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Enhancement of growth and flowering of *Rosa hybrida* L. plant in saline water via organic fertilizing (Date Palm Residues Application)

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Abstract

This study was concerned with the effect of organic fertilizing (date palm residues) and irrigating water salinity on growth, yield and vase life of *Rosa hybrid* L. which was examined in a pot trial laid out in a factorial experiment designed with CRD at Basrah University during 2020. Three ratios of organic residues and soil (0;1, 1:1 and 1:2 v/v) and three concentrations of water salinity (0, 100 and 200 mM NaCl) were used. Organic residues improved the growth, yield and vase life of Rose flowers, as plant height reached for 75.68 cm, number of branches reached for 8.60, leaf area (49.23 cm²), shoot length (48.3 cm) and shoot diameter (0.55 cm) which were significant differences ($p \leq 5\%$), also chlorophyll (0.163 mg/g fresh wt.), carbohydrates 27.78%, phosphorus 2.49% and potassium content in leaves 1.47% were elevated considerably in addition to the number of flowers 8.12, flower diameter 7.90 cm, flowering period 8.19 day and vase life 7.95 day when adding organic residues. While, salinity led to an important decrease in all the examined growth and flowering parameters. The interaction between the two factors was found significantly effective in the previous parameters' values excluding protein content in leaves and flower dry weight.

Keywords: Landscaping, floriculture, roses, plant residues, salinity, flowering

Introduction

Rose (*Rosa × hybrida*) is economically an important ornamental crop used as landscape and cut flower in all over the world. These flowers have variant colors, nice fragrance, and value addition, and there are about 170 to 300 species of roses with various ploidy levels, but only about 10 species have been used in the ornamental culture [2, 25]. They are also considered to be a source of visual satisfaction and symbol of sensuality, motivation, elegance, spirituality, and friendliness. They are cultivated since ancient times for decorating gardens [28]. There are many cultivars and species available that are cultivated in various environments across the world. In these conditions, roses are persistently uncovered in accordance with quite a few unfavorable conditions, such as salinity. However, the salinity stress tolerance rates are still not determined among different rose species [26].

There are many ways to enhance plant growth and increase its ability to withstand difficult conditions, one of these methods is using compost. Composting technology plays a great role in producing organic fertilizers through microbial degradation of organic matter. As the technology has become a solution for reduction for the municipal waste by recycling into compost. As compost became commercially produced and economically important in developed countries. It can be produced from available organic raw materials and it is environmentally friendly and suitable for sustainable soil enrichment [10]. Organic fertilizers encompass natural materials derived from both plant and animal sources, such as livestock manure, green manures, crop residues, household waste, compost, and other organic matter. These materials function directly as sources of essential plant nutrients while also exerting indirect effects on the physical, chemical, and biological characteristics of the soil [6]. Date palm (*Phoenix dactylifera* L.) is one of the predominant fruit trees grown in oases ecosystems (Southern Mediterranean regions) and produces several wastes during practicing cultivation since fruit and bunch thinning is frequently applied. Yet, the valorization of date palm wastes as bio resources has received little attention.

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Agricultural productivity is severely affected by soil salinity and the damaging effect of salt accumulation in agricultural soils has become an important environmental concern ^[19].

Saline conditions occur naturally in some regions or by human activity in others with use of low-quality water or excessive fertilizer application. Salinity has a strong effect on the entire plant system. In general, roses are considered sensitive to salinity. However, tolerance levels can be different among roses species and cultivars ^[26, 29]. Indicated that irrigation using saline water is extensively used in areas of agricultural production where freshwater is scarce. However, saline water irrigation adversely impacts soil's physicochemical characteristics and crop productivity ^[15]. Studied the influence of *Rosa rubiginosa* plant against saline environment and reported that the plants lose its ability of water uptake due to accumulation of salt in leaf water and leaves started to dry. Roses show the different influences against salinity, which depends on substance type, plants farming system (hydroponic or soil), kind and amount of salt, rose cultivar/species, type of rootstock and the irrigation system ^[22].

This study aims to evaluate the impact of date palm compost on growth and flowering of *Rosa hybrida* L. under saline conditions, and to determine optimal residue-soil ratios for best performance.

Materials and Methods

The present study was undertaken to explore the effect of organic fertilizing (Date palm residues) on vegetative growth, flowering and vase life of *Rosa hybrid* L. under irrigation water salinity in a pot trial laid out at Basrah University during 2020. Three ratios of organic residues and soil (0:1, 1:1 and 1:2 v/v) and three concentrations of water salinity (0, 100 and 200 mM NaCl) were prepared. Palm wastes were chopped into smaller sizes; then, they were kept in 1.5 m³ plastic bags for controlling the moisture and temperature. Some amounts of N and P fertilizers were added to them as a fermentation starter, and these bags were placed in hot (25 to 30 °C) condition. For respiration, some air holes were made on the bags. Every week, these materials were mixed together and put into the bags again and their moisture was adjusted to 55%, then, the bags were sealed and the composting period was 3 months (C/N ratio recorded 53.44%) ^[12].

Harmonized healthy one-year-old plants of *Rosa hybrid* L. Sultani variety grown from cuttings were brought and identified taxonomically, then they were transplanted in plastic pots with a volume of 1.3 liters containing the three ratios of organic residues and soil (0:1, 1:1 and 1:2 v/v). These seedlings were allowed to establish for 20 days before the start of applying the different salinity levels of irrigating water once a week for four months.

Data was tabulated six months after salinity treatments and included: Plant height (cm), number of branches (plant⁻¹), leaf area (cm²): was measured according to ^[8], shoot length (cm), shoot diameter (cm), total chlorophyll content in leaves (mg g⁻¹ fresh wt.): was estimated according to ^[13]. Carbohydrate content in leaves (%) was evaluated as

described by ^[7], protein (%): nitrogen was estimated using the Kjeldahl method as described by ^[18], then protein was evaluated according to the reported procedures in ^[5] by the equation: (Protein = N% X 6.25), phosphorus and potassium, P (%) was evaluated using spectrophotometer, while flame photometer was used for the determination of K (%) ^[23]. Number of flowers plant⁻¹, flower diameter (cm): was measured by Varner Caliper at the maximum point breadth for each flower, flower dry weight (g): was determined by placing the flowers in an aerated oven at 70 °C until the weight is constant, flowering period (day): was calculated from the first flowering bud appearance until the field experiment was ended, vase life (day). Three fully opened flowers were taken randomly from each treatment, placing in glass jars filled with distilled water at room temperature (25 ± 2 °C) and vase life was determined by calculating the number of days until the level of senescence became unacceptable ^[27, 30].

The trial was designed in a factorial experiment adopted in complete randomized design (C.R.D) with three pots per treatment ^[4]. Collected data were statistically analyzed and means values were compared via the least significant differences RLSD test (0.05). Statistical analysis was performed by GenStat discovery 15th edition software to detect the differences among the treatments ^[11].

Results and Discussion

Organic residues improved the vegetative growth of Rose plants, as plant height, number of branches, leaf area, shoot length and shoot diameter, were significantly raised, when adding organic residues in contrast to the salinity of irrigation water. The interaction between the two factors was found considerably effective in some of the previous parameters as the maximum plant height, number of branches and shoot diameter (75.68 cm, 8.60 and 0.55 cm, respectively) were recorded when adding the highest ratio of organic fertilizer (1:2 v/v) with zero water salinity. While, the maximum leaf area and shoot length (49.23 cm² and 48.30 cm, respectively) were scored by adding the lower ratio of organic fertilizer (1:1 v/v) with zero water salinity (Table 1).

Table (1) also shows a significant reduction in plant height, number of branches, leaf area, shoot length and shoot diameter when using saline water compared to control plants. This result confirms the findings of ^[3] where salt affected rose plants by showing reduction in plant height ^[24]. Mentioned that the reduction in plant height in treated rose plant may be ascribed to the decrease in the rate of cell elongation in salt affected plants as a primary response to high level of salinity. While, ^[21] stated that the inhibitory effects of salinity on plant growth could due to the high soil salt availability and are probably as a result of decreased water absorption and disturbed metabolic processes leading to decreased meristematic activity or cell enlargement ^[16]. Reported that there are two ways which salinity could retard growth, by damaging growth cells so that they cannot perform their functions or by limiting their supply of essential metabolites.

Table 1: Effect of Organic Fertilizer and Water Salinity on Growth of *Rosa hybrida* L. Plant

Treatment Group	Shoot Diameter (cm)	Shoot Length (cm)	Leaf Area (cm ²)	No. of Branches	Plant Height (cm)
Organic Fertilizer					
Organic Fertilizer	0.42	26.5	36.74	6.20	56.05
1	0.51	40.0	43.82	7.67	63.99
2	0.52	40.0	44.34	8.23	71.03
e.s.e.	0.011	1.75	1.00	0.131	1.070
s.e.d.	0.016	2.47	1.417	0.185	1.514
LSD (P=0.05)	0.034	5.230	3.005	0.391	3.209
Water Salinity					
0 (Water Salinity)	0.51	39.8	45.67	7.00	70.77
1	0.48	33.5	39.13	7.47	63.28
2	0.47	33.2	40.10	7.63	57.01
e.s.e.	0.011	1.75	1.00	0.131	1.070
s.e.d.	0.016	2.47	1.417	0.185	1.514
LSD (P=0.05)	0.034	5.230	3.005	0.391	3.209
Organic Fertilizer × Water Salinity					
0 × 0	0.45	31.3	39.99	6.30	65.14
0 × 1	0.41	25.7	35.11	6.40	58.40
0 × 2	0.41	22.4	35.12	5.90	44.60
1 × 0	0.53	48.3	49.23	7.10	71.50
1 × 1	0.50	37.5	40.00	7.50	63.33
1 × 2	0.52	34.4	42.22	8.40	57.14
2 × 0	0.55	39.9	47.79	8.60	75.68
2 × 1	0.53	37.4	42.28	8.50	68.12
2 × 2	0.49	42.8	42.95	7.60	69.29
e.s.e.	0.019	3.02	1.736	0.226	1.854
s.e.d.	0.027	4.28	2.455	0.320	2.622
LSD (P=0.05)	0.058	9.070	5.205	0.678	5.557

*Values are means of three replications; e.s.e. = estimated standard errors of means; s.e.d. = standard errors of differences of means.

[9] and [20] stated that a significant decrease in leaf area took part when salinity level in irrigation water was increased for lilac (*Syringa*) plant as a loss of cell turgor is caused by salinity which reduces leaf expansion rates. This, consecutively, reduce the leaf area available for photosynthesis and a loss of productivity.

Chlorophyll, carbohydrates, phosphorus and potassium content in leaves were raised up significantly in plants grown in organic residues. While, salinity represented a significant decrease in all these parameters. The interactions between the two factors was found meaningfully effective in the former parameters values too excluding protein content in leaves (Table 2).

Table 2: Effect of Organic Fertilizer and Water Salinity on Chemical Composition of *Rosa hybrida* L. Plant

Treatment Type	Treatment Level	K (%)	P (%)	Protein (%)	Carbohydrates (%)	Chlorophyll (mg/g fresh wt.)
Organic Fertilizer	0 (Control)	1.37	2.42	8.85	13.24	0.137
	1	1.41	2.46	9.63	23.80	0.148
	2	1.45	2.47	9.81	24.03	0.158
	e.s.e.	0.041	0.012	0.096	0.649	0.001
	s.e.d.	0.058	0.017	0.135	0.918	0.001
	LSD (P=0.05)	0.124	0.038	N.S.	1.947	0.003
Water Salinity	0 (Control)	1.44	2.47	9.58	19.28	0.149
	1	1.39	2.44	9.29	19.63	0.147
	2	1.39	2.43	9.42	22.17	0.147
	e.s.e.	0.041	0.012	0.096	0.649	0.001
	s.e.d.	0.058	0.017	0.135	0.918	0.001
	LSD (P=0.05)	0.124	0.038	N.S.	1.947	0.003
Organic Fertilizer × Water Salinity	0 × 0	1.40	2.44	8.91	14.80	0.144
	0 × 1	1.36	2.42	8.75	12.53	0.135
	0 × 2	1.35	2.39	8.87	12.40	0.132
	1 × 0	1.47	2.48	9.82	20.74	0.142
	1 × 1	1.37	2.45	9.44	22.89	0.154
	1 × 2	1.38	2.46	9.63	27.78	0.150
	2 × 0	1.46	2.49	10.00	22.29	0.163
	2 × 1	1.44	2.46	9.69	23.46	0.152
	2 × 2	1.45	2.45	9.75	26.33	0.160
	e.s.e.	0.071	0.021	0.166	1.125	0.001
	s.e.d.	0.101	0.030	0.235	1.591	0.002
	LSD (P=0.05)	0.214	0.065	N.S.	3.372	0.005

*Values are means of three replications; e.s.e. = estimated standard errors of means; s.e.d. = standard errors of differences of means; N.S.: not significant.

Among abiotic stresses, soil salinity due to accumulation of soluble salts (mainly NaCl) in arable soils is a key hazard to sustainable crop production especially in arid and semi-arid regions. Higher levels of Na⁺ salts alter physico-chemical properties of the soils such as decreased soil porosity, water movement, and soil aeration which negatively affect uptake of essential plant nutrients and access to water by plants ^[14, 17].

Data showed that organic residues improved growth as well. Salinity-induced oxidative stress and Na⁺ ion absorption lead to cellular damage including ionic instability, which inhibits growth and has detrimental effects on the morphological and

biochemical characteristics of plants.

As for the results presented in Table (3) it is evident that adding organic residues to the pots considerably improved flowering parameters of Rose plants, as the number of flowers, flower diameter, flowering period and vase life were raised when adding organic residues. While, salinity led to a significant decrease in all the examined flowering parameters. The interaction between the two factors was found meaningfully effective in the previous parameters values apart from flower dry weight.

Table 3: Effect of Organic Fertilizer and Water Salinity on Flowering and Yield of *Rosa hybrida* L. Plant

Treatment	Vase life (days)	Flowering period (days)	Flower dry wt. (g)	Flower diameter (cm)	No. of flowers
Organic Fertilizer					
0 (control)	5.65	5.98	1.21	6.31	5.31
1	7.67	7.83	1.75	6.87	6.49
2	7.78	7.72	2.17	7.52	7.76
e.s.e.	0.103	0.069	0.078	0.097	0.047
s.e.d.	0.146	0.098	0.110	0.137	0.067
LSD (P=0.05)	0.309	0.207	0.235	0.291	0.143
Water Salinity					
0 (control)	7.38	7.51	1.88	7.29	6.66
1	6.83	7.37	1.83	6.72	6.34
2	6.88	6.63	1.43	6.68	6.58
e.s.e.	0.103	0.069	0.078	0.097	0.047
s.e.d.	0.146	0.098	0.110	0.137	0.067
LSD (P=0.05)	0.309	0.207	0.235	0.290	0.143
Interaction (Fertilizer × Salinity)					
Organic 0 × Salinity 0	6.28	6.34	1.16	6.41	5.52
Organic 0 × Salinity 1	5.43	6.28	1.41	6.31	5.19
Organic 0 × Salinity 2	5.23	5.31	1.06	6.22	5.24
Organic 1 × Salinity 0	7.92	8.01	2.12	7.58	6.34
Organic 1 × Salinity 1	7.37	8.10	2.06	6.50	6.15
Organic 1 × Salinity 2	7.72	7.38	1.07	6.52	7.00
Organic 2 × Salinity 0	7.95	8.19	2.20	7.90	8.12
Organic 2 × Salinity 1	7.69	7.78	2.17	7.35	7.67
Organic 2 × Salinity 2	7.70	7.19	2.15	7.32	7.50
e.s.e.	0.180	0.120	0.135	0.168	0.082
s.e.d.	0.253	0.169	0.191	0.238	0.117
LSD (P=0.05)	0.537	0.359	N.S.	0.504	0.247

*Values are means of three replications; e.s.e. = estimated standard errors of means; s.e.d. = standard errors of differences of means; N.S.: not significant.

It was reported by ^[1] that the added organic residues caused a significant increase in the flowering parameters of *Delphinium ajacis* L. and that may be due to the contain of many required nutrients for growth when disintegrate into nitrogen, potassium and phosphorus, which stimulates the process of photosynthesis and the increase of processed substances such as carbohydrates.

Conclusion and Recommendations

From the results of this study we can conclude:

- Recycling organic waste is an eco-friendly practice that contributes to the regeneration of our planet's resources.
- Using organic residues such as date palm wastes is an important method for achieving sustainable horticulture even under saline irrigation.
- Organic residues and soil at 1:2 (v/v) with zero water salinity is the most effective treatment combination, but with the presence of salinity in irrigation water, the study recommends adding palm residues at a rate of 1:2 (v/v).

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