Mesopotamia Journal of Agriculture

https://magrj.mosuljournals.com

EFFECT OF COVERING LAYERS AND NPK FERTILIZER TYPES ON THE VEGETATIVE AND FLOWERING CHARACTERISTICS OF *ROSA DAMASCENA* MILL. UNDER PROTECTED GREENHOUSE CONDITIONS

Abdulkhaliq A. Al-Zebary [1], Montaser K. Khessro [2], Ali F. Al-Ma'athedi [3]
Northern Technical University, Mosul, Iraq [1]
College of Agriculture and Forestry, University of Mosul, Mosul, Iraq [2,3]

Article information
Article history:
Received: 22/10/2023
Accepted: 24/12/2023
Published: 31/12/2023

Keywords:
Protected farming, Covering types, NPK, Slow-release fertilizer.

DOI:
http://10.33899/mja.2023.144119.1285

Correspondence Email:
montaser.hussain@uomosul.edu.iq

ABSTRACT

Due to the increasing demand for ornamental plants in general and roses in particular in the world in different seasons, a study was conducted on the rose plant *Rosa damascene* Mill. In a private farm in the governorate of Dohuk, Iraq for the growing season 2020-2021. The main objective of the study was to test two forms of covering used in greenhouses and compare that with open field cultivation, in addition to testing two forms of fertilizer added to improve plant growth: the traditional compound fertilizer NPK (17:17:17) dissolved in irrigation water and two levels of slow-release fertilizer NPK (SRF) (20:10:10 + SO_3 7.5%) in two concentrations: 5 and 10 g. The vegetative and flowering characteristics of the plant have been studied during the growing season. Using both covering with one layer and two layers of polyethylene positively affected on most of the vegetative and flowering characteristics. The use of different fertilization treatments had a positive effect in improving most of the vegetative and flowering characteristics of the plant. Moreover, the NPK fertilization treatment recorded the best results in the characteristics of the number of branches for the autumn season. Furthermore, the number of leaves and leaf area for the autumn and spring seasons, while the $NPK_{SRF}2$ fertilization treatment, recorded the best results in each trait flowering period for the autumn and spring seasons. In addition, the characteristic of the number of flowers in the spring season.

INTRODUCTION

Genus Rosa belongs to the Rosacea family, and this genus contains more than 18,000 cultivars (Gudin, 2010). *Rosa damascene Mill*. is one of the most important subspecies of the rose, and it is believed that its original homeland is the western regions of the Middle East (Widrlechner, 1981). Based on previous studies, it was suggested that the parental origin of this species is back to the species (*R*. Mochata, *R*. gallica, *R*. fedchenkoan) (Shin *et al*., 2000). The economic importance of the damask rose is due to its use in the manufacture of perfumes extracted from its flower petals. It also enters into the manufacture of rose water, some cosmetic compounds, and food flavoring (Widrlechner, 1981). Flowers, if grown optimally, can achieve 15-20 times greater economic returns compared to the cultivation of cereals and other crops (Sultanpuri *et al*., 2021).

Rose is one of the plants whose flowering can continue throughout the year, provided the appropriate growth conditions. The process of producing rose flowers in the protected cultivation environment is affected by several agricultural and environmental factors, Such as the temperature, light, and carbon dioxide concentration (CO_2), agricultural diseases and pests, fertilization processes, and dates of their addition, in addition to the characteristics of the soil and the agricultural environment (Särkkä, 2005). Temperature is the determining factor in the rose plant's cultivation and its flowers' production. The temperature ranges between 20 - 30 °C during the day and 18 - 20 °C at night, which is the optimum temperature for the growth and flowering of roses (Beeson Jr, 1990). The decrease in temperature at night to a level (10-12 °C) during the flowering period leads to a negative impact on the quality and number of flowers produced. It leads to a decrease in the flower content of essential oils.

Protected cultivation techniques almost entirely provide the necessary control over environmental conditions (light, temperature, relative humidity, and CO_2 concentration) (Gary, 2002). Therefore, plant production under protected cultivation offers many advantages compared to outdoor cultivation in terms of ensuring product quality, and the most important of these advantages is to protect the plant from sudden changes in environmental conditions (Bot, 2001). One of the most important advantages protected agriculture offers producers in the agricultural field is the extension of the production season and the production of crops outside their seasons to reach the possibility of production throughout the year (Jain & Tiwari, 2002).

Hassanien *et al*., (2016) mentioned that controlling the internal climate of the greenhouse is one of the main problems that producers face inside protected agricultural facilities, as the lack of sufficient control of the internal climate has significant adverse effects on the production process quantitatively and qualitatively. It was observed that the use of double covering layers of polyethylene in greenhouses, with a thickness of 180 µm each, with an air space height between them of up to 60 cm, led to an increase in the temperature between 2 to 4 °c compared to the single layer covering (Vandevelde *et al*., 1984).

Fertilizers are one of the essential elements that work to ensure the plant's prosperity. Chemical fertilizers are one of the most important sources of plant nutrients that can be introduced to the plant through the soil, and it is one of the vital processes through which it is possible to increase the biomass of the plant and improve its productivity in quantity and quality (Sakakibara *et al*., 2006).

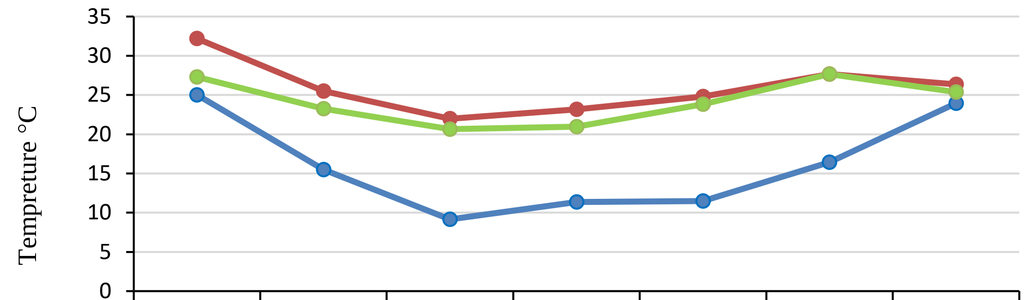
Nitrogen (N) is a vital element in plant life and sustainability as it improves the quality and quantity of plant biomass by influencing the biosynthesis of many plant biocomposites (Gholami *et al*., 2014). Phosphorous (P) has an important role in a range of plant cellular processes and biomolecular synthesis and its role in cell division (Razaq *et al*., 2017). Potassium (K) is considered one of the vital elements necessary for the growth and performance of plant functions, as well as being one of the components of the plant structure. It has many regulatory functions in biochemical processes and is dependent on many physiological processes, such as opening and closing stomata and photosynthesis. Potassium helps the plant resist environmental stresses. It maintains the ionic balance, regulates the osmotic balance under heat stress and drought conditions, and helps the plant adapt to water shortage conditions

(Hasanuzzaman *et al*., 2018). Chauhan & Sharma, (2021) mentioned in an experiment conducted on apple trees which belong to the rosacea family that the use of fertilizing with compound NPK fertilizer at different levels improved the vegetative characteristics (number of leaves, leaf area, dry weight of the shoot) compared to non-fertilization.

Slow-release fertilizers are a good alternative to traditional fertilizers because they reduce capital waste and significant environmental risks that affect land and water ecosystems by improving nutrient use efficiency, causing increased production and improved quality (Wani *et al*., 2019). This type of fertilizer, known by its acronym (SRF), is usually surrounded by a sheath consisting of an organic or inorganic material that controls the rate and pattern of plant nutrient release (Du *et al*., 2006). The nutrient release rate of these fertilizers aligns with the maximum absorption capacity of the plant, which fluctuates across different stages of plant growth throughout the growing season. (Irfan *et al*., 2018). Slow-release fertilizers (SRF) are a good alternative to conventional fertilizers because they reduce capital wastage, reduce significant environmental risks, and impact land and water ecosystems by improving nutrient use efficiency, causing increased production and improved quality. (Wani *et al*., 2019).

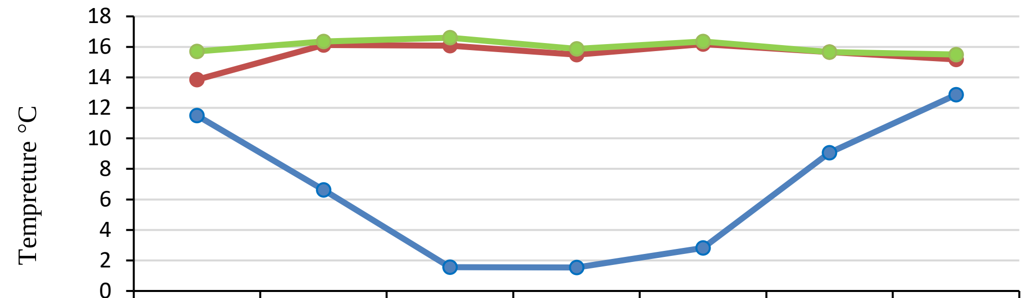
MATERIALS AND METHODS

A field experiment was carried out at a private farm in Dohuk Governorate, Iraq, in two seasons (autumn - spring) from 15/9/2020 to 1/5/2021 inside a plastic greenhouse with an area of 100 m^2. The area is divided into three sections. The first section of the greenhouse was constructed with a double metal frame covered with greenish-yellow agricultural nylon with a thickness of 180 µm. The second section of the area was covered with the same quality of nylon above, with only one layer. The third section was kept uncovered and considered as open field cultivation. The plants were obtained from private nurseries in Dohuk governorate; their age ranges between 2-3 years, planted in pots with a diameter of 10 cm. The plants were transformed into larger, unified anvils with a diameter of 25 cm and height of 30 cm. A medium consisting of one part of sandy soil and two parts of peat moss was used. All plants were pruned at a height of 30 cm from the soil's surface to prepare for flowering, with a rate of three branches for each plant. Dead and infected and small branches less than 4mm thick were removed. The experiment was carried out in a randomized complete block design (RCBD). It included 36 experimental units resulting from the interaction of two factors. The experimental unit contains six replicates with 216 plants (3*4*3*6) in three blocks. It included two factors: the covering type with three levels: A- open field cultivation without covering, B- covering with one layer of yellow agricultural nylon with a thickness of 180 µm, C- covering with two layers of yellow agricultural nylon with a thickness of 180 µm has an air space between the two layers with a thickness of 20 cm (Electric heating system was used in the greenhouse to prevent dropping the temperature below 15.5°C as a minimum to prevent plants from entering physiological dormancy). Figures (1) and (2) show observed average monthly temperature. The second factor is the fertilization: it included four levels: A- (0) Without fertilizing, B- (NPK) 2 g of compound NPK fertilizer in a ratio of 17:17:17 by dissolving it in 1000 ml of water and fertilizing each pot every two days with 500 ml from it C- (NPK_{SRF}1) Half a tablet of 5 gm of slow-release fertilization NPK fertilizer at a ratio of 20:10:10 + SO3 at a ratio of 7.5 added twice during the study season under the soil surface, D- (NPK_{SRF}2) A tablet of 10 gm of slow NPK fertilizer release fertilization at a ratio of 20:10: 10 + SO3 at 7.5 is added twice during the duration of the experiment (autumn and spring) under the soil surface (The fertilization factors addition was started after 15 days of the pruning process).



	October	November	December	January	February	March	April
Open field	25.02	15.48	9.15	11.34	11.47	16.44	23.95
one layer	32.19	25.48	21.97	23.16	24.8	27.66	26.35
two layer	27.3	23.24	20.65	20.95	23.81	27.66	25.37

Figure (1): Average monthly temperature (°C) during the day hours at the location of the experiment



	October	November	December	January	February	March	April
Open field	11.49	6.63	1.56	1.54	2.82	9.07	12.86
one layer	13.85	16.13	16.07	15.5	16.18	15.67	15.17
two layer	15.7	16.36	16.6	15.86	16.36	15.67	15.5

Figure (2): Average monthly temperature (°C) during the night hours at the location of the experiment

Vegetative and flowering traits are recorded during the autumn and spring seasons separately; the experiment included measuring four traits of vegetative growth, including the number of branches, number of leaves, leaf area (taken twice at the end of the autumn season once and the end of the spring season once) and the dry weight of the vegetative total (once at the end of the spring season), The studied flowering traits included the flowering date (calculated from the date of pruning to the appearance of the first flower on the plant), the percentage of flowering plants (calculated from the number of flowering plants dividing to the number of total plants), the flowering period (from the first appearance of flower on the plant until the last flower appears).

RESULTS AND DISCUSSION

Vegetative Growth Traits

The results of Table (1) indicate the superiority of the covering by double-layer treatment in both the number of branches in the autumn season and the number of leaves for the autumn and spring season, with 6.97 branches plant^{-1}, 78.32-70.57 leaves plant^{-1}. In contrast, the covering by one-layer treatment was superior in the leaf area of leaves, recording the highest values in the autumn season, 3430.17 cm^2. No significant differences were recorded in each of the characteristics of the leaf area and the number of branches in the spring season when using different levels of cover. As for the fertilizer treatments, the superiority of the NPK fertilization treatment in all traits for the autumn and spring seasons (number of branches, number of leaves, and leaf area) recorded the highest values of 6.84-9.75 branches plant^{-1}, 92.85-73.53 leaves plant^{-1} and 4356.62-3502.66 cm^2.

Among the results of the binary interaction of the experimental factors, the interaction treatment between single-cover covering and NPK fertilization recorded the highest value in each of the number of leaves for the autumn season and the leaf area for the autumn and spring seasons, with 110.94 leaves plant^{-1}, 6010.33-3918.60 cm^2, while the dual interaction between the double covering with NPK fertilization the highest values were recorded in each of the characteristics of a number of branches in the autumn season, number of leaves in the autumn season, recorded 7.60 branches plant^{-1}, 79.13 leaves plant^{-1}.

Table (1): Effect of covering way and fertilization quality on the vegetative characteristics of *Rosa damascene* Mill.

Treatment		No. of branches		No. of leaves		Leaf area (cm^2)		Dry weight of vegetative growth
		Autumn	Spring	Autumn	Spring	Autumn	Spring	
Covering	Open field	4.60 c	9.44 a	44.19 b	65.24 ab	1645.00 c	2311.65 a	27.73 b
	One layer	5.90 b	8.44 a	77.06 a	60.08 b	3430.17 a	2661.27 a	39.69 a
	Two-layer	6.97 a	8.66 a	78.32 a	70.57 a	2405.45 b	2164.27 a	41.18 a
Fertilization	Control	5.90 ab	8.40 ab	58.88 b	57.88 b	2013.25 b	1993.40 b	38.67 a
	NPK	6.84 a	9.66 a	92.85 a	73.53 a	4356.62 a	3502.66 a	38.07 a
	$NPK_{SRF}1$	5.21 b	9.75 a	56.39 b	65.35ab	1817.10 b	2034.93 b	34.06 a
	$NPK_{SRF}2$	3.34 b	7.57 b	57.98 b	64.4ab	1787.20 b	1985.26 b	34.92 a
Covering x Fertilization								
Open field	Control	5.38 a-c	8.55 a-c	43.88 cd	58.36 ab	1518.20 de	2019.40 cd	25.63 d
	NPK	5.38 a-c	9.00 a-c	62.80 bc	72.69 ab	3069.75 bc	3542.80 ab	26.96 cd
	$NPK_{SRF}1$	3.71 c	11.88 a	33.17 d	72.50 ab	1022.10 e	2174.60 cd	30.01 cd
	$NPK_{SRF}2$	3.94 bc	8.33 ab	36.94 d	57.41 ab	970.00 e	1509.80 d	28.35 cd
One-Layer	Control	5.11 a-c	7.28 bc	60.22 bc	54.33 b	2862.95 c	2573.40 b-d	43.59 ab
	NPK	7.55 a	10.88 ab	110.94 a	68.77 ab	6010.33 a	3918.60 a	39.60 a-c
	$NPK_{SRF}1$	5.72 a-c	7.89 bc	67.00 b	52.11 b	2399.00 cd	1851.20 cd	37.29 a-d
	$NPK_{SRF}2$	5.22 a-c	7.72 bc	70.11 b	65.13 ab	2448.40 cd	2301.90 cd	38.31 a-d
Two-layer	Control	7.21 a	9.38 a-c	72.56 b	60.97 ab	1658.60 de	1387.40 d	44.09 ab
	NPK	7.60 a	9.11 a-c	104.83 a	79.13 a	3989.80 b	3046.60 a-c	47.66 a
	$NPK_{SRF}1$	6.22 ab	9.49 a-c	69.00 b	71.44 ab	2030.20 c-e	2079.00 cd	34.87 b-d
	$NPK_{SRF}2$	6.88 a	6.66 c	66.89 b	70.75 ab	1943.20 c-e	2144.10 cd	38.10 a-d

Means with the same letter are not significantly different according to the Duncan test at $p \geq 0.05$ levels.

The treatment of covering with one layer and double layer recorded a significant superiority over the treatment of open field in the vegetative dry weight of the plant trait, with 39.69 and 41.18 g plant^{-1}, respectively, while the open field treatment recorded 27.73 g plant^{-1}. In contrast, the different fertilizer treatments did not record significant differences in this trait. The abovementioned binary interaction of the experiment factors also noticed significant differences in the vegetative dry weight of the plant, and the highest values were 47.66 g $plant^{-1}$ when the two covers were overlapped with NPK fertilization.

Flowering Traits

The results of Table (2) show that the factor of covering levels did not record significant differences in the flowering date in the autumn season, while the treatments of covering with one layer cover and covering with two layers caused a delay in the flowering date after performing the spring pruning process compared to the treatment of no covering that required fewer days for flowering (56.82 days). As for the effect of cover on the flowering period of plants, the results of the same Table show a significant effect of covering in the autumn and spring seasons, as the number of flowering days increased by a rate ranging between 64.03 and 63.53% when treated with one layer cover and two-layer cover, respectively, compared to no covering.

As for the effect of fertilizer treatments, it is noted from the results that fertilizing with slow-release fertilizers caused early flowering of plants, as it required fewer days to reach the flowering stage, recording 56.12 days when treating $NPK_{SRF}1$ and 48.24 days when fertilizing with $NPK_{SRF}2$, while the non-fertilization treatment recorded the largest number of days to reach flowering which is 65.12 days. The different fertilizer treatments did not record significant differences between them, including the treatment of non-fertilization in the characteristic of flowering period for plants in the autumn season, while the treatment of fertilizing with $NPK_{SRF}2$ recorded a significant superiority over the rest of the treatments in the characteristic of the flowering period of the spring season by recording 31.99 days.

Table (2): Effect of covering way and fertilization quality on the flowering characteristics of *Rosa damascene* Mill.

Treatment		Flowering date		Flowering period		% flowering plants		No. of flowers	
		Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring
Covering	Open field	56.82 a	56.37 b	17.14 c	13.20 b	40.12 b	90.37 b	1.49 c	7.33 b
	One layer	58.51 a	68.41 a	27.29 b	36.70 a	72.29 a	98.62 a	3.46 b	13.78 a
	Two-layer	59.23 a	68.35 a	37.05 a	36.20 a	83.37 a	100.00 a	4.67 a	14.70 a
Fertilization	Control	65.12 a	66.81 a	26.24 a	26.38 b	64.78 a	98.16 a	2.70 a	10.22 b
	NPK	62.74 a	65.11 a	29.65 a	27.83 b	72.27 a	94.50 a	3.69 a	12.32ab
	$NPK_{SRF}1$	56.64 ab	65.10 a	22.61 a	28.60 ab	66.64 a	96.33 a	3.33 a	11.99ab
	$NPK_{SRF}2$	48.24 b	60.47 a	30.14 a	31.99 a	57.39 a	96.33 a	3.12 a	13.21 a
Covering x Fertilization									
Open field	Control	59.30 a-c	55.83 c	16.00 de	12.50 d	44.17 bc	94.50 ab	1.33 c	7.00 c
	NPK	61.41 ab	57.33 c	21.91 c-e	12.33 d	61.17 ab	83.50 b	2.33 bc	8.16 c
	$NPK_{SRF}1$	53.58 a-c	57.00 c	14.66 e	12.83 d	38.67 bc	89.00 ab	1.33 c	8.00 c
	$NPK_{SRF}2$	53.00 a-c	55.33 c	16.00 de	15.16 d	16.50 c	94.50 ab	1.00 c	6.16 c
One layer	Control	68.25 a	72.61 a	27.08 c-e	34.16 bc	61.17 ab	100.00 a	2.36 bc	13.00 ab
	NPK	64.66 ab	72.77 a	22.11 c-e	31.16 c	77.83 a	100.00 a	3.44 ab	13.16 ab
	$NPK_{SRF}1$	57.61 a-c	69.16 a	28.58 b-e	38.16 a-c	83.50 a	100.00 a	4.63 a	12.83 ab
	$NPK_{SRF}2$	43.55 c	59.10 bc	31.41 a-d	43.33 a	66.67 ab	94.50 a	3.44 ab	16.16 a
Two-layer	Control	67.83 a	72.00 a	35.66 a-c	32.50 c	89.00 a	100.00 a	4.41 a	10.66 bc
	NPK	62.16 ab	65.25 ab	44.94 a	40.00 ab	77.83 a	100.00 a	5.30 a	15.66 a
	$NPK_{SRF}1$	58.75 a-c	69.16 a	24.61 c-e	34.83 bc	77.67 a	100.00 a	4.05 ab	15.16 ab
	$NPK_{SRF}2$	48.19 bc	67.00 a	43.02 ab	37.50 a-c	89.00 a	100.00 a	4.94 a	17.33 a

Means with the same letter are not significantly different according to the Duncan test at $p \geq 0.05$ levels.

As for the binary interaction between the two experimental factors and its effect on the flowering date, the results of the same Table show that significant differences were recorded between the different treatments in both the characteristics of flowering date and its duration. It is noted that the interaction coefficients between covering with one layer and two layers were recorded in combination with different fertilizer treatments, a delay in the date of flowering after spring pruning compared to the interaction coefficients between no covering with fertilization. Fertilizing with $NPK_{SRF}2$ has the lowest number of days to reach the flowering stage, 55.33 days. At the same time, it is noted that the treatment of covering with one-layer overlaps with NPK fertilization, the greatest number of days to reach flowering is 72.77 days. The interaction coefficients between the experimental factors recorded significant differences in the characteristics of the flowering period of plants for the autumn and spring seasons.

Table (2) shows that the treatment of covering with two-layer was superior in both the percentage of flowering plants and the number of flowers plant-1, where the highest valueswere recorded in the autumn and spring season where it was recorded 83.37 %, 100.00 %, 4.67 flower plant^{-1}, 14.70 flower plant^{-1}, while it was recorded. Plants grown in the open field had the lowest values in each of the characteristics of the percentage of flowering plants for the autumn and spring seasons, in addition to the lowest number of flowers of plant^{-1}.

The results show that the individual fertilizer treatments did not record significant differences among themselves in each of the characteristics of flowering plants for the autumn and spring seasons, and no significant differences were recorded in the number of flowers. plant^{-1} in the autumn season. In contrast, the treatment of fertilization with $NPK_{SRF}2$ recorded a significant superiority in the spring season by recording the largest value of 13.21 flowers. plant^{-1}.

It can be said that the plants grown under covering (one and two layers) were significantly superior in comparison with the plants grown in open field cultivation in the vegetative characteristics (number of branches, number of leaves, leaf area, dry weight of the vegetative total) in Table (1), and the flowering characteristics (flowering period, percentage of flowering plants, number of flowers) in Table (2) are attributed to the availability of the appropriate temperature secured by the covering factors (15.5-33 °C) and the use of heating which led to the continuation of growth, metabolism and flowering in them and not entering the rest period (dormancy), on the contrary the growing plants in the open cultivation which entered to the rest period (dormancy) from the period 15 November to 15 March, as the rose is one of the plants that can continue to grow and flowering throughout the year Provided that the appropriate environmental conditions, especially temperature, (Shin *et al*., 2000); (Särkkä, 2005); (Khayat *et al*., 1988); (Nadeem *et al*., 2011); (I. Ahmad *et al*., 2011).

Also, the increase in the number of branches in the autumn season, the number of leaves, and the leaf area of the autumn and spring seasons when fertilizing with compound NPK fertilizer 2 g L^{-1} is compatible with the results obtained by (Ahmad *et al*., n.d.) (Singh & Singh, 2003) (Qasim *et al*., 2008) (Altaee, 2013) (Ali, 2020) (Kamaluddin *et al.*, 2022) (Hammo, 2023). Furthermore, the increase in the number of shoots for the fall season when $NPK_{SRF}1$ fertilization which is compatible with

(Kaplan *et al*., 2013). The date of early flowering and the increase in the number of flowers plant^{-1}, when treated with $NPK_{SRF}2$ fertilization compared to the non-fertilization treatment (0), are compatible with (Sun *et al*., 2007).

These may be attributed to the continuous supply of mineral nutrients secured by the abovementioned transactions to the plant and to secure its nutritional needs. Roses are one of the plants that need a continuous nutrient supply because of their need to prune more than once during the year, as the process of growth and flower formation depends on the supply of nutrients, which affects the process of photosynthesis and the balanced relationship between the source and the consumer (Source-Sink Relationship) through the transfer of photosynthesis assimilate energy compound.

CONCLUSIONS

The study shows that wrapping layers of polyethylene with one or two greatly improves the vegetative and flowering properties of *Rosa Damascene* Mill. when compared to open-field cultivation. This enhancement is attributable mainly to the covering's ability to maintain an ideal temperature range, which encourages ongoing metabolism, development, and flowering by keeping the plant from being dormant. Furthermore, adding NPK and Slow-release NPK fertilizer increases the number of branches, leaves, leaf area, and flowers: a sign of the vital role that a steady supply of nutrients plays in promoting the development and blooming of roses. These results are consistent with earlier studies, emphasizing the value of carefully managed environments and sufficient fertilizer in maximizing rose growth and flowering potential.

ACKNOWLEDGMENT

The researchers thank the College of Agriculture and Forestry /University of Mosul for providing the given requirements for the research study.

CONFLICT OF INTEREST

The authors state that there are no conflicts of interest with the publication of this work.

تأثير اسلوب التغطية للبيت البلاستيكي ونوع السماد المركب NPK في الصفات الخضرية والتزهير للورد.*Rosa damascene* Mill تحت ظروف الزراعة المحمية

عبدالخالق اسعد الزيباري [1]، منتصر خيري خسرو [2]، علي فاروق المعاضيدي [3]

الجامعة التقنية الشمالية/ الموصل/ العراق [1]

كلية الزراعة والغابات/ جامعة الموصل/ الموصل/ العراق [2،3]

الخلاصة

نظراً للطلب المتزايد على نباتات الزينة بشكل عام والورد بشكل خاص في العالم في مختلف المواسم، فقد أجريت دراسة على نبات الورد الدمشقي صنف سلطاني في مزرعة خاصة في محافظة دهوك، العراق، للموسم الزراعي 2020−2021. تضمنت الدراسة اختبار نوعين من اسلوب التغطية (طبقة واحدة وطبقتين من

النايلون بينهما وسادة هوائية) داخل البيت المحمي ومقارنتهما بالزراعة المكشوفة، بالإضافة إلى اختبار نوعين من الأسمدة المضافة: السماد المركب التقليدي NPK (17:17:17) مذاب في ماء الري. ومستويين من السماد المركب NPK بطيئ التحلل (20:10:10 + 7.5% SO_3) وبواقع 5 و10 غرام. وتمت دراسة الخصائص الخضرية والزهرية للنبات خلال موسم النمو. إن استخدام اسلوبي التغطية (بطبقة واحدة وطبقتين من البولي إيثيلين) أثر إيجاباً على معظم الصفات الخضرية والزهرية وأعطى أفضل النتائج لجميع الصفات المدروسة مقارنة بالحقل المكشوف. كما كان لاستخدام معاملات التسميد المختلفة أثر إيجابي في تحسين معظم الصفات الخضرية والزهرية للنبات، حيث سجلت معاملة التسميد NPK أفضل النتائج في صفات عدد الأفرع للموسم الخريفي، عدد الأوراق، والمساحة الورقية لموسمي الخريف والربيع، بينما سجلت معاملة التسميد NPKSRF2 أفضل النتائج في كل من صفات فترة التزهير للموسمين، بالإضافة إلى صفة عدد الأزهار في فصل الربيع.

الكلمات المفتاحية: البيوت البلاستيكية، التغطية البلاستيكية، السماد المركب، السماد بطيء التحلل.

REFERENCES

Ahmad, I., Khalid, M. S., Khan, M. A., & Saleem, M. (2011). Morpho-physiological comparison of cut rose cultivars grown in two production systems. *Pak. J. Bot, 43*(6), 2885–2890. https://pakbs.org/pjbot/PDFs/43(6)/39.pdf

Ahmad, M. T., Yousaf, M., Shah, A. N., Khan, M. J., Jalal, S. F. B. U. Z., & Iqbal, U.-D. B. M. (2015). Different Level of Fertigation Influences Rose Flowering and Production. *Journal of Biology and Medical Sciences*, *3*(1), 1-4. https://core.ac.uk/download/pdf/234690862.pdf

Ali, M. A. (2020). Comparison Effects of Soil and Foliar NPK Fertilizers Applications with Various Times on Growth of Rosa Plant (Rosa hybrida L.). *Passer Journal of Basic and Applied Sciences*, *2*(2), 76–80. https://doi.org/10.24271/psr.15

Altaee, Alaa H. Y. (2013). Effect Different Levels of Nitrogen and Phosphate Fertilizer on The Vegetative Growth and Chemical Content of *Yucca Aloifolia* L.. *Mesopotamia Journal of Agriculture*, *41*(2), 26-38. http://doi:10.33899/magrj.2013.80100

Beeson Jr, R. C. (1990). Ribulose 1, 5-bis phosphate Carboxylase/Oxygenase Activities in Leaves of Greenhouse Roses. *Journal of Experimental Botany*, *41*(1), 59–65. https://doi.org/10.1093/jxb/41.1.59

Bot, G. P. A. (2001). The solar greenhouse; technology for low energy consumption. *International Congress on Greenhouse Vegetables. The Production Chain of Fresh Tomatoes, Peppers and Cucumbers 611*, 61–71. *https://*doi:10.17660/actahortic.2004.633

Chauhan, P., & Sharma, N. C. (2021). Influence of different NPK doses on plant growth and soil nutrient contents of apple (*Malus×domestica Borkh*.) nursery. *Indian Journal of Ecology*, *48*(1), 43–46. https://www.indianjournals.com/ijor.aspx?target=ijor:ije1&volume=48&issue=1&article=008

Du, C., Zhou, J., & Shaviv, A. (2006). Release characteristics of nutrients from polymer-coated compound controlled release fertilizers. *Journal of Polymers and the Environment*, *14*, 223–230. https://doi.org/10.1007/s10924-006-0025-4

Gary, C. (2002). Crop stresses and their management in greenhouse production. *VI International Symposium on Protected Cultivation in Mild Winter Climate: Product and Process Innovation 614*, 489–497. https://www.actahort.org/books/614/614_73.htm

Gholami, S., Pishva, Z. K., Talaei, G. H., & Amini, M. (2014). Effects of biological and chemical fertilizers nitrogen on yield and yield components in cumin (Cuminum cyminum L.). *Int. J. Biosci.(IJB)*, *4*(12), 93–99. https://rb.gy/hzuxcr

Gudin, S. (2010). Rose: genetics and breeding. *Plant Breed. Rev*, *17*, 159–189. https://www.cabdirect.org/cabdirect/abstract/20001616422

Hammo, Y. (2023). Effect of NPK Fertilizer and Growing Media on The Growth and Gel Production of Two Species of Aloe Plant (*Aloe Vera* and *Aloe Butteneri*). *Mesopotamia Journal of Agriculture*, *51*(3), 109-121. https://doi:10.33899/magrj.2023.139367.1226

Hasanuzzaman, M., Bhuyan, M. H. M. B., Nahar, K., Hossain, M. S., Mahmud, J. Al, Hossen, M. S., Masud, A. A. C., Moumita, & Fujita, M. (2018). Potassium: A vital regulator of plant responses and tolerance to abiotic stresses. *Agronomy*, *8*(3), 31. https://doi.org/10.3390/agronomy8030031

Hassanien, R. H. E., Li, M., & Lin, W. D. (2016). Advanced applications of solar energy in agricultural greenhouses. *Renewable and Sustainable Energy Reviews*, *54*, 989–1001. https://doi.org/10.1016/j.rser.2015.10.095

Irfan, S. A., Razali, R., KuShaari, K., Mansor, N., Azeem, B., & Versypt, A. N. F. (2018). A review of mathematical modeling and simulation of controlled-release fertilizers. *Journal of Controlled Release*, *271*, 45–54. https://doi.org/10.1016/j.jconrel.2017.12.017

Jain, D., & Tiwari, G. N. (2002). Modeling and optimal design of evaporative cooling system in controlled environment greenhouse. *Energy Conversion and Management*, *43*(16), 2235–2250. https://doi.org/10.1016/S0196-8904(01)00151-0.

Kaplan, L., Tlustoš, P., Száková, J., & Najmanová, J. (2013). The influence of slow-release fertilizers on potted chrysanthemum growth and nutrient consumption. *Plant, Soil and Environment*, *59*(9), 385–391. https://doi.org/10.17221/45/2013-PSE

Kamaluddin, A. A., Mohsin, R. M., & Kamil, A. N. (2022). Effect of NPK nano fertilizer on vegetative, flowering, and content traits of Kalanchoe blossfeldiana. *Tikrit Journal for Agricultural Sciences*, *22*(3), 113–119. https://doi.org/10.25130/tjas.22.3.13

Khayat, E., Zieslin, N., Mortensen, L., & Moe, R. (1988). Effect of alternating temperature on dark respiration and 14C export in rose plants. *Journal of Plant Physiology*, *133*(2), 199–202. https://doi.org/10.1016/S0176-1617(88)80137-8

Nadeem, M., Khan, M. A., Riaz, A., & Ahmad, R. (2011). Evaluation of growth and flowering potential of Rosa hybrida cultivars under Faisalabad climatic conditions. *Pak. J. Agri. Sci*, *48*(4), 283–288. https://www.pakjas.com.pk/papers/1959.pdf

Qasim, M., Ahmad, I., & Ahmad, T. (2008). Optimizing fertigation frequency for Rosa hybrida l. *Pak. J. Bot*, *40*(2), 533–545. https://pakbs.org/pjbot/PDFs/40(2)/PJB40(2)533.pdf

Razaq, M., Zhang, P., Shen, H., & Salahuddin. (2017). Influence of nitrogen and phosphorous on the growth and root morphology of Acer mono. *PloS One*, *12*(2). https://doi.org/10.1371/journal.pone.0171321

Sakakibara, H., Takei, K., & Hirose, N. (2006). Interactions between nitrogen and cytokinin in the regulation of metabolism and development. *Trends in Plant Science*, *11*(9), 440–448. https://doi.org/10.1016/j.tplants.2006.07.004

Särkkä, L. (2005). Yield, quality and vase life of cut roses in year-round greenhouse production. *Academic dissertation, University of Helsinki, Department of Applied Biology*, Publication no. 23. Helsinki 64p. https://helda.helsinki.fi/server/api/core/bitstreams/954a52ed-f919-41de-baa7-a1fef10d8a08/content

Shin, H. K., Lieth, J. H., & Kim, S.-H. (2000). Effects of temperature on leaf area and flower size in rose. *III International Symposium on Rose Research and Cultivation 547*, 185–191. http://lieth.ucdavis.edu/pub/pub048_shinliethkim.pdf

Singh, A. K., & Singh, Y. P. (2003). Leaf nutrient status, growth and flower yield in rose as influenced by organic and inorganic sources. *Journal of Ornamental Horticulture*, *6*(3), 229–233.

Sultanpuri, Arshi Sultanpuri., S.R. Dhiman, Y.C. Gupta, Puja Sharma, Bharati Kashyap, Meenakshi Bsoil And Ch Kalkame. (2021). Scheduling of Planting Dates for Maximum Profitability in Carnation (L.) under Mid Dianthus caryophyllus Hills of Solan, Himachal Pradesh. *Indian Journal of Ecology*, *48*(5), 1521-1528.

Sun, Y. T., Zhang, M., Xu, Z., Kong, D. X., And Sun, L. L. (2007). Effects of Controlled Release Compound Fertilizers on Soil Nutrient and Growth of Potted Rosa Chinensis [J]. *Journal of Soil and Water Conservation*, (3). http://stbcxb.cnjournals.com/stbcxben/article/abstract/200703115

Vandevelde, R., De Muynck, B., & Ben Hassine, H. (1984). Influence of the combination of an infrared plastic thermal screen and solar heating system on the bioclimate and plant growth of a muskmelon grown under polyethylene greenhouse (1). *II International Symposium on Plastics in Mediterranean Countries 154*, 233–240.

Wani, T. A., Masoodi, F. A., Baba, W. N., Ahmad, M., Rahmanian, N., & Jafari, S. M. (2019). Nanoencapsulation of agrochemicals, fertilizers, and pesticides for improved plant production. *Advances in Phytonanotechnology* (pp. 279–298). Elsevier. https://doi.org/10.1016/B978-0-12-815322-2.00012-2

Widrlechner, M. P. (1981). History and utilization of *Rosa damascena*. *Economic Botany*, *35*, 42–58. https://doi.org/10.1007/BF02859214