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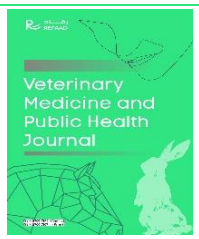

Effect of Visible Light Blocking Ratio, Irrigation Intervals and Free Amino Acids on Vegetative Growth Parameters of Chrysanthemum

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Abstract:

Objectives: An experiment was conducted under plastic shades set up for this purpose in the Mashroo Almussaib area (45 km north of Babil Province) to improve vegetative growth indicators for chrysanthemum plants Minngopher cultivar with red flowers.

Methods: Use 3 factors in the experiment include the first factor different percentages of visible light blocking (50 and 75) %, The second factor treating plants with three Irrigation Intervals (daily, every 24 hours, and every 48 hours) as for the third factor spraying plants with several concentrations of free amino acids (0,1, 1.50 and 2.00) mg L^{-1}. The experiment design in a (2x3x4) factorial design using a R.C.B.D. with three replicates per treatment. Each replicate contained three pots, each with one plant.

The results: Showed the study factors have significant impact of the studied parameters, the interaction (75% shading, daily irrigation, and 150 mg L^{-1}) give significant impact in the number of leaves (129.0 leave) and the length of the vegetative branch (15.33 cm) while achieved the triple treatment (75% shading, daily irrigation, and 200 mg L^{-1}) significant impact in number of vegetative branches (7.67 vegetative branches) and the main stem diameter (6.76 mm), as for the height of the plant, the interactions treatment was impact (75% shading, daily irrigation, and 100 mg L^{-1}).

Conclusions: From here we conclude that shading ratios play an important role in reducing the impact of stress intensity humidity and thermal associated with treating plants with free amino acids spraying on vegetative plant.

Keywords: *Chrysanthemum; Shading; free amino acids; Irrigation Intervals.*

1 Introduction

Chrysanthemum (*Chrysanthemum indicum* L.) is a perennial herbaceous plant belonging to the Compositae family of short-day plants. It renews its cultivation annually and is believed to have originated in China, where it has been cultivated for over 2000 years (Chae, 2016). This plant stands out by blooming when other flowers in the garden are scarce, reaching its peak production in the fall, earning it the title "Autumn Monarch" (Senapati et al., 2020). The appeal of trading chrysanthemum flowers is enhanced by their robust stems, integrated blossoms that resist easy plucking, as well as their diverse colors and varied sizes, making them suitable for a range of purposes, including decoration, medicinal herbs, and natural pest deterrents (Yanagisawa et al., 2023).The location of Iraq, influenced by the semi-tropical high-pressure system characterized by high radiation and excessive summer temperatures, coupled with a decrease in rainfall, has caused environmental problems and significant variations in weather conditions. These factors have led to clear stresses affecting the growth and spread of plants. Therefore, it is more appropriate to explore methods to overcome issues related to extreme light intensity. These include selecting suitable shading ratios to reduce the impact of solar radiation, as well as spraying certain nutrients, such as amino acids, which may play a role in mitigating the damage from high light intensity and water scarcity. The current study aims to investigate the impact of light quality, irrigation periods, and free amino acids on the growth of Chrysanthemum plants.

2 Materials and Methods

An experiment was conducted under plastic shades set up for this purpose in the almussaib mashro During the period from April 1, 2023, to November 15, 2023, the experiment aimed to study the impact of the quality of visible light by varying shading percentages using polyethylene (Saran) and foliar feeding with foliar acids sprayed on water-stressed Chrysanthemum plants. This was achieved by subjecting them to different irrigation intervals Chrysanthemum plants of the Minngopher variety with red flowers were obtained from a private nursery in Karbala at the age of 18 months on March 15, 2023. Subsequently, the plants were propagated into two types: first, the formed shoots, which were selected as uniformly as possible, and second, the basal shoots. Various types (basal, lateral, and terminal) were planted, with lengths ranging from 10 to 15 cm after pruning on March 28–30, 2023. The plants were placed in plastic pots with a diameter of 22 cm and a volume of 3 kg, filled with river mix soil with specified physical and chemical characteristics as indicated in Table (1). One plant was placed per pot, and soil compaction was ensured during the planting of basal shoots and formed shoots to prevent seedling displacement. All necessary service operations were carried out, following the procedures applied during the study period (Kadhim, 2020). Prior to this, a plastic greenhouse with an area of (2.5×3.5m) for each shade was prepared independently, covered with two types of polyethylene (green Saran). The pots were arranged with a one-meter gap between the two shades.

3 Results and Discussion

Table 1: Effect of visible light quality, irrigation intervals, and free amino acids, and their interactions, on the trait of the of plant height for Chrysanthemum plants (cm)

Shading X irrigation intervals	Amino acid concentration, mg L^{-1}				Irrigation Intervals (hour)	Shading Ratio (%)
	2.00	1.50	1.00	0.00		
40.71	39.33	42.33	41.33	37.67	daily	
31.42	31.00	34.67	29.67	30.33	Every 24	50
27.17	31.33	32.00	22.33	23.00	Every 48	
40.92	39.00	39.00	49.00	36.67	daily	
40.50	48.67	43.00	34.22	36.00	Every 24	75
31.50	30.33	34.33	28.67	32.67	Every 48	
5.843			11.685		L.S.D. $_{0.05}$	
Shading	**Shading × Amino acid concentration**					
32.92	33.89	36.33	31.11	30.33	50	
37.64	39.33	38.78	37.33	35.11	75	
3.373			6.746		L.S.D. $_{0.05}$	
Amino Acid	**Irrigation intervals × Amino acid concentration**					
40.54	39.17	40.67	45.17	37.17	Daily	
35.96	39.83	38.83	32.00	33.17	Every 24	
29.33	30.83	33.17	25.50	27.83	Every 48	
4.131			8,263		L.S.D. $_{0.05}$	
	36.61	37.56	34.22	32.72	Amino acid	
			4.770		L.S.D. $_{0.05}$	

Table 2: Effect of visible light quality, irrigation intervals, and free amino acids, along with their interactions, on the number of leaves trait for Chrysanthemum plants (Plant $Leaf^{-1}$)

Shading X irrigation Intervals	Amino acid concentration, mg L^{-1}				Irrigation Intervals (hour)	Shading (%)
	2.00	1.50	1.00	0.00		
60.7	70.3	58.7	59.0	55.0	daily	
63.9	79.0	63.7	56.0	57.0	Evert 24	50
57.8	60.0	71.3	55.7	44.3	Every 48	
102.7	124.3	129.0	75.0	82.7	daily	
80.0	80.3	97.7	79.7	62.3	Every 24	75
70.8	69.3	85.3	73.7	55.0	Every 48	
7.85			15.70		L.S.D. $_{0.05}$	
Shading	**Shading × Amino acid concentration**					
60.8	69.8	64.6	56.9	52.1	50%	
84.5	91.3	104.0	76.1	66.7	75%	
4.53			9.06		L.S.D. $_{0.05}$	
Amino Acid	**Irrigation intervals × Amino acid concentration**					
81.8	97.3	93.8	67.0	68.8	daily	
72.0	79.7	80.7	67.8	59.7	Every 24	
64.3	64.7	78.3	64.7	49.7	Every 48	
5.55			11.10		L.S.D. $_{0.05}$	
	80.6	84.3	66.5	59.4	Amino acid	
			6.41		L.S.D. $_{0.05}$	

Table 3: Effect of visible light quality, irrigation intervals, and free amino acids, and their interactions, on the trait of the number of branches for Chrysanthemum plants

Shading X irrigation intervals	Amino acid concentration, mg L^{-1}				Irrigation intervals (hour)	Shading (%)
	2.00	**1.50**	**1.00**	**0.00**		
5.00	4.00	6.33	4.67	5.00	daily	
4.58	5.00	4.67	4.33	4.33	Every24	50
4.42	5.00	5.00	4.33	3.33	Every48	
6.42	7.67	6.33	5.33	6.33	daily	
6.00	7.00	7.00	5.00	5.00	Every24	75
5.50	5.67	6.33	6.00	4.00	Every48	
1.575			3.149		L.S.D. 0.05	
Shading	**Shading × Amino acid concentration**					
4.67	4.67	5.33	4.44	4.22	50	
5.97	6.78	6.56	5.44	5.11	75	
0.909			1.818		L.S.D. 0.05	
Amino acid	**Irrigation intervals × Amino acid concentration**					
5.71	5.83	6.33	5.00	5.67	**daily**	
5.29	6.00	5.83	4.67	4.67	**Every24**	
4.96	5.33	5.67	5.17	3.67	**Every48**	
N. S.			2.227		**L.S.D. 0.05**	
	5.72	5.94	4.94	4.67	**Amino acid**	
			N. S.		**L.S.D. 0.05**	

Table 4: Effect of the visible light quality, irrigation intervals, free amino acids, and their interactions on the trait of green branch length in chrysanthemum plants (cm)

Shading X irrigation intervals	Amino acid concentration, mg L^{-1}				Irrigation Intervals (hour)	Shading (%)
	2.00	**1.50**	**1.00**	**0**		
10.83	11.67	12.00	10.00	9.67	daily	
11.17	12.33	12.67	10.67	9.00	Every 24	50
10.17	10.67	11.33	10.67	8.00	Every 48	
14.33	14.67	15.33	14.00	13.33	daily	
13.33	14.33	13.33	14.00	11.67	Every 24	75
11.83	11.33	13.00	11.67	11.33	Every 48	
1.831			3.663		L.S.D. 0.05	
Shading	**Shading × Amino acid concentration**					
10.72	11.56	12.00	10.44	8.89	50	
13.17	13.44	13.89	13.22	12.11	75	
1.075			2.115		L.S.D. 0.05	
Amino Acid	**Irrigation intervals × Amino acid concentration**					
12.58	13.17	13.67	12.00	11.50	daily	
12.25	13.33	13.00	12.33	10.33	Every 24	
11.00	11.00	12.17	11.17	9.67	Every 48	
1.295			2.590		L.S.D. 0.05	
	12.50	12.94	11.83	10.50	Amino acid	
			1.495		L.S.D. 0.05	

Table 5: Effect of the quality of visible light, irrigation intervals, and free amino acids and their interactions on the trait of the main stem diameter plants (mm).

Shading X irrigation intervals	Amino acid concentration, mg L-1				Irrigation Intervals (hour)	Shading (%)
	2.00	**1.50**	**1.00**	**0**		
5.04	4.95	5.30	4.92	4.97	daily	
4.90	4.86	5.24	4.22	5.27	Every 24	50
4.87	5.62	5.10	4.29	4.45	Every 48	
5.55	6.76	5.59	4.97	4.90	daily	
4.72	4.99	4.74	3.81	5.36	Every 24	75
4.09	3.93	4.66	3.97	3.80	Every48	
0.934			1.868		L.S.D. 0.05	
Shading	**Shading × Amino acid concentration**					
4.93	5.15	5.21	4.48	4.90	50%	
4.79	5.23	5.00	4.25	4.69	75%	
N. S.			1.079		L.S.D. 0.05	
Amino Acid	**Irrigation intervals × Amino acid concentration**					
5.30	5.86	5.45	4.94	4.94	daily	
4.81	4.92	4.99	4.01	5.32	Every 24	
4.48	4.78	4.88	4.13	4.12	Every 48	
0.328			1.321		L.S.D. 0.05	
	5.19	5.11	4.36	4.79	Amino acid	
			0.763		L.S.D. 0.05	

4 Discussion

The achieved spiritual excellence in the carefully considered traits, as shown in tables (1-5), may be attributed to the light attenuation percentage implemented through coverage with polyethylene. Its role in increasing the measured indicators is evident in reducing the light intensity reaching the plant, leading to an expansive increase in plant cell volume, especially in leaf tissue. This is because auxins' effects are more effective in plant parts located in shaded areas due to the oxidation of the IAA hormone in sun-exposed regions. The hormone tends to move to areas with lower light intensity (Verma and Verma, 2010). The results in the above tables may also indicate the potential impact on the growth of chrysanthemum plants under high light, causing damage to the plant's internal structure and negatively affecting overall biological and physiological processes. The results reflect the developmental growth when covered at higher percentages, indicating that the plant has received sufficient light for carbohydrate synthesis through photosynthetic representation in adequate quantities to meet its needs (Mariscal et al. 2000). Furthermore, shading plays a role in providing suitable environmental conditions for growth, especially in terms of temperature, light intensity, and humidity. Environmental adaptation leads chloroplasts to change their location within the cell towards the light, aligning along the upper and lower surfaces of the leaf to capture more sunlight (Taiz and Zeiger, 2002). The variations in values in the mentioned tables may be attributed to the impact of irrigation intervals, especially with watering every 48 hours, causing a noticeable decrease in the studied traits. This could result in a condition of water stress experienced by growing plants, negatively affecting cell division and elongation rates, reducing both absorption and transport processes, and widening stems and leaves. Consequently, there is a decrease in the average plant height, number of leaves, stems, unlike daily watering plants, which obtained sufficient moisture, enhancing the rates and speed of biological processes influencing growth and development. of both the aboveground and root systems of plants throughout their life cycle. (Kadhim et al, 2020 and Amare and Abebe, 2020). The spaced irrigation period reduces root system activity by impeding its growth and slowing cell elongation. This hinders the plant's ability to absorb and transport nutrients to the upper parts, especially in sandy soil, known for its limited water retention (Dayok et al, 2019). Adequate moisture, combined with shading levels, can enhance root growth, positively impacting overall plant growth through their mutual effect on activating the photosynthetic process and accelerating biological processes, contributing to increased growth speed (Toman, 2021). The notable improvement resulting from foliar spraying of plants with free amino acids may be explained by their role in regulating and developing the plant's root system, activating plant growth by stimulating physiological activities, particularly gibberellin biosynthesis. Additionally, amino acids rapidly supply cells with nitrogen, facilitating quicker uptake compared to inorganic nitrogen. This leads to balanced and coordinated vegetative growth or overall plant structure (Pareek et al, 2000). Amino acids play a crucial role in stimulating cell division and elongation, triggering various processes related to protein synthesis. Moreover, amino acids serve as the primary precursors for natural plant components, including carbohydrates, hormones, pigments, and compounds with secondary metabolites (Abd El-Aziz et al,2010).

5 Conclusions

The response of all the studied growth parameters to the influence of the stimulating factors of the study, as the response was consistent but varied in values except for the effect of irrigation intervals, which gave a different effect than that. The reason for controlling the percentage of visible light is a obvious response to all study factors except for the stem diameter, which indicates the importance of light in stimulating and activating the growth processes towards increasing the values and its important role in the production and propagation of Chrysanthemum flowering plants, as the higher percentage of shading had the greatest effect compared to the percentage Shading 50%. The results of the characteristics studied in the research experiment confirmed the importance of using environmentally friendly compounds of plant origin in increasing growth and agricultural production and the trend towards clean agriculture away from harmful chemicals, which is considered a necessity to increase growth indicators and quality to push the plant to exploit its maximum production capabilities, and this was reflected directly with increasing concentration

amino acids. The possibility of growing Chrysanthemum plants under conditions of moisture stress, combined with spraying with amino acids under protected (greenhouse) conditions.

Recommendations:

Propagation of Chrysanthemum plants under protected cultivation conditions in order to control light levels due to their growth facing hot climate conditions in summer season and high intensity of solar brightness. Depending the concentration of 1.5 mg L^{-1} due to its small differences with the concentration of 2 mg L^{-1} of amino acids in plant nutrition and experimenting with its application as a natural, environmentally friendly material against the risk of various stresses with other types of plants or with different ornamental plants.

Study the effect of various abiotic stresses and invest them in increasing indicators of plant secondary metabolic compounds and trying to reduce their harm to plant growth and flowering. Experimenting with the use of modern techniques in reducing growling in irrigation quantities with the possibility of calculating the water-print of the plant and studying its effect on the growth of new varieties of the Chrysanthemum plant in order to achieve the best integrated program for flower production.

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