RESPONSE OF SOME VARIETIES OF *Vigna unguiculata* (L.) WALP CULTIVATED IN SOUTHERN IRAQ TO DIFFERENT METHODS OF ADDITION AND CONCENTRATIONS OF HUMIC ACID IN GROWTH AND YIELD

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ABSTRACT

The experiment was conducted in the autumn season of 2019 to the growth and yield response of three cowpea (*Vigna ungiculata* (L.) Walp) varieties to humic acid concentrations and addation method. Three varieties of cowpea used were (Ramshorn, TSD and Biader) var. Humic acid were addid using foliar spray and ground irrigation at concentrations of 0, 2 and 4 mL liter^{-1}. The experiment was laid out in split plot design with three replicates. Mean values were compared using L.S.D at 0.05 level of probability. Results showed that the varieties differ significantly in growth parameters such as plant height and lateral branchees and yield parameters such as green pods, soft seeds in response to different concentrations of humic acid. 4 mL liter^{-1} of humic acid was highest in all the varieties for both addation methods than other concentrations. Ground irrigation method was better in application than foliar spray application. Bayader variety showed a better response in response to humic acid concentrations and applications.

Keywords: *Vigna ungiculata*; varieties; humic acid; method of addition; growth; yield.

INTRODUCTION

Humic acid is an organic acid that is naturally produced from the basic components of humus and consists of a mixture of hematics, phosphates and humates. Humic acid is important in permeability of cell membranes, stimulating enzymatic reactions, increasing cell division,

elongating cells, increasing enzyme production and stimulating vitamins inside cells [1].

Humic acid can be added to the soil by watering or spraying on the vegetative system, which gives positive results in plant growth [2]. Several studies have proven that the addition of humic acid to the soil increases the absorption of nutrients by the plant and increases the strength of the root system growth and increases the number of beneficial microorganisms in the soil [3,4,5,6,7].

Cowpea (*Vigna ungiculata* (L.) Walp) is a legume plant that belongs to the Fabaceae family and its nutritional importance comes from its high content of protein and carbohydrates and some mineral salts such as calcium, iron and some vitamins (A1, B1, B2). green pods can be used as cooked food for humans or as animal feed [8]. Researches has been carried out on the effects of different nutrients and application on the growth and yield of cowpea Information on the amount of humic acid required for the growth and yield of cowpea is dearth. Therefore, concentration of humic acid and application methods required for the optimum growth and yield and of cowpea varieties under study needs clarification, hence this study.

Two nutrients application methods (foliar spray and ground irrigation) were used for adding humic acid at three concentrations (2, 0, 4 mL Litre^{-1}).

Humic acid application was carried out three times throughout the course of the experiment. The first addition was made after 21 days of planting, and subsequently at 10 days intervals at a rate of 400 g / line. The drip irrigation system was extended in the area of the lines and watered by the Shatt Al-Arab water. Three to four seeds of cowpea varieties were sown (after soaking them for 6 hours) on both sides of the line and at a distance of 30 cm between one pit and another. The seedlings were later thinned down to 2 plants per pit.

The experiment was laid out in split split plot design with three replicates.

The following growth parameters were determined at the end of the season; height of the plant, the number of lateral branches, the number of leaves and the area of leaves (dcm^2). The yield parameters determined were; number of flowers in the inflorescence, the number of inflorescences per plant, number of green pods, weight of green pods (gm) and number of seeds in pods per.

The results were analyzed using the Genstat program. The arithmetic mean of the coefficients was compared and tested according to the test of the least significant difference of L.S.D and at a probability level of 0.05.

RESULTS AND DISCUSSION

From Table 1, method of nutrient applications significantly affected plant height and number of lateral branches, while concentrations of humic acid spray did not have a significant effect on these parameters of the three varieties. Plant height of Bayader compared to other varieties increased 69.81 and 39.11% Number of branches of Rameshorn and Bayader cultivars increased by 7.17 and 5.42% respectively compared to TSD varieties. This significant increase may be attributed to the genetic factors of the variety and the extent of its response to climatic factors. This finding is consistent with what El-Hefny [9] and al- Al-Tahafyi and his group [10] found.

The ground irrigation method was significantly effects than the foliar application to height plant and latiral branches, with an increase of 15.61 and 5.67%. This may be attributed to the effect of Humic acid in altering soil properties by reducing acidity (pH), increasing microorganism activity and releasing necessary nutrients N, P, K from unavailable forms. This is consistent with the study of Yousif [11].

The interactions did not show a significant effect on the number of branches and the height of the plant except for the overlap between the cultivars and the application methods on lateral branches. Bayader variety has the highest plant height (129 cm) for both humic acid (2 ml L^{-1}) and ground irrigation method, while Rameshorn sprayed with distilled water had the lowest plant height (52 cm).

Table 1. Shows the effect of the cultivar, the method of adding and different concentrations of humic acid and their interactions in height of the plant. Cm & Number of latiral branches plant^{-1}

Varitety	Method add	Height of the plant. cm				Number of latiral branches. Plant $^{-1}$			
		Concentrations ml. L $^{-1}$			Interference between varieties and the method of addition	Concentrations ml. L $^{-1}$			Interference between varieties and the method of addition
		0	2	4		0	2	4	
Ramshorn	spray	52.0	66.2	53.4	57.1	3.33	4.36	4.59	4.098
	Ground irrigation	69.0	76.7	82.5	76.1	3.31	3.92	4.79	4.010
TSD	spray	86.2	60.2	82.5	76.4	3.51	4.19	4.93	4.212
	Ground irrigation	80.7	91.7	86.2	86.2	3.610	4.59	5.22	4.478
Bayader	spray	102.5	113.4	109.6	108.5	3.553	3.97	4.51	4.014
	Ground irrigation	103.0	129.0	120.8	117.6	3.727	4.54	5.33	4.534
L.S.D 0.05			36.27		N.S		N.S		0.146
					Varieties rate				Varieties rate
Interference between varitety and concentrations	Ramshorn	60.5	71.5	67.7	66.6	3.325	4.142	4.695	4.054
	TSD	83.3	76.0	84.5	81.3	3.560	4.397	5.078	4.345
	Bayader	102.8	121.2	115.2	113.1	3.640	4.258	4.925	4.274
L.S.D 0.05			N.S		11.76		N.S		0.098
					Average addition				Average addition
Overlap between the addition method and the concentrations	spray	80.2	80.0	81.8	80.7	3.467	4.177	4.681	4.108
	Ground irrigation	84.3	99.2	96.5	93.3	3.550	4.354	5.11	4.341
L.S.D 0.05			N.S		9.55		N.S		0.109
Average concentrations		82.3	89.6	89.2		3.508	4.266	4.899	
L.S.D 0.05			N.S				N.S		

From Table 2 (variety and addition methods and concentration significantly affected the total number of leaves and the leafy area. TSD variety significantly outperformed the Rameshorn and Bayader varieties with an increase of (8, 2.7, 3.43 and 5.43) %. The increase may be attributed to the genetic factors of the varieties and its response to climatic factors (Ref). This study is in agreement with Shhada and Saeed [12]. The ground irrigation method was significantly superior in number of leaves and the leafy area compared to the spraying method, with an increase of 6.96 and 11.53%, This result is consistent with Yousif [11] Humic acid concentrations had a significant effect on number of leaves and the leafy area The concentration of humic acid (4 ml.L^{-1}) was the highest on number of leaves and the leafy area compared to the concentration at 0 and 2 ml.L^{-1} at an increase rate of 40.31 and 16.58% and 5.2 and 31.73%, respectively, The increase may be attributed to the action of humic acid, which supplies the nutrients that contribute to vital activities like N.PK…. The increase might also be attributed to the nitrogen available in humic acid into building the amino acids that stimulate the plant to produce the auxin that promote cell division and elongation of cells, thereby increasing the number of leaves and the leaf area (Dantasetal, 2007). This result is consistent with [6,9,12].

The overlap between the varieties and the addition method showed a significant effect, in number of leaves and the leaf area, Bayader variety supplied with ground irrigation method had the most number of leaves (20.956), while Bayader variety supplied with spray method had the lowest number of leaves (18,233) Rameshorn cultivar

supplied with irrigation method had the highest leaf area of (26.48 dcm^2), while the plants of the cultivar Rameshorn and Bayader, supplied with spraying method, gave the lowest leaf area of (21.88 dcm^2).

The interaction between the addition method and the concentrations showed a significant effect number of leaves and the leaf area, Those varieties supplied with the ground irrigation method with a concentration of 4 ml. L^{-1} the largest number of leaves (23,578) and the most leaf area (33.97 dcm^2), while the plants sprayed with distilled water had the least number of leaves (15.813) leaves and leaf area (19.11 dcm^2).

The overlap between the cultivars and concentrations, significantly affected the leaf area TSD cultivar supplied with with humic acid at a concentration of 4 $ml.L^{-1}$ had the best.

The triangular overlap, showed a significant effect on the leafy area only, as the Bayader cultivar plants supplied with watering method with a concentration of 4 ml^{-1} liter of humic acid had the highest leaf area (35.51 dm^2),while the cultivar plants Rameshorn sprayed with distilled water gave the lowest area of 18.53 dm^2.

From Table 3 the two varieties Rameshorn and TSD had higher number of flower per plant compared to the cultivar Bayader, with an increase rate of 1.64 and 2.32%, The varieties did not differ significantly between them in the number of flowers inflorescences and may be attributed to the genetic factors and the extent of their response to climatic and terrestrial factors Addition method had a significant effect on the number of flowering inflorescences as well as the average number of flowers in the inflorescence. The ground irrigation method was significantly

Table 2. Shows the effect of the cultivar, the method of adding and different concentrations of humic acid and their interactions in number of leaves $plant^{-1}$ and leaf area dcm^2 $plant^{-1}$

Varitety	Method add	Number of leaves. $Plant^{-1}$				Leaf area. dcm^2 .$plant^{-1}$			
		Concentrations ml. L^{-1}			Interference between varieties and the method of addition	Concentrations ml. L^{-1}			Interference between varieties and the method of addition
		0	2	4		0	2	4	
Ramshorn	spray	15.707	18.550	21.380	18.546	18.53	21.73	25.40	21.88
	Ground irrigation	15.333	18.067	22.067	18.489	19.46	26.57	33.25	26.48
TSD	spray	16.167	19.267	22.700	19.378	19.45	24.71	31.40	25.19
	Ground irrigation	16.633	21.167	24.067	20.622	19.33	22.03	33.15	24.84
Bayader	spray	15.567	18.300	20.833	18.233	19.34	21.72	24.58	21.88
	Ground irrigation	17.267	21.000	24.600	20.956	18.77	22.40	35.51	25.56
L.S.D 0.05			N.S		0.307		1.401		0.818
					Varieties rate				Varieties rate
Interference between varitety and concentration	Ramshorn	15.520	18.308	21.723	18.517	19.08	24.15	29.32	24.18
	TSD	16.400	20.217	23.383	20.00	19.39	23.37	32.27	25.01
	Bayader	16.417	19.650	22.717	19.594	19.06	22.06	30.05	23.72
L.S.D 0.05			N.S		0.243		0.975		0.648
					Average addition				Average addition
Overlap between the addition method and the concentrations	spray	15.813	18.706	21.638	18.719	19.11	22.72	27.13	22.98
	Ground irrigation	16.411	20.078	23.578	20.022	19.25	23.67	33.97	25.63
L.S.D 0.05			0.486		0.212		0.838		0.566
Average concentrations		16.112	19.392	22.608		19.18	23.19	30.55	
L.S.D 0.05			0.396				0.602		

Table 3. Shows the effect of the cultivar, the method of adding and different concentrations of humic acid And their interactions in the average number of flower stands plant^{-1} and the number of flowers in the inflorescence

Varitety	Method add	The average number of flower stands plant^{-1}				The average number of flowers in the inflorescence			
		Concentrations ml. L -1			Interference between varieties and the method of addition	Concentrations ml. L -1			Interference between varieties and the method of addition
		0	2	4		0	2	4	
Ramshorn	spray	19.467	22.833	25.567	22.622	7.233	9.165	12.068	9.490
	Ground irrigation	19.233	22.700	24.467	22.132	7.063	9.245	12.560	9.624
TSD	spray	18.033	22133	24.200	21.456	7.305	9.105	12.020	9.477
	Ground irrigation	16.33	22.600	25.533	21.522	7.235	9.480	12.580	9.765
Bayader	spray	19100	21.800	27.767	22.889	6.900	9.088	12.062	9.350
	Ground irrigation	18.733	23.500	24.900	22.378	7.100	9.036	12.169	9.402
L.S.D 0.05			1.044		0.969		0.246		0.109
					Varieties rate				Varieties rate
Interference between varitety and concentrations	Ramshorn	19.350	22.767	25.017	22.378	7.153	9.205	12.314	9.557
	TSD	17.233	22.367	24.867	21.489	7.270	9.293	12.300	9.621
	Bayader	18.917	22.650	26.333	22.633	7.000	9.036	12.169	9.402
L.S.D 0.05			0.966		N.S		0.246		0.109
					Average addition				Average addition
Overlap between the addition method and the concentrations	spray	18.876	22.256	25.844	22.322	7.148	9.119	12.050	9.439
	Ground irrigation	18.133	22.933	24.967	22.011	7.134	9.237	12.472	9.614
L.S.D 0.05			N.S		N.S		N.S		0.105
Average concentrations		18.500	22.594	25.406		7.141	9.178	12.261	
L.S.D 0.05			0.282				0.163		

superior compared to the method of foliar spray and with an increase rate 1.85% while addition method did not significantly affect the number of flower inflorescences, This might be due to the effect of the addition method, which causes an increase in the strength of vegetative growth by which stimulating the increase in flowering growth. This result corresponds to [13], which found a significant increase in number of flowering inflorescences with addition of humic acid at two concentrations of 2.4 g.L^{-1} and 4 g.L^{-1} in bean plants (*Phaseolus vulgaris* L.). Concentrations of humic acid, affected both traits concentration of on the traits exceeded concentrations (0 and 2) ml.L^{-1}, with an increase rate of 3.73 and 12.44% and 71.69 and 33.59% for both traits the effect increased significantly, with increased spray concentration and both traits.

The increase may be attributed to the role of humic acid in improving the vegetative growth of the plant and increasing the efficiency of the photosynthetic process, which was positively reflected in the increase in the number of flowers and inflorescences [14].

This result is consistent with tariq and his group [15] on the addition of humic acid on cucumber plants (*Cucmis sativus* L.). Andwith [16] also observed increase in the number of flower inflorescences of strawberry plants, with ground addition of humic acid at a concentrations of 300,

450, 600 and 750 mgL^{-1} and leaf spray at concentrations of 300, 600, 900, 1200 mgL^{-1}.

The overlap between the varieties and the addition method showed a significant effect for number of flower $plant^{-1}$ and flowers in the inflorescence cultivar Bayader Foliar spray plants had the largest number of flower inflorescences (22.889), while the TSD Foliar spray plants had the lowest number of flower inflorescences to (21.456). Rameshorn variety supplied with ground irrigation method had more flower numbers (9,765) flowers, while Bayader Foliar spray had the lowest number of flowers reached (9,350) flowers. The overlap between the varieties and concentrations showed a significant effect for number of flower stands $plant^{-1}$ and flowers in the inflorescence. Bayader variety treated with humic acid at a concentration of 4 mlL^{-1} had the largest flower inflorescences (26,333), while untreated TSD plants with humic acid gave the lowest number of flower inflorescences to (17,233).

Rameshorn cultivar treated with humic acid at a concentration of 4 ml L^{-1} had the largest number of flowers per inflorescence reached (12.314) flowers, while the cultivar Bayader untreated with humic acid had the lowest number of flowers (7) for the inflorescence.

The interference between the addition method and the concentrations did not show a significant effect for both traits, whereas the triple interference had a significant effect for both traits, as the cultivar Bayader sprayed with humic acid at a concentration of 4 ml L^{-1} gave the largest number of flower inflorescences (27.767) while the TSD plants irrigation with distilled water gave the lowest number reached (16.433). TSD cultivars sprayed with humic acid at a

Table 4. Shows the effect of the cultivar, the method of adding and different concentrations of humic acid And their interactions on green pods yield and seeds, soft. Gm. $plant^{-1}$

varitety	method add	Green pods yield gm.$plant^{-1}$				Seeds yiled gm. $plant^{-1}$			
		Concentrations ml. L -1			Interference	Concentrations ml. L -1			Interference
		0	2	4	between varieties and the method of addition	0	2	4	between varieties and the method of addition
Ramshorn	spray	47.76	75.00	82.97	68.57	22.06	44.24	64.66	43.65
	Ground irrigation	42.51	81.38	89.27	671.05	20.53	52.71	78.12	50.45
TSD	spray	48.00	66.21	88.52	67.58	25.61	40.95	75.82	47.46
	Ground irrigation	43.00	72.80	95.34	70.38	21.26	44.83	77.22	47.77
Bayader	spray	42.99	64.28	68.77	58.68	19.89	34.77	59.97	38.21
	Ground irrigation	41.85	77.75	86.01	68.54	20.79	47.25	77.83	48.62
L.S.D 0.05			N.S		N.S		N.S		2.711
					Varieties rate				Varieties rate
Interference between varitety and concentrations	Ramshorn	45.14	78.19	86.12	69.81	21.30	48.47	71.39	47.05
	TSD	45.50	69.51	91.93	68.98	23.44	42.89	76.52	47.62
	Bayader	42.42	71.02	77.39	63.61	20.34	41.01	68.90	43.42
L.S.D 0.05			2.907		1.375		3.291		1.866
					Average addition				Average addition
Overlap between the addition method and the concentrations	spray	46.25	68.50	80.09	64.94	22.52	39.99	66.82	43.11
	Ground irrigation	42.45	77.31	90.20	69.99	20.86	48.27	77.73	48.95
L.S.D 0.05			3.352		2.744		2.906		1.878
Average concentrations		44.35	72.90	85.15		21.69	44.13	72.27	
L.S.D 0.05			1.907				2.063		

concentration of 4 ml L^{-1} gave the largest number of flowers in one inflorescence (12.580) while Bayader sprinkled with distilled water had the lowest number reached (6.9) flowers in one inflorescences.

From the results obtained in Table 4 the humic acid addition methods and concentrations significantly affected green pods and soft seeds of all the cowpea varieties Rameshorn and TSD had higher green pods and soft seeds than Bayader variety with an increase of 9.76 and 8.44%, 8.36 and 9.67%. There was no significant difference ($p \leq 0.05$) in green pods and soft seeds between Rameshorn and TSD cultivars. This finding is consistent with what [6,9,12].

The ground irrigation method showed significant increase in green pods and soft seeds compared to the spray method, (7.77 and 13.54)%, This may be due to the addition of humic acid to the soil, which improved the properties of the soil, including the pH which facilitated the plant to absorb nutrients and subsequently increase in the efficiency of photosynthesis and carbohydrates accumulation and thus increasing the yield [11].

Increasing the concentrations of addition with humic acid led to a significant increase, as the effect increased significantly in the yield of green pods and fresh seeds plant by increasing the acid concentration. Plants added to humic acid at a concentration of 4 ml 1 liter exceeded the treatment and treatment 2 ml 1 liter by an increase (91.99) and 16.80%, (233.19) and 63.67%, respectively, and the increase can be attributed to the role of humic acid in increasing the vegetative and syphilis growth, which was reflected in the increased accumulation of processed nutrients and their accumulation in fruits. This finding is consistent with what Barakat et al. [17].

The overlap between varieties and the concentrations showed a significant effect for green pods and soft seeds Ground irrigation method with a concentration of 4 mlL^{-1} had the highest yield of green pods and soft seeds (90.20 and 77.73 g), while the plants irrigated with distilled water had the lowest values (42.45 and 20.34 g) Rameshorn cultivar had the highest yield (50.45), while the Bayader cultivar Foliar spray with humic acid the lowest yield of 38.2g.

CONCLUSION

From the results obtained in this study Rameshorn and TSD responded better to humic acid concentrations and applications than Bayader Method of adding humic acid by ground irrigation at a concentration of 4 ml L^{-1} had higher growth and productivity on cowpea varieties to other treatments cultivated in city conditions (Basrha during the autum season).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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