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THE EFFECT OF STORAGE TEMPERATURE ON THE FLOWERING AND MARKETING LIFE OF ROSE FLOWERS TREATED WITH ORGANIC AND BIOFERTILIZERS

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ABSTRACT

The research was conducted in the Care and Storage Laboratory, Department of Horticulture and Garden Engineering at the College of Agricultural Engineering Sciences- University of Baghdad, Jadriyah, during the growing season 2022-2023 to determine the effect of storage temperature on the flowering and Vase life of rose flowers treated with organic and bio-fertilizers. The experiment was conducted after completing all measurements related to both vegetative and flowering growth. Flowers were harvested at the half-open bud stage (when 3 of the sepals leaves are open), which is the appropriate stage for harvesting flowers. The flowers were placed in similar containers with equal volumes of distilled water supplemented with 5 gl^{-1} an aspirin tablet containing the active substance salicylic acid. The containers were stored for 5 days in refrigerators at a temperature of ±4°C and then continued storage at room temperature until the end of the vase life. The average results for the treatments showed that treatment T5 gave the highest relative fresh weight and water uptake rate at 110.1% and 3.647 g per stem per day, respectively. Treatment T14 showed the lowest water loss rate at 2.44 g stem^{-1} day^{-1}, followed by treatments T7 and T30. Treatment T6 showed the highest vase life for stored flowers at 12.33 days, followed by treatments T23 and T14. The control treatment had the lowest values for all treatments included in the study.

Keywords: Bio-fertilization, flower storage, vase life.

[*] **This article is taken from the doctoral dissertation of the first researcher.**

تأثير درجة حرارة الخزن في العمر المزهري والتسويقي لازهار الورد الجوري المعامل بالأسمدة العضوية والحيوية

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الخلاصة

نفذ البحث في مختبر العناية والخزن التابع لقسم البستنة وهندسة الحدائق في كلية علوم الهندسة الزراعية – جامعة بغداد. الجادرية خلال الموسم الزراعي للعام 2022 - 2023 لمعرفة تأثير درجة حرارة الخزن في العمر المزهري والتسويقي لأزهار الورد الجوري المعامل بالأسمدة العضوية والحيوية، اجريت التجربة الخزنية بعد الانتهاء من اخذ كافة القياسات الخاصة بكل من النمو الخضري والزهري قطفت الازهار في مرحلة البرعم نصف المتفتح (عند تفتح 3 من الأوراق الكاسية) وهي المرحلة المناسبة لقطف الازهار. ووضعت الازهار في اواني متشابهة وبحجم متساوي من الماء المقطر مضاف اليه 5غم لتر$^{-1}$ سكر ونصف قرص من الاسبرين . انية$^{-1}$ الذي يحتوي على المادة الفعالة حامض السالسيلك وخزنت لمدة (5) يوم في البرادات الموجودة في المختبر على درجه حرارة (4±) ومن ثم أكمل مدة الخزن في جو الغرفة لحين انتهاء العمر المزهري. وأظهرت متوسط النتائج للمعاملات حيث أعطت المعاملة T5 اعلى معدل للوزن الطري النسبي والماء الممتص بمعدل 110.1% , 3.647 غم ساق زهري$^{-1}$ يوم$^{-1}$ وأعطت المعاملة T14 اقل ماء مفقود 2.44 غم ساق زهري$^{-1}$ يوم$^{-1}$ تليها المعاملة T7, T30 والتوازن المائي أعطت اعلى معدل للمعاملة T7, T30 على التوالي واعطت المعاملة T6 اعلى عمر مزهري للإزهار المخزونة بمعدل 12.33 يوم تليها المعاملات الأخرى T23 , T14 وكانت معاملة المقارنة اقل القيم لجميع المعاملات الداخلة في الدراسة.

الكلمات المفتاحية: التسميد الحيوي، خزن الازهار، العمر المزهري.

INTRODUCTION

Flower cultivation has become one of the most common strategies in the horticulture sector in recent years. The international trade of cut flowers has expanded, and it is expected to increase with promotion and application in various industries due to the wonderful nature of cut flowers and their popularity among people worldwide. However, the short vase life of cut flowers creates a problem in maintaining their shape and quality **(Al-Miyah, 2001).**

The post-harvest period for cut flowers is of utmost importance in determining their value in the market. Additionally, marketing cut flowers with a short vase life without quality loss is challenging. Therefore, it is highly important to maintain the quality of cut flowers and increase their vase life. One of the primary factors determining their vase life is water stress **(Bayat & Aminifard, 2017)**.

Cut flowers are commercial products in the floriculture industry and They are among the most demanded flowers by consumers worldwide due to their aesthetic appeal, diverse forms, and captivating fragrances **(Gun & Ozturk, 2019).** There is increasing interest in ornamental flowers day by day, driven by sectoral developments and increased purchasing power of consumers. One of the significant factors leading to the rapid deterioration of flowers is the presence of microorganisms and living organisms that proliferate in the vase water. These organisms can clog the flower's vascular bundles, leading to water loss and increased respiration in the flowers, ultimately shortening their vase life. The wilting of flowers due to water loss in the cells marks the end of their vase life **(Vinodh *et al.*, 2013).**

The rose (*Rosa* damascena*is* Mill.) a shrub or climbing plant belonging to the Rosaceae family. It grows all over the world and is cultivated for the beauty of its flowers, which adorn gardens with vibrant colors. Roses are planted as flowering shrubs, ornamental hedges, in flowerbeds, or for economic purposes such as cut flower production and perfume making **(Gun & Ozturk, 2019).** Roses are suitable for floral arrangements due to the variety of their colors, the beauty of their blooms, their large size, diameter, and long necks, provided they are properly cared for and preserved in vases **(Al-Sultan *et al.*, 1992).** They are also suitable for long-distance shipping without affecting their shape or color **(Vinodh *et al.*, 2013).** Rose flowers are distributed in a limited cluster or individually at the end of the stem. Rose varieties are characterized by their variety of colors and shapes, including white, yellow, red, and multicolored varieties. They are also distinguished by the abundance of their petals, which can reach up to 40 petals in a single flower **(Wissemann & Ritz, 2007).** The vase life of most rose varieties is up to 12 days. In addition to their ornamental value, roses have other medical and aromatic uses. The production and marketing of flowers have evolved, with ornamental plants bearing cut flowers becoming a significant and widespread trade worldwide. The high export value of cut flowers has increased their production, especially in many developing countries, where they are extensively used in various religious, social, and official occasions **(Alwan & Sadiq, 2019).**

Several factors must be taken into consideration, such as consumer taste, which is the primary factor influencing flower demand, flowering season, growth conditions, stem length, and vase life **(Abdullah *et al.*, 2020; Yue & Hall, 2010).** Vase life depends on genetic makeup and pre- and post-harvest conditions **(Ghazi *et al.*, 2022).** Furthermore, the production of cut flowers and ornamental plants prepared for export has become an industry requiring expertise and the use of the latest technological means. It also requires a high level of specialization in cut flower production, accompanied by an effective marketing system that recognizes the desires and needs of importers and balances them with the preference and capabilities of exporters **(Ratib & Qasim, 2015).** Rose flowers are harvested at the stage of half-open buds, during which the amount of soluble carbohydrates is good, and their production of ethylene, known as the aging hormone, is low. Therefore, their vase life is relatively average. They consume large amounts of stored carbohydrates inside them, and when the flowers open, the production of ethylene increases. Usually, preventive measures are taken to slow down this process and preserve the vitality of the flowers. The effective way to retain glucose and other carbohydrates inside the rose stems is through the process of "pulsing" or "rehydration." Pulsing involves immersing the cut rose stems in special solutions, usually based on sugar, where the plant roots placed in these solutions absorb sufficient amounts of carbohydrates to preserve the flowers. Consequently, this prevents their loss of coordination, wilting, petal shedding, and ultimately, the end of their vase life **(Elgimabi, 2011)**. Like all other living organisms, flowers undergo respiration, which generates heat. The retention of this metabolic heat is linked to the rapid aging of cut flowers. Although ambient heat can be easily dissipated in most outdoor locations, storing flowers in tightly sealed boxes accelerates their aging rate. This decrease in lifespan is attributed to the non-dissipated thermal energy retained around the flowers. As a result, the flowers respire faster, generate more heat, and consequently age more quickly. To avoid storing flowers in a hot and damaging environment, flower sellers should consider cooling systems for flower storage. Flower coolers can help maintain ambient temperatures within acceptable ranges in flower storage units, thus ensuring that the flowers remain fresh for longer periods. Additionally, treating plants or flowers with substances before storage can extend their vase life.

In order to improve plant growth and development, plants have been cultivated in organic media such as peat, sugarcane bagasse, and rice husks. These various media contain many substances that can have a direct or indirect effect on plant growth and development. They allow for better nutrient absorption and sufficient growth and development to improve water and oxygen retention. Improving the biological properties of the soil also enhances microbial diversity, thereby creating a suitable environment for plant root growth and soil organisms **(Ghehsareh, 2013; Alwan *et al.*, (2023)** found that cultivating gerbera plants in an organic substrate, such as peat, resulted in a significant improvement in most vegetative and flowering growth characteristics. Additionally, they observed positive effects on the vase life of gerbera flowers, which reached 14.22 days compared to the control plants, which had a vase life of 10.33 days. Furthermore, using various forms of organic materials as partial substitutes for mineral fertilizers and fulfilling the plant's needs contributed to these positive effects **(Manea *et al.*, 2019; Shaker & Abdul Rasool 2023)** concluded that the use of organic fertilizers increased the growth and yield characteristics of potato plants. However, in recent years, biological fertilization has emerged in modern agriculture to enhance agricultural productivity and compensate for soil nutrient deficiencies. Nevertheless, the excessive and indiscriminate use of chemical fertilizers can cause damage and catastrophic consequences to the soil itself, as well as to the atmospheric and environmental surroundings **(Moustafa, 2018). Sadiq & Abdullatif (2023)** found that treating lily flowers with organic fertilizers resulted in a significant increase in vegetative and flowering characteristics of the plant, thereby increasing the vase life of flowers. The vase life reached 22.00 days compared to control plants, which had a vase life of 16.00 days. **Al Rubaye *et al.*, (2019)** found that using liquid organic fertilizer at half the recommended rate was sufficient to achieve optimal nitrogen and phosphorus uptake in the plant's biomass. Therefore, the study aimed to understand the effect of storage temperature on the vase life of cut roses treated with organic and biological fertilizers. Additionally, it aimed to encourage preserving the flowers for the longest possible period and minimizing losses resulting from unstructured storage, based on scientific studies.

MATERIALS AND METHODS

The study included a storage experiment conducted at the Care and Storage Laboratory, Department of Horticulture and Landscape Engineering at the College of Agricultural Engineering Sciences, University of Baghdad, Al-Jadriyah, during the growing season of 2022-2023. The aim was to determine the effect of storage temperature on the vase life of roses treated with organic and biological fertilizers. The storage experiment was conducted after completing all measurements related to both vegetative and flowering growth. The flowers were harvested at the stage of half-opened buds (when three sepals were open), which is the appropriate stage for harvesting flowers. The flowers were placed in similar containers with equal volumes of distilled water supplemented with 1% sucrose and half a tablet of aspirin per liter, which contains the active substance salicylic acid **(Al-Sultan *et al.*, 1992).** They were stored for 5 days in refrigerators at the Care and Storage Laboratory, with a temperature of approximately ±4°C. Then, the storage continued in room temperature conditions, and the calculation of vase life began until reaching the end of vase life (i.e., wilting stage)such as Signs of wilting appear at the end of the vase life, the shape of the flower is unacceptable, and the stem becomes curved**(Elgimabi &Ahmed 2009).**

The field experiment treatments included multiple factors before flowers were subjected to storage. The first factor was the hybrids, represented by roses of the "Brighton" and "Pink Martini". The second factor was the organic medium, consisting of: the control treatment (B0) using only field soil, treatment B1 and B2 with a mixture of field soil and rice husks (2, 4 kg m^{-2}, and treatment B3 and B4 with a mixture of field soil and sugarcane bagasse. Each treatment involved planting flowers on a standardized area (1m²) with a rate of 2, and 4 kilograms of organic materials per square meter. The third factor was biofertilization, comprising two treatments: treatment C1 involved soaking the plant roots in a solution containing *Azospirillum* before planting, while *Trichoderma* (C2) was added to the soil at a rate of 75g before planting. In addition to control treatment (C0). The planting was conducted according to the experimental design Analysis of the collective variation RCBD, resulting in a total of 30 treatments in the field experiment (5 * 3 * 2). Each treatment was replicated three times, and there were four plants for each treatment in each replication. Therefore, the total number of plants was 360. All plant care operations, including watering, fertilization, and pest control, were carried out. The studied traits in the storage experiment were:

1. Relative fresh weight of the flower stem (%)
2. Water absorbed (g flower stem $^{-1}$ day $^{-1}$)
3. Water loss (g flower stem $^{-1}$ day $^{-1}$)
4. Water balance (g flower stem $^{-1}$ day $^{-1}$)
5. Vase life.

Statistical analysis

The statistical analysis was conducted using a randomized complete block design (RCBD) with three replications. The first factor included two levels of storage conditions: room temperature storage (S1) and refrigerated storage (S2). The second factor included the combined treatments (interactions) involving the hybrids and organic and biological amendments and their effects on the vase life of the flowers after harvesting from the field (treatment), totaling 30 combination treatments. Data were analyzed using the GenStat statistical software, and means were compared using the least significant difference (LSD) test at a significance level of 0.05% **(Al-Rawi & Khalafallah, 2000).**

RESULTS AND DISCUSSION

1. Relative fresh weight of the flower stem

The results indicate that there were no significant differences between the storage types for the harvested rose flowers regarding the relative fresh weight percentage when stored at room temperature or in refrigerated conditions (Table 1). The storage at room temperature resulted in the highest average relative fresh weight percentage of 101.35%, followed by refrigerated storage at 99.51%. However, there were significant differences among the treatments, with treatment T5 showing the highest relative fresh weight percentage at 110.12%, followed by treatments T24 and T25 at 107.37% and 105.97%, respectively. The other treatments followed with lower percentages, while the control treatment showed the lowest relative fresh weight percentage at 86.25%.

Regarding the two-way interaction between treatments and storage types, significant differences were observed. Treatment S1T5 showed the highest relative fresh weight percentage at 118.33% when the flowers were stored at room temperature, followed by treatment S2T24. Conversely, treatment S1T23 had a relative fresh weight percentage of 113.80% when the flowers were stored in refrigerated conditions. The control treatments (S2T1 and S1T1) showed the lowest relative fresh weight percentages at 86.08% and 86.42%, respectively.

From Table (1), we observe that the increase in the relative fresh weight percentage of the rose stem may be attributed to an increase in the absorbed water by the stem, a decrease in the lost water, and an increase in water balance. The reason behind this could be the field treatments and their effects on the cultivated plants. The use of organic fertilizers and biological fertilization may lead to an increase in the stem thickness, flower size, and carbohydrate content, consequently lengthening the flowering period. The use of organic fertilizers has been shown to have a positive effect on increasing the thickness of the epidermis, cortex, and cambium layer of the plant, which significantly affects growth and yield characteristics **(Al-Hlfie & Hussein, 2024).** Additionally, the addition of organic fertilizers with biological fertilizers had a significant effect on all studied vegetative and yield characteristics **(Al-Silmawy& Abdul- Ratha, 2023).**

Table (1): Effect of storage temperature on the percentage of relative fresh weight of the flower stem on roses treated with organic and biofertilizers.

Field treatments	**Storage type**		**Treatment mean**
	S1	**S2**	
T1	86.42	86.08	86.25
T2	95.75	98.06	96.90
T3	95.42	96.30	95.86
T4	108.92	99.13	104.03
T5	118.33	101.92	110.12
T6	106.82	97.33	102.08
T7	104.36	102.05	103.21

T8	107.67	100.18	103.92
T9	110.33	100.13	105.23
T10	96.25	95.79	96.02
T11	107.74	101.92	104.83
T12	108.49	99.71	104.1
T13	100.11	96.25	98.18
T14	100.7	103.3	102.0
T15	110.31	98.28	104.3
T16	88.27	94.31	91.29
T17	93.55	96.03	94.79
T18	97.60	100.54	99.07
T19	100.46	101.85	101.15
T20	106.28	95.47	100.87
T21	96.79	97.46	97.12
T22	93.62	98.14	95.88
T23	113.8	98.03	105.91
T24	100.55	114.2	107.37
T25	111.25	100.7	105.97
T26	99.40	100.1	99.75
T27	94.85	102.24	98.54
T28	93.94	97.69	95.82
T29	98.27	107.29	102.78
T30	94.16	104.67	99.42
LSD 0.05	12.205		**LSD 0.05** T 8.631
Mean Storage	101.35	99.51	
LSD 0.05 S	N.S		

S1: Storage at room temperature, S2: Storage in the refrigerator

2. Water absorbed (g flower stem $^{-1}$ day $^{-1}$)

The results presented in Table (2) indicate that harvested flowers significantly differed in the amount of absorbed water during their flowering period when stored at different temperatures. We observe that flowers stored in the refrigerator had a superior amount of absorbed water, yielding the highest rate of 3.530 g floral stem^{-1} day^{-1}. In contrast, storage at room temperature yielded a rate of 2.350 g floral stem^{-1} day^{-1}. There were significant differences among the treatments within storage conditions, with T5 showing the highest rate of absorbed water at 3.647 g floral stem^{-1} day^{-1}, which was not significantly different from T22 at 3.616 g floral stem^{-1} day^{-1}. Following these treatments were the others, with the control treatment showing the lowest rate of absorbed water at 1.775 g floral stem^{-1} day^{-1}. The interaction between treatments and storage types was not significant. The highest rate of water absorption was observed in the refrigerated storage for the treatment S2 T5, yielding the highest rate at 4.630 g floral stem^{-1} day^{-1}. This was followed by treatment combinations S2 T22 and S1 T22, with rates of 4.360 and 2.880 g floral stem^{-1} day^{-1}, respectively. The control treatment S1 T1 showed the lowest rate of water absorption among the treatments, at 1.200 g floral stem^{-1} day^{-1}. From the same table, it is noted that the clogging of xylem vessels due to the presence of microorganisms, especially bacteria and fungi growing in storage solutions or water, has a negative effect on the longevity of harvested flowers. Microbes can also produce ethylene and secrete toxic compounds, leading to accelerated aging of many flowers **(Alaey *et al.*, 2011; Reid & Wu, 1992).**

Table (2): Effect of storage temperature on the percentage of relative fresh weight of the flower stem on roses treated with organic and biofertilizers**.**

Field treatments	Storage type		Treatment mean	
	S1	S2		
T1	1.200	2.350	1.775	
T2	2.180	3.490	2.835	
T3	2.240	4.010	3.124	
T4	2.610	3.820	3.216	
T5	2.660	4.630	3.647	
T6	2.700	4.050	3.374	
T7	2.430	3.460	2.946	
T8	2.810	3.610	3.21	
T9	2.500	3.010	2.751	
T10	2.740	3.680	3.211	
T11	2.050	3.300	2.678	
T12	2.410	2.600	2.505	
T13	2.440	2.340	2.389	
T14	1.930	2.970	2.45	
T15	3.110	3.230	3.172	
T16	1.410	3.280	2.344	
T17	2.060	3.400	2.729	
T18	2.130	3.270	2.698	
T19	2.620	4.140	3.38	
T20	2.320	3.610	2.963	
T21	2.020	2.980	2.497	
T22	2.880	4.360	3.616	
T23	2.280	3.390	2.836	
T24	2.200	3.730	2.968	
T25	2.110	4.160	3.136	
T26	2.660	3.850	3.256	
T27	2.230	3.660	2.945	
T28	2.280	3.890	3.084	
T29	2.380	3.920	3.152	
T30	2.790	3.560	3.176	
LSD 0.05	1.209		LSD 0.05 T	0.855
Mean Storage	2.350	3.530		
LSD 0.05 S	0.368			

S1: Storage at room temperature, S2: Storage in the refrigerator

3. Water loss (g flower stem $^{-1}$ day $^{-1}$)

The result in Table 3 indicates significant differences in storage types, with flowers stored in room temperature (S1) showing the lowest rate of water loss at 2.796 g flower stem^{-1} day^{-1}, while refrigerated storage (S2) resulted in the highest rate of water loss at 4.013 g flower stem^{-1} day^{-1}. Regarding the effect of treatments, significant differences were observed, with treatment T14 showing the lowest rate of water loss at 2.438 g flower stem^{-1} day^{-1}, followed by treatments T7 and T13 at rates of 2.670 and 2.714 g flower stem^{-1} day^{-1}, respectively. Control treatments T1 and T16 exhibited the highest rate of water absorption at 4.32 for both treatments. Moreover, the interaction between storage types and treatments showed significant differences, with the interaction S1T14 outperforming other interactions, resulting in the lowest rate of water loss at 1.951 g flower stem^{-1} day^{-1}, followed by the interaction S1T25 with a water loss rate of 1.975 g flower stem^{-1} day^{-1}. The control treatment exhibited the highest water loss at 4. g flower stem^{-1} day^{-1}.

Table (3): Effect of storage temperature on water loss (gm of flower stem^{-1} day^{-1}) on roses treated with organic and biofertilizers.

Field treatments	Storage type		Treatment mean	
	S1	S2		
T1	3.667	4.967	4.317	
T2	2.975	4.749	3.862	
T3	3.388	4.744	4.066	
T4	2.800	4.330	3.565	
T5	2.399	5.203	3.801	
T6	2.228	4.243	3.236	
T7	2.411	2.930	2.670	
T8	3.258	3.588	3.423	
T9	2.779	2.830	2.805	
T10	3.195	4.303	3.749	
T11	2.169	3.830	3.000	
T12	2.394	3.276	2.835	
T13	2.271	3.157	2.714	
T14	1.951	2.925	2.438	
T15	2.715	3.943	3.329	
T16	4.053	4.587	4.320	
T17	2.747	4.243	3.495	
T18	3.753	4.337	4.045	
T19	2.915	4.738	3.826	
T20	2.581	4.669	3.625	
T21	2.273	4.061	3.167	
T22	3.312	3.912	3.612	
T23	2.149	3.548	2.849	
T24	2.566	3.757	3.162	
T25	1.975	4.967	3.471	
T26	2.959	4.649	3.804	
T27	2.781	4.364	3.573	
T28	2.895	4.693	3.794	
T29	2.801	2.833	2.817	
T30	3.521	2.000	2.761	
LSD 0.05	1.238		**LSD 0.05** T	0.875
Mean Storage	2.796	4.013		
LSD 0.05 S	0.258			

S1: Storage at room temperature, S2: Storage in the refrigerator

The decrease in water in the flower stems is due to lower water absorption compared to transpiration rates, resulting in low water balance. This is associated with reduced water uptake and high loss in flower storage vessels **(Van Doorn, 1997; Ali & AbdulLatif (2024)** found that using the interaction between organic fertilizers and biological fertilization had a significant effect on the vegetative and floral growth traits and flowering period of tuberose plants. Perhaps the reason for this is the role of the interaction between organic matter and biological fertilization in creating a suitable environment for the roots and providing the necessary nutrients for plant growth, consequently positively affecting its floral traits. This aligns with the findings of **Al-Obaid &Abdul-Ratha (2021)** when using vermicompost organic medium with biological fertilization, which showed significant differences compared to the control treatment.

4. Water balance (g flower stem $^{-1}$ day $^{-1}$)

The results indicate that the type of storage for cut flowers had an effect on water balance (Table 4). Treatment S1 showed the highest water balance rate at -0.61 gm flower stem^{-1} day^{-1}, while treatment S2 showed the lowest rate at -0.22 gm flower stem^{-1} day^{-1}. Regarding the effects of treatments, it is observed that treatment T30 and treatment T29 had the highest water balance rate at (0.42 and 0.33) gm flower stem^{-1} day^{-1}, respectively. Meanwhile, treatment T1 and treatment T16 showed the lowest water balance rate at (-2.54 and -1.98) gm flower stem^{-1} day^{-1}, respectively.

The results indicate that the interaction between the types of storage and treatments was significant, with treatments S2T30 and S2T29 showing the highest water balance rate at (1.56, 1.09) gm flower stem^{-1} day^{-1}, respectively. While, the control treatments S1T1, S1T16, and S2T1 showed the lowest water balance rate at (-2.47, 2.64, 2.16) gm flower stem^{-1} day^{-1}, respectively.

The reason for the decrease in water balance is the increase in water loss at the expense of water absorption, resulting in decreased water balance. When flowers are placed in water during storage, fungi in the flower stem underwater can clog the stem and reduce water absorption, thus decreasing the vase life of cut flowers **(Alaey *et al.*, 2011).** Adding organic matter to the soil, whether plant-based or animal-based, improves the physical and chemical properties of the soil and provides nutrients, which reflects on production. This is consistent with the findings of **Al-bayat & Al-Juboori (2023),** where the use of organic fertilizers had a significant effect on growth and yield properties, indicating that organic fertilizers play a role in providing nutrients to plant roots and therefore affect the studied traits.
Furthermore, the use of *Azospirillum* as a biofertilizer not only enhances plant growth but also acts as a biological controller, leading to better growth and improved yield **(Cruz-Hernández *et al.*, 2022).**

Table (4): Effect of storage temperature on the water balance (gm of flower stem^{-1} day^{-1}) on roses treated with organic and biofertilizers.

Field treatments	Storage type		Treatment mean	
	S1	S2		
T1	-2.47	-2.614	-2.542	
T2	-0.796	-1.257	-1.027	
T3	-1.152	-0.732	-0.942	
T4	-0.189	-0.51	-0.349	
T5	0.261	-0.568	-0.154	
T6	0.472	-0.196	0.138	
T7	0.016	0.534	0.275	
T8	-0.451	0.026	-0.213	
T9	-0.284	0.176	-0.054	
T10	-0.456	-0.621	-0.539	
T11	-0.118	-0.525	-0.321	
T12	0.013	-0.674	-0.331	
T13	0.167	-0.816	-0.325	
T14	-0.017	0.042	0.012	
T15	0.396	-0.71	-0.157	
T16	-2.643	-1.308	-1.975	
T17	-0.684	-0.848	-0.766	
T18	-1.627	-1.068	-1.348	
T19	-0.295	-0.597	-0.446	
T20	-0.263	-1.06	-0.662	
T21	-0.253	-1.086	-0.669	
T22	-0.435	0.444	0.005	
T23	0.133	-0.158	-0.013	
T24	-0.361	-0.025	-0.193	
T25	0.135	-0.806	-0.335	
T26	-0.301	-0.796	-0.548	
T27	-0.549	-0.706	-0.627	
T28	-0.62	-0.8	-0.71	
T29	-0.417	1.087	0.335	
T30	-0.727	1.557	0.415	
LSD 0.05	1.143		**LSD 0.05** T	0.808
Mean Storage	-0.451	-0.487		
LSD 0.05 S	N.S			

S1: Storage at room temperature, S2: Storage in the refrigerator

5. vase life (days) of rose flowers

The results revealed that storage in room temperature gave the highest number of days for the vase life (12.10 days), while the storage in the refrigerator recorded the lowest vase life of 9.04 days (Table 5). The treatments in the experiment had a significant effect, with treatments T6 and T23 showing superiority with the highest vase life for stored flowers at (12.33, 12.17) days respectively. This was followed by treatments T14 and T15, with a vase life of 11.83 days for both treatments. Control treatments T1 and T16 showed the lowest vase life for stored flowers for both storage methods.

Regarding the interaction between storage methods and treatments, we notice that the vase life is superior for the storage method in room temperature (S1) for the combination S1T6, S1T11, and S1T15, with a vase life of 13.67 days. This was followed by treatment S1T14 and S1T24 with a vase life of 13.33, 13.00 days respectively. While the control treatment for storage methods S1T1 and S2T1 showed a vase life of 9.00, 7.00 days respectively, and the interaction S2T16, S1T2showed a vase life of 8.67, 6.67 days respectively.

Table (5): Effect of storage temperature on vase life (days) on roses treated with organic and biofertilizers.

Field treatments	**Storage type**		**Treatment mean**	
	S1	**S2**		
T1	9.00	7.00	8.00	
T2	12.00	9.00	10.50	
T3	11.33	7.67	9.50	
T4	12.00	9.00	10.50	
T5	12.67	9.53	11.10	
T6	13.67	11.00	12.33	
T7	11.00	8.00	9.50	
T8	12.67	10.33	11.50	
T9	12.67	10.00	11.33	
T10	11.00	8.33	9.67	
T11	13.67	9.33	11.50	
T12	12.67	9.67	11.17	
T13	12.00	8.67	10.33	
T14	13.33	10.33	11.83	
T15	13.67	10.00	11.83	
T16	8.67	6.67	7.67	
T17	12.33	8.00	10.17	
T18	10.33	7.00	8.67	
T19	12.33	9.67	11.00	
T20	12.67	9.67	11.17	
T21	11.67	9.33	10.50	
T22	11.33	8.33	9.83	
T23	14.33	10.00	12.17	
T24	13.00	10.00	11.50	
T25	11.67	8.67	10.17	
T26	13.33	9.33	11.33	
T27	12.33	9.33	10.83	
T28	10.33	7.33	8.83	
T29	12.67	9.67	11.17	
T30	12.67	10.33	11.50	
LSD 0.05	1.522		**LSD 0.05** T	1.076
Mean Storage	12.10	9.04		
LSD 0.05 S	0.221			

S1: Storage at room temperature, S2: Storage in the refrigerator

The results in the above tables indicate that the effects of organic and biological fertilization treatments varied from one treatment to another, thus positively impacting the increase in vase life for stored flowers in room temperature and also in cold storage. It is noticeable that the relative fresh weight of the flower stems, absorbed water, water balance, and vase life decreased significantly as the vase life of stored flowers progressed for both storage types. This is contrary to the lost water, which increased as the vase life of stored flowers progressed. The results in Table 5 indicated that the vase life increased compared to other treatments when planting rose variety A1 in 2 kg of organic matter from rice husks treated with *Azospirillum* bacteria, giving the longest vase life compared to other treatments. Perhaps the reason for this is the increase in its relative fresh weight as shown in Table 1; the loss of water was minimal, leading to an increase in its vase life. The vegetative growth traits played a role in this, as there was an increase in plant leaf area when treated with Tulip *Azospirillum* bacteria. This increase in leaf area enhances the plant's photosynthetic rate, thus benefiting the flowers **(Abood, 2017).** The control treatment in Table 5 had the shortest vase life, and one of the influencing factors is the clogging of xylem vessels due to the effects of microorganisms, especially bacteria and fungi, which grow in preservative solutions, negatively affecting the vase life of cut flowers. Additionally, the increased water loss, as seen in Table 3, can be attributed to microbial production of ethylene and secretion of toxic compounds, leading to flower senescence. Ethylene accelerates the aging process in many flowers **(Reid & Wu, 1992).** Many experiments have been conducted using preservative solutions for cut flowers to prolong their vase life and improve water uptake **(Lu *et al.*, 2010).**

CONCLUSIONS

We conclude that hybrid A1 exhibited superior performance in most of the studied traits, consequently showing higher vase life when stored directly in room conditions compared to hybrid A2. Regarding the impact of organic media, the organic medium composed of 2 kg of rice husks showed the highest number of days for flowers to remain fresh, followed by the organic medium of sugarcane bagasse residues (4 kg). Biological fertilization also played a significant role in increasing the flowering longevity, with the treatment of plants with *Trichoderma* showing significant superiority when treated with *Azospirillum*. The interaction of the three factors, treatment A1 with 2 kg of rice husks and treatment with Trichoderma or Azospirillum showed significant differences in vegetative, flowering, and vase life traits for the flowers.

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