining post-harvest structural and physiological stability. The enhanced firmness observed in P100-VS (67.2% retained after 60 days) supports the hypothesis that timely phosphorus supply during early cell wall development improves fruit texture and resistance to softening. This is in line with findings by Yildirim et al. (2021), who reported stronger cell integrity and reduced degradation in phosphorus-optimized melon fruits.

The elevated soluble solids content (10.4 °Brix) and ascorbic acid levels (17.1 mg/100g) in P100-VS further highlight phosphorus's role in biochemical enrichment, as these attributes are essential markers of nutritional and sensory quality. Such improvements can be linked to more efficient photosynthate allocation and membrane stability enabled by optimal phosphorus nutrition (Marschner, 2012). Notably, phosphorus application at the pre-sowing stage produced relatively lower quality parameters, possibly due to limited early-stage uptake and phosphorus fixation in carbonate-rich soils.

Spoilage rate and weight loss were also lowest in the P100-VS treatment, suggesting enhanced post-harvest resistance to microbial decay and water loss. This can be attributed to balanced internal osmotic pressure and stronger epidermal structure, which are phosphorus-sensitive processes. In contrast, both underdosing (P50) and overdosing (P150) resulted in either insufficient physiological development or nutrient imbalances that may have interfered with optimal fruit preservation.

Overall, the study confirms that 100 kg/ha phosphorus applied at the vegetative stage represents the optimal agronomic practice for improving melon shelf life and post-harvest quality. These findings not only align with global research but also provide practical implications for melon growers in arid regions where phosphorus fixation and timing of application are critical factors for productivity and storability.

Conclusion: This study demonstrated that both the amount and application timing of phosphorus fertilizer significantly influence the post-harvest physiological quality of late-ripening melons grown in the light gray soils of the Samarkand region. Among all treatments, applying 100 kg/ha of P_2O_5 during the early vegetative stage resulted in the most favorable outcomes, including the highest firmness retention (67.2% after 60 days), enhanced biochemical parameters (10.4 °Brix and 17.1 mg/100g ascorbic acid), and the lowest spoilage rate (12.4%).

These results confirm that timely phosphorus supply is essential not only for yield formation but also for improving fruit storability by strengthening cell wall integrity and promoting efficient nutrient metabolism. While higher phosphorus doses (150 kg/ha) offered slight improvements in sugar content, they did not translate into significantly better storage outcomes, indicating that 100 kg/ha is the economically and physiologically optimal dose under these conditions.

Phosphorus fertilization strategies should consider both dose and timing to maximize post-harvest quality. For melon growers operating in phosphorus-limited soils such as those in Samarkand, applying 100 kg/ha of phosphorus during early vegetative growth offers the best approach to enhance both market quality and reduce post-harvest losses. This finding can serve as a practical recommendation for sustainable melon production in arid regions.

REFERENCES:

1. Marschner, P. (2012). Marschner’s Mineral Nutrition of Higher Plants (3rd ed.). Academic Press. Core reference on phosphorus function and nutrient physiology in plants.
2. Turan, M. A., Ketterings, Q. M., & Gunes, A. (2010). Phosphorus application and melon yield in phosphorus-deficient soils. Scientia Horticulturae, 126(2), 178–181.

3. Isokov Y. et al. Effects of aviation kerosene contents on the environment and method of its cleansing //E3S Web of Conferences. – EDP Sciences, 2021. – Т. 264. – С. 01036.

4. Yildirim, E., Karlidag, H., & Turan, M. (2021). Timing of phosphorus application and its effects on cucurbit fruit quality. Journal of Plant Nutrition, 44(5), 707–718.

5. XORIDDINOVICH I. Y., NORMAKHMAT Y. Determination of the Adoption Characteristiscs of Activated Carbon on the Basis of Nut Seeds //International Journal of Innovations in Engineering Research and Technology. – Т. 7. – №. 4. – С. 1-5.

6. Buriev, H. Ch., & Dosmuratova, S. I. (2000). The role of mineral fertilizers in melon physiology and yield. Uzbekistan Agricultural Bulletin, 1(4), 35–39.

7. Xayrullo o'g P. U. et al. Using natural plant extracts as acid-base indicators and pKa value calculation method //fan va ta'lim integratsiyasi (integration of science and education). – 2024. – Т. 1. – №. 3. – С. 80-85.

8. Исоков Ю. Х., Ёдгоров Н., Юсупов Ф. М. Разработка и исследования сорбционного способа очистки воды //инновационные подходы в современной науке. – 2019. – С. 130-133.

9. Бобожонов Ж. Ш., Шукуров Ж. С., Тогашаров А. С. Растворимость системы тетракарбамидохлората кальция-ацетат аммония-вода //Universum: технические науки. – 2022. – №. 4-8 (97). – С. 30-33.

10. Shukurov Z. S. et al. Component Solubilities in the Acetic Acid–Monoethanolamine–Water System //Russian Journal of Inorganic Chemistry. – 2021. – Т. 66. – С. 902-908.

11. Khoriddinovich I. Y. et al. Purification of spent methyldiethanolamine solutions with activated carbon au-ko. – 2023.

12. Karimov, N., Rakhmatov, O., & Akbarov, S. (2018). Soil phosphorus dynamics in arid zones of Central Asia. Agrochemical Journal of Uzbekistan, 3(11), 21–27.

13. Xayrullo o‘g, P. U. B. (2025). Investigation of the repellent activity against ixodid ticks based on the structural and physicochemical properties of dibutyl adipate. Tanqidiy nazar, tahliliy tafakkur va innovatsion g‘oyalar, 2(1), 265-273.

14. Xayrullo o‘g, P. U. B. (2025, June). Chemical analysis-based assessment of the herbicidal efficiency of azido-substituted triazines. In conference of advance science & emerging technologies (Vol. 1, No. 2, pp. 53-62).

15. FAO. (2017). Soil fertility management in dryland horticulture. Food and Agriculture Organization of the United Nations.

16. Xayrullo o'g P. U. et al. The essence of the research of synthesis of natural indicators, studying their composition and dividing them into classes //fan va ta'lim integratsiyasi (integration of science and education). – 2024. – Т. 1. – №. 3. – С. 50-55.

17. Yusuf I. et al. Development of termochemical carbon adsorbents based on fruit seeds and application in sorption of rare metals //Universum: технические науки. – 2022. – №. 10-7 (103). – С. 4-8.

18. Nurmonova E., Berdimuratova B., Pardayev U. Davriy sistemaning iii a guruhi elementi alyuminiyning davriy sistemada tutgan o ‘rni va fizik-kimyoviy xossalarini tadqiq etish //Modern Science and Research. – 2024. – Т. 3. – №. 10. – С. 517-526.

19. Khusanov E. S. et al. Solubility of Components in the Acetic Acid–Triethanolamine–Water System //Russian Journal of Inorganic Chemistry. – 2023. Т. 68. №. 11.С. 1674-1680.

20. Jiemuratova A., Pardayev U., Bobojonov j.coordination interaction between anthranilic ligand and d-element salts during crystal formation: a structural and spectroscopic approach //Modern Science and Research. – 2025. – Т. 4. – №. 5. – С. 199-201.

21. БОБОЖОНОВ Ж. Ш. и др. ИЗУЧЕНИЕ РАСТВОРИМОСТИ СИСТЕМЫ CH3COOH-NH 3-H 2 O //Uzbek Chemical Journal/O'Zbekiston Kimyo Jurnali.2022. – №. 3.

22. Tursunov, M. M. (2022). Influence of macro-element nutrition on fruit storability in cucurbits. Journal of Central Asian Agro-Sciences, 4(1), 55–62.