

Impact of Nitrogen Levels on Some Flower Growth Traits of Several Hibiscus (*Hibiscus Sabdarriffa* L.) Cultivars

Noora Shafea Mareh¹, Shaimaa Ibrahim Mahmood Al-Refai²

^{1,2}College of Agriculture, Al-Muthanna University, Iraq

Received: 2025, 15, Jul

Accepted: 2025, 21, Aug

Published: 2025, 30, Sep

Copyright © 2025 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).



Open Access

<http://creativecommons.org/licenses/by/4.0/>

Annotation: An experiment was conducted in one of the fields affiliated with the Directorate of Agriculture in Diwaniyah Governorate, Abu Al-Fadl Forest Nursery during the 2023-2024 agricultural season, to study the effect of four levels of nitrogen fertilization (40, 80, 120 and 160) kg ha⁻¹, represented by the symbols F1, F2, F3, and F4, respectively, on four hibiscus cultivars (red, white, striped, and black), represented by the symbols V4, V3, V2, and V1, respectively. The experiment was conducted using a split-plot method with a Randomized Complete Block Design, with four replicates. Nitrogen fertilization levels occupied the main plots, while hibiscus cultivars occupied the sub-plots. The results showed that 160 kg N ha⁻¹ level outperformed the other levels in the number of nuts per plant, the number of seeds per nut, and the weight of the sepal leaves. As for the cultivars, the V4 cultivar outperformed the other cultivars in the number of nuts per plant, the number of seeds per nut, and the weight of the sepal leaves.

Keywords: *Hibiscus Sabdarriffa* L., Nitrogen fertilization, Varieties, flower growth.

Introduction

Medicinal plants are currently of great importance in agricultural and industrial production in many countries around the world. They are a major source of medicinal preparations and plant extracts, as well as a source of active ingredients used in the preparation of pharmaceuticals (Parvin, 2023).

The World Health Organization (WHO, 2001) confirmed that approximately 80% of the world's population used medicinal plants to treat various diseases, psychological disorders, and bacterial infections.

Treatment with medicinal plants, including guava, may be more medically beneficial, less expensive, and safer than drugs made from chemicals. (Borokini and Omotayo, 2012).

Hibiscus (*Sabdariffa Hibiscus* L.) belongs to the widespread Malvaceae family, it is an annual or biennial shrubby plant, believed to be native to Asia and tropical regions of Africa. Some authors believe that India is the plant's original home (Tounkara *et al.*, 2011).

Hibiscus plant is an economically important crop in the central governorates of Iraq, especially in the Al-Qadisiyah Governorate, Al-Saniya sub-district, where its yield reached 800 kg/ ha⁻¹. The medicinal importance of the plant is concentrated in the calyx leaves, as they are a rich source of vitamin C, tartaric acid, and citric acid. In addition, it contains antioxidants such as procatechins. It also contains hibiscin (Al-Sarraf, 1991; Kilic *et al.*, 2011).

Many agricultural studies and research have shown that nitrogen is the primary nutrient that determines crop productivity (Abdul Hadi *et al.*, 2009; Al Salman and Al-Gharawi, 2019). The results of a study conducted by Al-Hassan and Al-Awadi (2011), also showed that adding different levels of nitrogen fertilizer (0, 30, 60, 90, and 120 kg/ha⁻¹), caused significant changes in the flowering and yield characteristics of the cauliflower plant when fertilized at a level of 120 kg N/ha⁻¹.

This study aimed to determine the effect of nitrogen levels on some flower growth traits of several Hibiscus (*Hibiscus sabdariffa* L.) cultivars

Materials and Methods:

Experimental Site and Design:

The field experiment was conducted in Diwaniyah Governorate during the summer season of 2023-2024, at Abu al-Fadl Forest Nursery, affiliated with the Diwaniyah Governorate Agriculture Directorate. The experiment was implemented using a split-plot method. A Randomized Complete Block Design (RCBD) with four replicates was used. Nitrogen fertilization levels occupied the main plots. Varieties were placed in the sub-plots. Factors were randomly distributed within each plot. Thus, the total number of experimental units was $4 \times 4 \times 4 = 64$ experimental units. The soil type in which the experiment was conducted was clayey.

Traits studied:

Number of nuts per plant (nuts. Plant⁻¹): The number of nuts set per plant was calculated and then averaged.

Number of grains per nut (grain nut⁻¹): Nuts were taken from the selected plants in each experimental unit, and the number of seeds was counted and averaged.

Fresh weight of sepal leaves (gm. Plant⁻¹): The fresh weight of sepal leaves was measured using a Sartorius balance.

Statistical Analysis:

The experiment was analyzed according to a completely randomized block design, and significant differences between means were tested using the least significant difference (LSD) at a 5%

probability level (Al-Rawi and Khalaf Allah, 1990).

Results and Discussion:

Number of nuts per plant (nuts. Plant⁻¹):

Table (1) indicates the significant effect of nitrogen levels, cultivars, and their interaction on the number of nuts per plant. The results indicated significant differences between nitrogen levels in the number of nuts per plant trait. F4 outperformed the other levels in the number of nuts per plant trait, yielding the highest average (147.67 nuts. Plant⁻¹). F3 followed with an average of 129.46 nuts. Plant⁻¹. While levels F2 and F1 yielded the lowest averages (115.30 and 99.17 nuts. Plant⁻¹), respectively. The increased number of nuts per plant may be due to increased nitrogen levels. Nitrogen has a significant effect on increasing the number of branches during the vegetative growth stage, reflected in the increased number of nuts per plant (Abu Dahi and Al-Younis, 1988; Hamman *et al.*, 1996). These results are consistent with Ramadan and Jameel (2010); Al-Dabin (2022) in their studies on the Hibiscus plant.

The results also showed an increase in the number of nuts per plant depending on the cultivar. Cultivar V4 outperformed, yielding the highest average (181.01 nuts. Plant⁻¹). This was a significant difference from the other cultivars. It was followed by cultivars V1 and V2, with averages of 135.07 and 103.74 nuts. Plant⁻¹, respectively. While cultivar V3 yielded the lowest average of 71.79 nuts. Plant⁻¹. The superiority of cultivar V4 is attributed to differences in genotype, in addition to the different environmental conditions, that are suitable for it, which led to good vegetative growth, and consequently, an increase in the number of nuts per plant. These results are consistent with Al-Jumaili (2023) when studying different cultivars of the Hibiscus plant.

Regarding interaction, the results showed a significant effect of the interaction between the two factors on the number of nuts per plant. The combination (F4×V4) outperformed, yielding the highest average number of nuts, with a significant difference over the other combinations, at 206.95 nuts. Plant⁻¹. Meanwhile, the combination (V3×F1) recorded the lowest number of nuts per plant, at 50.35 nuts. Plant⁻¹.

Table (1) shows the effect of nitrogen fertilization levels, Hibiscus varieties, and their interaction on the number of nuts per plant (nuts. Plant⁻¹).

Nitrogen levels	Varieties				Mean
	V1	V2	V3	V4	
F1	110.60	84.00	50.35	151.75	99.17
F2	124.50	100.00	62.10	174.60	115.30
F3	141.25	107.75	78.10	190.75	129.46
F4	163.95	123.20	96.60	206.95	147.67
Mean	135.07	103.74	71.79	181.01	
L.S.D _{0.05}	F		V		F×V
	1.603		1.696		3.247

Number of grains per nut (grain nut⁻¹):

Table (2) shows the significant effect of nitrogen levels, hibiscus cultivars, and their interaction on grain number per plant. The results indicated that nitrogen levels significantly affected grain number per plant. The 160 F4 kg N ha⁻¹ level significantly outperformed the other levels, with an average of 28.18 grain nut⁻¹. This was followed by the 120 F3 kg N ha⁻¹ and the 80 F2 kg N ha⁻¹ levels, with averages of 24.33 and 22.06 grain nut⁻¹, respectively. Meanwhile, the 40 F1 kg N ha⁻¹ level recorded the lowest average, at 19.47 grain nut⁻¹. This may be due to the role of nitrogen in improving growth and fertilization. This led to an increase in the number of seeds per plant. These results were consistent with Al-Bou Khader (2019); Koyani *et al.* (2014) on sweet seed plants, and Kadbe (2106) on dill seed.

The same results indicated that the V3 striped variety yielded the lowest average number of seeds per nut, at 19.80 grain nut⁻¹, while the black variety yielded the highest average, at 28.00 grain nut⁻¹, significantly outperforming the other varieties. It was followed by the red and white varieties, with averages of 24.17 and 22.08 grain nut⁻¹, respectively.

The interaction between nitrogen levels and hibiscus cultivars had a significant effect on the number of seeds per nut. The combination (160 kg N ha⁻¹ × Black cultivar) recorded the highest average of 34.95 grain nut⁻¹, while the combination (40 kg N ha⁻¹ × Striped cultivar) produced the lowest average of 15.75 grain nut⁻¹.

Table (2) Effect of nitrogen fertilization levels, hibiscus varieties, and the interaction between them on the number of grains per nut.

Nitrogen levels	Varieties				Mean
	V1	V2	V3	V4	
F1	20.30	18.80	15.75	23.05	19.47
F2	22.90	20.90	18.75	25.70	22.06
F3	25.15	22.85	21.05	28.30	24.33
F4	28.35	25.80	23.65	34.95	28.18
Mean	24.17	22.08	19.80	28.00	
L.S.D _{0.05}	F		V		F×V
	0.516		0.503		0.980

Fresh weight of sepal leaves (gm. Plant⁻¹):

Table (3) shows the significant effect of nitrogen levels, hibiscus cultivars, and their interaction on the fresh weight of sepal leaves. The results indicated significant differences between nitrogen levels in the fresh weight of sepal leaves. The 160 kg N ha⁻¹ level significantly outperformed the other levels in the fresh weight of sepal leaves, yielding the highest average of 257.18 gm. plant⁻¹, while the 40 kg N ha⁻¹ level yielded the lowest average of 210.86 gm. plant⁻¹. This may be due to the role of nitrogen in increasing vegetative growth, which led to the efficiency of photosynthesis, which helped increase the number of branches, and thus the fresh weight of sepal leaves.

The results also indicated a significant increase in the average fresh weight of hibiscus leaves achieved by hibiscus cultivars, compared to the striped cultivar, which yielded the lowest average of 183.82 gm. plant⁻¹, the black cultivar outperformed the other cultivars, achieving the highest average of 266.45 gm. plant⁻¹. It was followed by the red and white cultivars, with averages of 248.48 and 233.58 gm. plant⁻¹, respectively, and a significant difference between them. The superiority of the Black variety in hibiscus leaf weight may be due to its superior number of branches, which provides sufficient space for the plant to form hibiscus leaves and increase their number, thus increasing their fresh weight. Alternatively, it may be due to the variety's genetic nature, which allows it to better utilize available resources, which is significantly reflected in the increased fresh weight of hibiscus leaves (Khattab et al., 2016).

Regarding interaction, the results of the same table indicated a significant effect of interaction between the two factors on the fresh weight of hibiscus leaves in nuts. The combination (160 kg N ha⁻¹ × Black variety) outperformed, yielding the highest average of 296.93 gm. plant⁻¹, with a significant difference from the other combinations. Meanwhile, the combination (40 kg N ha⁻¹ × Striped variety) recorded the lowest average for the trait, reaching 158.24 gm. plant⁻¹.

Table (3) Effect of nitrogen fertilization levels, hibiscus varieties, and interaction between them on hibiscus leaf weight (gm. plant⁻¹).

Nitrogen levels	Varieties				Mean
	V1	V2	V3	V4	
F1	226.26	217.84	158.24	241.11	210.86

F2	236.58	227.94	177.71	256.21	224.61
F3	256.83	237.86	192.48	271.53	239.68
F4	274.24	250.68	206.86	296.93	257.18
Mean	248.48	233.58	183.82	266.45	
L.S.D_{0.05}	F		V		F×V
	1.238		1.994		3.610

References:

1. Abdul Hadi, A.A., M.S. Khader, and A.A. Abdel Aati. 2009. Symptoms of nutrient deficiency in some field and horticultural crops. Soil, Water and Environment Research Institute, Agricultural Research Center, and International Potassium Institute, IPI, Egypt.
2. Abu Dahi, Y.M. and M.A. Al-Younis. 1988. Plant Nutrition Guide. Bayt Al-Hikma. University of Baghdad. Mosul University Press. Iraq.
3. Al-Bou Khader, N.S.M. 2019. Effect of planting dates and NPK levels on the growth and yield of sweet seed. Master's thesis. College of Agriculture. Al-Muthanna University.
4. Al-Dabbin, M.A.S. 2022. Response of Hibiscus Sabdarriffa L. to Nitrogen and Potassium Fertilization and their Interaction on Growth Traits, Yield and Medically Active Ingredient. Ministry of Higher Education and Scientific Research. University of Karbala.
5. Al-Hassan, A.S.A. and H.F.N. Al-Awadi. 2011. Response of hibiscus varieties to nitro-gene fertilization and its effect on the yield and its components. Al-Qadisiyah Journal of Agricultural Sciences, Volume 1.
6. Al-Jumaili, M.A.M. 2023. The role of spraying with arginine and tryptophan on growth, yield and active ingredient in genetic structures of hibiscus (*Hibiscus sabdarriffa* L.). Ministry of Higher Education and Scientific Research. Tikrit University. College of Agriculture.
7. Al-Rawi, K.M. and A.M. Khalaf Allah. 1990. Design and Analysis of Agricultural Experiments. Ministry of Higher Education and Scientific Research. University of Mosul. College of Agriculture and Forestry. Iraq.
8. Al Salman, N.T.Sh.; and Al-Gharawi. J.K.M. (2019). Effect of Eucalyptus leaves water extract on some productive traits of broilers. Plant Archives Vol. 19, Supplement 1, pp. 920-923.
9. Al-Sarraf, A.M. 1991. Guidance bulletin on carob cultivation. General Authority for Agricultural Services. Agricultural Extension Department. Baghdad. Iraq.
10. Borokini, T.I., and Omotayo, F.O. 2012. Comparative phytochemical analysis of selected medicinal plants in Nigeria. Inter J Adv Chem Res, 1, 011-018.
11. Hamman, R.A., E. Dami, T.M. Waish and C. Stushnoff .1996. Seasonal carbohydrate changes and gold hardness of chardonnay and Riesling grapevines. Amer. J. Enol. Vitic. 47(1):43-48.
12. Kadbe, U. 2016. Effect of Row Spacing and Nitrogen Levels on Growth and Yield of Dill (*Anethum graveolens* L.). College of Horticultiar, Mandsaur (M.P.) 458001.
13. Khattab, A.S., E. Abou El-Saadate and K. Al-Hasni. 2016. Effect of with dietary quercetin enrichment. Experimental physiology, 100(1): 12-22.
14. Kilic, C., Aslan, S., Kartal, M. and Coskun, M. 2011. Fatty acid composi Tion of Hibiscus tyionum L. Rec.Nat.Prod. 5(1): 65-69.
15. Koyani,C.R., P.K.Chovataia and G.S. Gohil. 2014. Effect of nitrogen and phosphorus on growth, yield attributes and Yields of rabi fennel (*Foeniculum vulgare* Mill.) In: Agriculutar-Towards aNew Paradingm of sustainability. ISBN;978-93-83083-64-0.167-171.

16. Parvin, S., Reza, A., Das, S., Miah, M. M. U., and Karim, S. (2023) . Potential Role and International Trade of Medicinal and Aromatic Plants in the World. *European Journal of Agriculture and Food Sciences*, 5(5), 89-99.
17. Ramadan, A.F. and S.M. Jameel. 2010. Effect of spraying with some nutrients on the growth and yield of Hibiscus Sabdariifa L.. *Anbar Journal of Agricultural Sciences*: 8(4).
18. Tounkara, F., Amadou, I, Wei L.G. and Hui H.Y. 2011. Effect of boiling on the hysicochemical properties of Roselle seeds (Hibiscus sabdariffa L.) cultivated in Mali. *Afri. J. of Biotech.*,10(79):18160-18166.
19. WHO. 2001. *Legal Status of Traditional Medicine and Complementary*.