

EFFECT OF ORGANIC MEDIA AND BIOLOGICAL FERTILIZATION ON THE VEGETATIVE AND FLORAL GROWTH AND SOME QUALITATIVE TRAITS OF TWO ROSE HYBRIDS.

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ABSTRACT

The study was conducted to study the impact of rice straw and sugarcane bagasse residues, as well as biofertilization (*Azospirillum* and *Trichoderma*), on the growth, flowering, and quality of two hybrids of roses. The experiment included three main factors: the varieties (Pink-Martini and Brighton), five organic media factors including rice straw at two levels (2 and 4 kg/m², sugarcane bagasse residues at two levels (2 and 4 kg/m²), in addition to a control treatment without additives. The third factor represented biofertilization by adding *Azospirillum* and *Trichoderma*. The results indicated that the applied treatments led to better results in most of the studied characteristics. Overall, the results showed that using rice straw or sugarcane bagasse residues as a source of organic fertilizers, along with biofertilization, improved the growth, flowering, and quality of roses. The results also showed that the triple interaction between the treatments exhibited superiority, with treatment A2B1C1 showing the highest percentage of phosphorus (0.38%), flower count (11.25 flowers per plant), and treatment A2B1C2 in the floral stem diameter and its longevity on the plant (3.57 cm² and 28.33 days). The study recommends the use of the Brighton hybrid with 4 kg of rice straw and biofertilizer (*Azospirillum*) to achieve optimal overall growth, flowering, and quality. This combination yielded the best results in the study.

Keywords: biofertilizer, Rice husk residues, Rose plant, Sugarcane bagasse residues

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INTRODUCTION

Rose shrubs are among the most widely spread flowering shrubs in private and public gardens in Iraq. No garden is without one or more types of rose shrubs. They are characterized by their hybrid of flower colors, their suitability for harvesting, and the fragrant scent of the flowers of some species. The ability of rose shrubs to withstand high temperatures during the summer has contributed to the success of their cultivation in different regions of Iraq (Muhammad & et al. 2010). Rose flowers are very desirable for their light weight when exporting and for their ease of production. The flowers are of many colors and shapes and

have a fragrant scent in many varieties (Al-Chalabi, & Al-Khayyat. 2013). Many civilizations have integrated flowers into their daily lives as an expression of beauty and art. Since ancient times, flowers have been used for decoration and celebrating significant events. Anderson (Anderson, 2006) stated that economically valuable flowering plants are cultivated to benefit from their harvest flowers for floral arrangements, bouquets, or displays. The process of flower production and marketing has evolved, turning the cultivation of ornamental plants with harvestable flowers into a significant and widespread global trade. The high export value of harvest flowers has

increased production. This is particularly notable in many developing countries, where the use of these flowers has become extensive in various religious, social, and official occasions (Alwan, & Mahmad. 2019). Increasing production and improving the quality of flowers can be achieved through the use of organic and bio fertilizers. Microorganisms present in bio fertilizers work to restore the natural nutrient cycle of the soil and build organic matter. By using bio fertilizers, healthy plants can be cultivated, promoting soil sustainability and health. It is expected that the use of bio fertilizers will reduce the reliance on chemical fertilizers and pesticides. Found that treating certain **Bermuda grass** species with bio inoculants increased the nitrogen content compared to untreated plants. Beneficial bacteria, such as Plant Growth-Promoting Rhizobacteria (PGPR), for example, *Azospirillum*, play a significant role. The root application of chemical fertilizers, without wisdom, leads to soil and environmental pollution at a faster rate (Anonymous, 2012). Sadiq and Abdullatif (2023) found a significant increase in plant height when treating Japanese lily. plants with organic fertilizers. Fertilization is considered a system for recycling organic waste (Oyewole, & Obaje. 2013). Different media contain various substances that can have a direct or indirect impact on plant growth and development. Their use as anchors allows for better nutrient absorption, improving soil properties, water retention, and oxygen absorption. Improvements in soil biological properties reflect microbial diversity, creating a pollution-free environment (Al-Hamd, & Mahmood. 2020) suitable for plant root growth and soil organisms (Ghehsareh, 2013.). Al Rubaye *et al.* (2019) concluded that the use of organic fertilizers with 75% of the recommended fertilization led to an increase in plant height and dry weight of potato plants. Among various crop residues, rice straw, a lignocellulosic material, constitutes a significant portion (Sukumaran, et al. 2010). Despite the environmental hazard posed by its burning in open fields, it possesses properties that make it suitable for use as organic fertilizer and animal feed (Kaur, et al. 2007).

Lignocellulose primarily consists of cellulose (32-47%), hemicellulose (19-27%), and lignin (5-24%). Therefore, exploring the hidden value of rice straw through the biological conversion of sugars into value-added products is possible (Garrote, et al. 2002). Rice husks, considered agricultural waste, contain a high percentage of silicon and potassium. Mixing rice straw with its husks can improve soil properties by reducing its bulk density, enhancing soil reactivity, adding organic carbon, increasing available nutrients, and removing heavy metals. Ultimately, this leads to an increase in plant yield (Milla, et al. 2013). Therefore, the study aims to study the impact of adding rice straw, sugarcane bagasse residues, and organic fertilization (inoculation with *Trichoderma* fungus and *Azospirillum* bacteria) on the growth and flowering of rose hybrids. The goal is to encourage the cultivation and propagation of rose hybrids through scientific methods, considering them as globally harvested flowers. This approach aims to reduce the dependence on importing such flowers from abroad using hard currencies.

MATERIALS AND METHODS

The experiment was conducted at Station B of the College of Agricultural Engineering - Al-Jadriya for the spring season 2021-2022 using two varieties of roses, Pink-martini and Brighton. The planting was carried out directly in the soil within beds in the plastic greenhouse. The aim was to study the effect of rice straw medium, sugarcane residues, and *Azospirillum* and *Trichoderma* biofertilizers on the growth and flowering of two varieties of roses. The treatments were as follows: =

Factor 1: Hybrid, denoted by (A1, A2).

Factor 2: Organic media: The organic media were prepared according to the method of Al-Ziedi (2016) and included:

1. Treatment B1: Field soil only.
2. Treatment B2: Mixture of field soil and rice straw (2 kg per cultivation plot of 1 m²).
3. Treatment B3: Mixture of field soil and sugarcane bagasse residues (2 kg plot-1).
4. Treatment B4: Mixture of field soil and shredded sugarcane bagasse (4 kg plot-1)

Factor 3: the addition of *Azospirillum* was designated as C1, *Trichoderma* as C2, in

addition to the control treatment labeled as C₀; both treatments were applied before planting. Then, the saplings were planted, and all necessary cultivation operations, including plowing, leveling, and smoothing, were performed. Soil samples were taken from the plastic greenhouse, and chemical and physical analyses were conducted as shown in Table (1). Drip irrigation pipes were installed, and organic media were added. The saplings were then planted on 1/5/2022, using two rows with a spacing of 50 cm between plants and rows.

Consequently, the number of treatments in the field experiment was (5*3*2), totaling 30 treatments, replicated three times, with four plants per treatment. The following traits were studied: plant height (cm), leaf area (cm²), number of main branches per plant, percentage of nitrogen, phosphorus, and potassium in the leaves, number of flowers per plant, pedicel diameter, duration of flowers on the plant (days), and sugar concentration in the flowers (mg 100g⁻¹).

Table 1. Some chemical and physical properties of the soil before planting and before adding the media

Character	Value	Unit
Soil pH	7.4	
Electrical conductivity (EC)	3.53	Ds m ⁻¹
Organic matter	% 0.98	g kg ⁻¹ soil
Nitrogen (N)	0.46	g kg ⁻¹ soil
Phosphorus (P)	2.87	mg L ⁻¹
Potassium (K)	14.2	mg L ⁻¹
Magnesium (Mg ⁺⁺)	1.5	mg dL ⁻¹
Calcium (Ca ⁺⁺)	18.1	mg L ⁻¹
Iron (Fe ⁺⁺)	2.54	mg L ⁻¹
Sand	85.5%	g kg ⁻¹ soil
Silt	%8.3	g kg ⁻¹ soil
Clay	%6.2	g kg ⁻¹ soil
Soil texture class	Sandy	

The experiment was conducted as a randomized complete block design, with a split-plot arrangement with three replications. The varieties were assigned to the main plot, and combination of the second factor (organic media) and the third factor (biofertilizer) in the sub-plot. The data were analyzed using the GenStat statistical software package and the means were compared using the least significant difference (LSD) test at a probability level of 0.05 %. The anthocyanins of each hybrid were analyzed in a factorial experiment with a complete randomized block design and three replications. (Al-Rawi, & Khalaf Allah. 2000.).

RESULTS AND DISCUSSION

1- Effect of the growth and flowering of two varieties of roses (Pink-martini and Brighton) on organic media and biofertilizer : The results of table 2 show that the three-way interaction between the varieties, organic media, and biofertilizer had a significant effect on the measured traits. The treatment A₂B₁C₁ had the highest percentage

of phosphorus in the leaves (0.38%), and the highest number of flowers per plant (11.25 flowers per plant). Treatment A₂B₁C₂ had the highest diameter of the pedicel (3.57 cm) and the longest duration of flower longevity on the plant (28.33 days). Treatment A₂B₂C₁ had the highest plant height (58.42 cm), the highest number of main branches per plant (5.69 branches per plant), and the highest total sugar content in the flowers (3.92 mg/100 g). Treatment A₂B₀C₀ had the lowest values for these traits. When the same hybrid was grown in the organic medium of 2 kg of sugarcane residues (A₂B₃C₁) treated with Azospirillum bacteria, it had a significant superiority in terms of the leaf area (3625.13 cm²), the percentage of nitrogen in the leaves (3.14%), and the duration of flower longevity on the plant (28.33 days). Treatment A₂B₃C₂ had the highest percentage of potassium in the leaves (1.90%). The same hybrid gave the lowest value of this trait (1.00 %) when grown in the control treatment (A₂B₀C₀).

Table 2. The effect of the three-way interaction between Brighton and Pink-martini rose hybrids, organic media, and biofertilization on vegetative and flowering growth and the percentage of elements N, P, and K in the leaves

	Plant height (cm)	Leaf area (cm ²)	Main branches	N %	P %	K %	Number of flowers Plant ⁻¹	Diameter of the flower stalk (cm)	Flower longevity (day)	Sugar content in the flower (%)
A1B0C0	40.42	1408.22	4.10	2.00	0.23	1.27	7.00	2.37	19.67	2.27
A1B0C1	48.50	1704.83	4.25	2.55	0.30	1.15	8.08	2.95	20.33	2.61
A1B0C2	52.50	1852.55	4.50	2.66	0.32	1.49	7.93	2.54	21.33	3.70
A1B1C0	45.58	1623.48	4.42	2.80	0.28	1.36	8.68	3.40	26.00	3.63
A1B1C1	53.58	2435.74	4.50	2.81	0.28	1.31	8.85	3.17	25.00	3.02
A1B1C2	48.08	1764.45	4.75	2.98	0.30	1.30	9.00	2.92	24.33	3.16
A1B2C0	45.58	2959.90	4.33	2.83	0.29	1.37	8.33	3.24	25.33	3.39
A1B2C1	48.67	2350.28	4.97	2.56	0.35	1.42	9.67	2.89	26.33	2.66
A1B2C2	52.67	1778.67	4.67	2.82	0.37	1.30	7.92	2.96	22.67	3.86
A1B3C0	50.33	1896.70	4.17	2.71	0.26	1.20	8.25	2.98	24.00	2.92
A1B3C1	51.83	2301.08	4.58	2.95	0.32	1.87	8.67	2.80	25.67	3.64
A1B3C2	48.83	3016.92	4.42	2.58	0.28	1.40	9.33	2.72	24.67	3.91
A1B4C0	44.92	2134.93	4.17	2.97	0.33	1.14	7.68	3.05	24.33	2.70
A1B4C1	45.00	2364.72	4.75	2.92	0.28	1.67	9.50	3.38	25.33	3.65
A1B4C2	56.42	1815.72	4.75	2.63	0.33	1.25	8.43	3.13	26.67	2.46
A2B0C0	48.33	1595.00	4.67	2.58	0.27	1.00	8.67	2.42	21.67	2.84
A2B0C1	57.83	2101.74	4.75	2.63	0.36	1.56	9.67	2.54	22.00	3.16
A2B0C2	53.83	2358.18	4.67	2.95	0.24	1.33	9.75	2.58	23.33	3.19
A2B1C0	53.00	2431.56	5.33	2.07	0.36	1.38	8.67	2.72	26.67	3.60
A2B1C1	57.58	3127.50	5.25	2.69	0.38	1.69	11.25	2.61	27.00	3.49
A2B1C2	54.25	2265.74	5.08	2.62	0.26	1.28	9.58	3.57	28.33	3.84
A2B2C0	54.67	2648.30	5.42	2.83	0.27	1.21	9.33	2.53	25.33	3.33
A2B2C1	58.42	3087.63	5.69	3.07	0.33	1.55	11.00	2.91	26.00	3.92
A2B2C2	52.33	2410.83	5.33	2.43	0.31	1.31	10.08	3.20	26.00	3.89
A2B3C0	49.33	2347.41	5.25	2.77	0.27	1.38	9.75	2.90	25.67	3.71
A2B3C1	56.33	3625.13	5.50	3.14	0.35	1.79	10.42	2.90	28.33	3.53
A2B3C2	50.92	2621.21	5.08	2.56	0.35	1.90	10.17	2.72	26.00	3.22
A2B4C0	51.58	2880.97	4.92	2.80	0.26	1.13	9.00	3.30	24.33	2.63
A2B4C1	58.17	3185.64	5.17	2.65	0.30	1.76	9.92	3.18	28.00	3.68
A2B4C2	54.00	2215.79	5.25	2.83	0.35	1.68	10.00	3.35	26.67	3.56
L.S.D	2.86	856.04	0.66	0.49	0.04	0.37	0.99	0.68	2.40	0.82
0.05%										

Hybrids Pink-martini (A1), Brighton (A2), Organic media - Control treatment (B0), 2 kg rice husks/m² (B1), 4 kg rice husks/m² (B2), 2 kg sugarcane waste/m² (B3), 4 kg sugarcane waste/m² (B4) - Biofertilizer control treatment (C0), Azospirillum (C1), Trichoderma (C2).

2- The effect of the two-way interaction of two rose hybrids, organic media, and biofertilizer on vegetative and floral growth: The results of **Table 3** show a significant effect of the two-way interaction between the hybrids and organic media on the measured traits. The treatment A₁B₁ gave the highest rate of nitrogen percentage in the leaves at 2.86%, while the interaction A₁B₂ gave the highest rate of nitrogen percentage in the leaves, reaching 0.34%. While treatment A₂B₁ showed superiority in the duration of flower retention on the plant. The treatment A₂B₂ with the highest significant rate for plant height, 55.14 cm, the number of branches per plant at a rate of (5.48) branches per plant, the number of flowers (10.14) flowers per plant, and the sugar content in the flower 3.71 mg. 100 g⁻¹, while treatment A₂B₃

surpassed the leaf area by a rate of (2864.58 cm²) as well as the percentage of potassium percentage in the leaves by a rate of (1.69%). Treatment A₂B₄ recorded the highest rate for pedicle at 3.28 cm. The results from **Table 3**, show that the two-way interaction between the hybrid and the biofertilizer had a significant effect on most of the traits. Treatment A₂C₁ was significant superiority for the trait of plant height (57.67 cm), leaf area (3025.53 cm²), number of branches per plant 5.27 branches per plant, nitrogen percentage (2.84%), phosphorus (1.67%), potassium percentage in the leaves 0.34%, number of flowers 10.45 flowers per plant, and flower longevity 26.27 days and the content of flowers from sugars 3.55 mg. 100 g⁻¹ on the other treatments, while treatment A₂C₂ excelled in the diameter of the pedicle of the flower. While the

two-way interaction treatment between the organic matter and the biofertilizer recorded significant differences between the treatments. The plants grown in the organic medium of 2 kg of rice husk B1 treated with Azospirillum bacteria B₁C₁ gave the highest rate for plant height at 55.58 cm, while the plants growing in the medium of 4 kg of rice husk B₂C₁ excelled in the number of branches as well as the number of flowers per plant, reaching 5.33 branches per plant, 10.33 flowers per plant,

while treatment B₂C₂ gave a significant superiority in the percentage of sugars in the flower with a rate of 3.87 mg. 100 g⁻¹, and treatment B₃C₂ excelled in leaf area 2963.11 cm², nitrogen percentage in the leaves 3.04%, potassium percentage 1.83%, and the flower longevity on the plant 27.00 days, and treatment B₄C₁ excelled in the diameter of the flower pedicle at a rate of 3.28 cm, and treatment B₄C₂ in the percentage of phosphorus in the leaves at a rate of 0.34%.

Table 3. Effect of two-way interaction between rose hybrids, organic media, and biofertilization on vegetative and flowering growth

Plant height (cm)	Leaf area (cm ²)	Main branches	N %	P %	K %	Flowers Plant ⁻¹	Flower pedicle (cm)	Flower longevity (day)	Flower Sugar content (%)	
Hybrid A * Organic media B										
A1B0	47.14	1655.20	4.28	2.40	0.29	1.30	7.67	2.62	20.44	2.86
A1B1	49.08	1941.22	4.56	2.86	0.29	1.32	8.84	3.16	25.11	3.27
A1B2	48.97	2362.95	4.66	2.74	0.34	1.36	8.64	3.03	24.78	3.30
A1B3	50.33	2404.90	4.39	2.75	0.29	1.49	8.75	2.83	24.78	3.49
A1B4	52.19	2105.12	4.56	2.84	0.31	1.35	8.54	3.19	25.44	2.94
A2B0	53.33	2018.31	4.69	2.72	0.29	1.30	9.36	2.51	22.33	3.06
A2B1	54.94	2608.27	5.22	2.46	0.33	1.45	9.83	2.97	27.33	3.64
A2B2	55.14	2715.59	5.48	2.78	0.30	1.36	10.14	2.88	25.78	3.71
A2B3	52.19	2864.58	5.28	2.82	0.32	1.69	10.11	2.84	26.67	3.49
A2B4	54.58	2760.80	5.11	2.76	0.30	1.52	9.64	3.28	26.33	3.29
L.S.D	1.650	494.235	0.382	0.281	0.022	0.213	0.571	0.391	1.385	0.473
Hybrid A * Biofertilizer C										
A1C0	45.37	2004.65	4.24	2.66	0.28	1.27	7.99	3.01	23.87	2.98
A1C1	49.52	2231.33	4.61	2.76	0.31	1.48	8.95	3.04	24.53	3.12
A1C2	51.70	2045.66	4.62	2.73	0.32	1.35	8.52	2.86	23.93	3.42
A2C0	51.38	2380.65	5.12	2.61	0.29	1.22	9.08	2.77	24.73	3.22
A2C1	57.67	3025.53	5.27	2.84	0.34	1.67	10.45	2.83	26.27	3.55
A2C2	53.07	2374.35	5.08	2.68	0.30	1.50	9.92	3.08	26.07	3.54
L.S.D	1.278	382.832	0.296	0.217	0.017	0.165	0.442	0.303	1.073	0.366
Organic media B * Biofertilizer C										
B0C0	44.38	1501.61	4.38	2.29	0.25	1.13	7.83	2.39	20.67	2.55
B0C1	53.17	1903.29	4.50	2.59	0.33	1.36	8.88	2.74	21.17	2.88
B0C2	53.17	2105.36	4.58	2.80	0.28	1.41	8.84	2.56	22.33	3.45
B1C0	49.29	2027.52	4.88	2.43	0.32	1.37	8.68	3.06	26.33	3.62
B1C1	55.58	2781.62	4.88	2.75	0.33	1.50	10.05	2.89	26.00	3.26
B1C2	51.17	2015.10	4.92	2.80	0.28	1.29	9.29	3.24	26.33	3.50
B2C0	50.13	2804.10	4.88	2.83	0.28	1.29	8.83	2.88	25.33	3.36
B2C1	53.54	2718.95	5.33	2.81	0.34	1.49	10.33	2.90	26.17	3.29
B2C2	52.50	2094.75	5.00	2.63	0.34	1.31	9.00	3.08	24.33	3.87
B3C0	49.83	2122.05	4.71	2.74	0.27	1.29	9.00	2.94	24.83	3.32
B3C1	54.08	2963.11	5.04	3.04	0.34	1.83	9.54	2.85	27.00	3.59
B3C2	49.88	2819.07	4.75	2.57	0.32	1.65	9.75	2.72	25.33	3.56
B4C0	48.25	2507.95	4.54	2.89	0.30	1.14	8.34	3.18	24.33	2.67
B4C1	51.58	2775.18	4.96	2.78	0.29	1.72	9.71	3.28	26.67	3.66
B4C2	55.21	2015.75	5.00	2.73	0.34	1.46	9.22	3.24	26.67	3.01
L.S.D	2.019	604.707	0.467	0.344	0.027	0.261	0.698	0.478	1.694	0.579

Hybrids Pink-martini (A1), Brighton (A2), Organic media - Control treatment (B0), 2 kg rice husks/m² (B1), 4 kg rice husks/m² (B2), 2 kg sugarcane waste/m² (B3), 4 kg sugarcane waste/m² (B4) - Biofertilizer control treatment (C0), Azospirillum (C1), Trichoderma (C2).

3- Effect of hybrids, organic media, and biofertilization, on vegetative and flowering characteristics of the rose.

The results in **Table 4** indicate that the hybrid A2 has a significant impact, excelling in plant height, the number of main branches per plant, the number of flowers, the flower longevity, and the concentration of sugars in the flowers. The rates are 54.04 cm, 5.16 branches per plant, 9.82 flowers per plant, 25.69 days, and 3.44 mg 100⁻¹ grams, respectively, compared to hybrid A1. The results also indicate significant differences between organic media. Organic media B2, with 2 kg of rice straw, excelled in the flower longevity with 26.22 days. while, organic medium 4, with 4 kg of rice husks, excelled in plant height, number of main branches, phosphorus percentage in leaves, and sugar content in flowers, with rates of 52.06 cm, 5.07 branches plant⁻¹, 0.32%, and 3.51 mg 100⁻¹ grams, respectively. On the other hand, treatment with 2 kg of sugar cane

residues in the leaf area resulted 2634.74 cm², a potassium percentage in the leaves of 1.59%, and 9.43 flowers per plant. When cultivating roses in 4 kg of sugar cane residues, there was an advantage in the flower pedicel by 2.97 cm compared to the control treatment of soil cultivation only. Biofertilization treatments showed significant differences, with plants treated with Azospirillum C1 bacteria excelling in plant height, leaf area, number of branches, nitrogen, phosphorus, and potassium percentages in leaves, number of flowers, and flower longevity with rates of 53.59 cm, 2628.43 cm², 4.94 branches per plant, 2.80%, 0.32%, 1.58%, 9.70 flowers per plant, and 25.40 days, respectively. On the other hand, the treatment with Trichoderma showed superiority in the diameter of the flower by 2.97 cm and the sugar content in the flowers at a rate of 3.48 mg per 100 grams, compared to the control treatment without adding any biofertilizer to the cultivated rose plants.

Table 4. The effect of the two hybrids, organic media, and biofertilization on the vegetative and flowering growth characteristics of rose plants

Main factors	Flower Sugar content (%)	Flower longevity (day)	Flower pedicel (cm)	Flowers Plant ⁻¹	K %	P %	N %	Main branches	Leaf area (cm ²)	Plant height (cm)
Hybrid	3.17	24.11	2.97	8.49	1.37	0.30	2.72	4.49	2093.88	48.86
Hybrid	3.44	25.69	2.90	9.82	1.46	0.31	2.71	5.16	2593.51	54.04
LSD	0.20	1.24	0.62	0.82	0.15	0.02	0.32	1.09	866.72	2.25
B										
B0	2.96	21.39	2.57	8.52	1.30	0.29	2.56	4.49	1836.75	50.24
B1	3.46	26.22	3.06	9.34	1.39	0.31	2.66	4.89	2274.75	52.01
B2	3.51	25.28	2.96	9.39	1.36	0.32	2.76	5.07	2539.27	52.06
B3	3.49	25.72	2.84	9.43	1.59	0.31	2.78	4.83	2634.74	51.26
B4	3.11	25.89	3.23	9.09	1.44	0.31	2.80	4.83	2432.96	51.68
LSD	0.334	0.979	0.276	0.404	0.151	0.016	0.199	0.270	349.477	1.167
C										
C0	3.10	24.30	2.89	8.54	1.24	0.28	2.64	4.68	2192.65	48.38
C1	3.34	25.40	2.93	9.70	1.58	0.32	2.80	4.94	2628.43	53.59
C2	3.48	25.00	2.97	9.22	1.42	0.31	2.71	4.85	2210.01	52.38
L.S.D	0.259	0.759	0.214	0.313	0.117	0.012	0.154	0.209	270.703	0.904

Hybrids Pink-martini (A1), Brighton (A2), Organic media - Control treatment (B0), 2 kg rice husks/m² (B1), 4 kg rice husks/m² (B2), 2 kg sugarcane waste/m² (B3), 4 kg sugarcane waste/m² (B4) - Biofertilizer control treatment (C0), Azospirillum (C1), Trichoderma (C2).

4-The effect of organic media, biofertilization, and their interaction on the concentration of anthocyanins in the petals of the rose hybrid Brighton:

The results of Table 5 indicate significant differences among the treatments when cultivating rose plants in different organic media. The treatment with 4 kg of sugar cane

residues showed superiority in concentration of anthocyanins in the petals at 32.86 mg 100⁻¹grams of fresh weight, which does not differ significantly from cultivation in the organic medium with 4 kg of rice husks (27.72 mg 100⁻¹ grams of fresh weight). The biofertilization treatments with Trichoderma fungus showed the highest concentration at

31.55 mg 100⁻¹ grams of fresh weight, compared to the control treatment, (29.09 55 mg 100⁻¹ grams of fresh weight. The interaction between cultivating plants with 4 kg of rice husks and treatment with

Azospirillum B₂C₁ bacteria yielded the highest concentration at 36.03 mg per 100 grams of fresh weight, while the control treatment resulted in the lowest concentration at 24.14 mg per 100 grams of fresh weight.

Table 5. The effect of organic media, biofertilization, and their interaction on the concentration of anthocyanins in the petals of the hybrid Brighton (mg per 100 grams of fresh weight).

Organic media	Biofertilizer			Mean organic media
	C0	C1	C2	
B0	24.14	30.50	28.52	27.72
B1	27.04	29.10	33.14	29.76
B2	31.47	36.03	30.66	32.72
B3	28.97	30.32	29.66	29.65
B4	33.83	28.99	35.75	32.86
LSD		2.990		1.727
Mean	29.09	30.99	31.55	
LSD		1.337		

5- The effect of organic media, biofertilization, and their interaction on the concentration of carotenoids in the flower petals of the hybrid Brighton (mg per 100 grams of fresh weight): The primary pigment in flowers is carotenoids, concentrated in the epidermal and sub-epidermal cells. The data in the table 6 indicate significant differences when cultivating rose plants in different organic media. The superiority of cultivation in organic medium with 4 kg of rice husks (B2), yielding the highest concentration of carotenoids at 9.20 mg 100⁻¹ grams of fresh weight. This does not differ significantly from cultivation in organic medium with 2 kg and 4 kg of sugar cane residues. While, the control

treatment recorded the lowest carotenoid concentration at 8.02 mg 100⁻¹ grams of fresh weight. Biofertilization had a significant effect, with the Trichoderma treatment result with the highest concentration at 9.07 mg 100⁻¹ grams of fresh weight compared to the control treatment, which yielded the lowest concentration at 8.20 mg 100⁻¹ grams of fresh weight. The interaction between organic media and biofertilization also had a significant impact, with the organic treatment of 4 kg of rice husks showing superiority when treated with Trichoderma, with the highest concentration of 10.19 mg 100⁻¹ grams of fresh weight. This is compared to the control treatment at 7.20 mg 100⁻¹ grams of fresh weight.

Table 6. The effect of organic media, biofertilization, and their interaction on the concentration of carotenoids s in the petals of the hybrid Brighton (mg per 100 grams of fresh weight).

Organic media	Biofertilizer			Mean organic media
	C0	C1	C2	
B0	24.14	30.50	28.52	27.72
B1	27.04	29.10	33.14	29.76
B2	31.47	36.03	30.66	32.72
B3	28.97	30.32	29.66	29.65
B4	33.83	28.99	35.75	32.86
LSD		2.990		1.727
Mean	29.09	30.99	31.55	
LSD		1.337		

The three-way interaction of the study factors outlined in Table 2 led to achieving the best values in the vegetative and floral growth

traits. There was a significant superiority for most traits in the three-way interaction for the Brighton hybrid over the Pink-Martini hybrid

when cultivating these rose varieties in organic media with 2 kg of rice husks (B2). In case it is not available, 2 kg of sugar cane residues can be used as an organic medium, treated with biofertilizer containing *Azospirillum* bacteria. Similarly, the two-way interactions from the table 3 showed better results for the Brighton hybrid with mediums B2 and B3, as observed in Table 4 for individual traits. The results indicate a superiority of the Brighton hybrid over the Pink-Martini hybrid in most traits. This could be attributed to the influence of genetic traits and their responsiveness to environmental conditions. Alternatively, it could be due to the distinct characteristics of each hybrid. As seen in Table 4, B2 and B3 treatments excelled in most floral growth traits. This could be due to the medium's content of essential elements for plant growth, such as cellulose, hemicellulose, and silicon. It could also be attributed to the role of growth-regulating compounds present in the medium, enhancing plant growth, as suggested by Al-Zurfi (2015). Planting with organic mediums, sugar cane residues (4 kg, plot⁻¹), could be attributed to the content of essential nutrients, particularly nitrogen and magnesium, important for increasing leaf content of chlorophyll and anthocyanins as observed in the pink variety, might be aided by the organic environment. This is similar to the findings in the pink variety mentioned by Gordon (Gordon, et al 2008). Additionally, the plants treated with *Azospirillum* biofertilizer excelled in most studied traits significantly. This could be due to the bacteria's role in secreting growth regulators, especially auxins, as well as releasing amino acids and enzymes that break down available phosphates (Ibrahim, 2022.). This aligns with Abood (2017), where an increase in leaf area was observed when treating tulip bulbs with *Azospirillum*, resulting in the highest rate of 158.17 cm². Saleem and Jawad (2022) found that biofertilizer surpassed in growth indicators compared to sole biofertilizer addition, such as plant height, number of branches, number of leaves, leaf area, plant branch, and leaf count, as well as cumulative yield. Moreover, the bacteria's ability to fix nitrogen and increase the proportion of total soluble proteins in the

plant contributed to its increased concentration in the plant's green mass, reflecting on the plant's health and improving floral growth traits. This aligns with Ali (2023).

CONCLUSION

The conclusions are as follows:

1. Plants cultivated in the organic medium with 4 kg of rice husks and 2 kg of sugar cane residues m⁻², treated with *Azospirillum* bacteria, showed significant superiority in various vegetative and floral growth traits, as well as qualitative characteristics.
2. Plants treated with *Azospirillum* biofertilizer exhibited significant distinction in all floral traits, emphasizing its notable impact on the overall floral characteristics.

GENERAL RECOMMENDATIONS

Consider using the Brighton hybrid (A2) in combination with 4 kg rice straw (B2) and *Azospirillum* biofertilizer (C1) for optimal overall growth, flowering, and quality. This combination yielded the best results in the study, but keep in mind that local conditions and soil composition may affect results.

-Explore the use of organic media like rice straw and sugarcane residues as substitutes for field soil. These can improve plant growth and quality while being more sustainable than traditional methods.

-Investigate the potential of biofertilizers like *Azospirillum* and *Trichoderma* for rose cultivation. These can enhance nutrient uptake, suppress soil borne diseases, and reduce reliance on chemical fertilizers.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

DECLARATION OF FUND

The authors declare that they have not received a fund.

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تأثير الأوساط العضوية والتسميد الحيوي في النمو الخضري و الزهري وبعض الصفات النوعية لهجينين من الورد الجوري

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المستخلص

نفذ البحث بهدف دراسة تأثير وسطي قش الرز ومخلفات قصب السكر والتسميد الحيوي (Azospirillum و Trichoderma في نمو وازهار ونوعية لهجينين من الورد الجوري. شملت التجربة ثلاث عوامل رئيسية هي الاصناف (Brighton و Pink- martini)، وخمس معاملات اوساط عضوية تشمل وقشور الرز بمستويين (2 و 4 كغم لوح⁻¹، ومخلفات قصب السكر بمستويين 2 و 4 كغم لوح⁻¹، بالإضافة الى معاملة مقارنة بدون اضافة، والعامل الثالث يمثل التسميد الحيوي باضافة Azospirillum و Trichoderma. اظهرت النتائج الى ان المعاملات المستخدمة أدت إلى أفضل النتائج في معظم الصفات المدروسة. وبشكل عام، أظهرت النتائج أن استخدام قش الأرز أو مخلفات قصب السكر كمصدر للأسمدة العضوية، بالإضافة إلى التسميد الحيوي، أدى إلى تحسين نمو وازهار ونوعية الورد الجوري اوصت الدراسة في استخدام هجين Brighton مع 4 كجم من قش الأرز والسماح الحيوي (Azospirillum) لتحقيق النمو الشامل الأمثل والإزهار والجودة. أدى هذا المزيج إلى أفضل النتائج في الدراسة.

الكلمات المفتاحية: تسميد حيوي، قش الأرز، ورد جوري، مخلفات قصب السكر.