

# Some Physiological Parameters of the Yields of *Vicia faba* L and *Triticum vulgare* L Irrigated with Zamzam, Desalinized and Well Water.

Hamed, B. A.<sup>1</sup>; Mutwally, H. M. A.<sup>2</sup> and Omar, S. A. M.<sup>1</sup>

1- Basic science Department, Faculty of Community, Al-Baha University, KSA.

2- Biology Department, Faculty of applied Science, Umm Al-Qura University, KSA.

## Abstract

Broad bean (*Vicia faba* L.) and wheat (*Triticum vulgare* L.) were grown on artificial soil and were irrigated with zamzam, desalinized and well water. Zamzam water recorded the highest values of yield criteria, soluble carbohydrates, total carbohydrates, protein and total nitrogen contents. Well water recorded moderated results, while desalinized water (as control) recorded the lowest values. Results were discussed according to mineral contents of the used water.

## Introduction

The problem of food shortage and deficiency is considered to be one of the most extremely global and dramatic problems across the world. FAO recorded that about 10-15% of the peoples do not obtain their enough food requirements (Koubaili and Khodary, 2005), so scientists should exert a lot of effort to be with the hope of increasing food production in terms of both quality and quantity so that a radical solution is found. *Vicia faba* plant is considered as one of the most popular and cheapest protein source (Spilsbury,2004), while *Triticum vulgare* is considered as one of the most common source of carbohydrate food stuff (Yu, 2008 ). Zamzam well is a well present in Makkah, Saudi Arabia which contains multi-minerals such as Ca, Mg, S, Fe, Mn and Cu.(Mutwally and Al-Sayaad, 2002). This well is considered to be the most famous well in the Islamic world. Muslims, from all walks of life, visit the well to drink, to seek cure, to do their ablution and wash. This, in fact, makes plenty of this water goes to the sewage system. Because of that, The need arises to invest this huge amount of water in agriculture, where some plants can be grown either as food crops or as useful street trees especially at holly places such as Arafat and Mina places. In this connection Mutwally *et al.*, (2008) studied the effect of zamzam water as a an irrigating water on

some growth parameters of wheat and broad bean plants and they found that zamzam water improved those estimated parameters.

The aim of this work was to investigate the effect of Zamzam water, in comparison with well water (already used in irrigation) and desalinated water (as control), on some parameters of the yield quality of two of the most famous crops; broad bean (*Vicia faba* L.) and wheat (*Triticum vulgare* L.).

## Material and Methods

Broad bean seeds (*Vicia faba* L.) and wheat grain (*Triticum vulgare* L.) were kindly provided by Field Crops Research Institute, Agricultural Research Center (ARC), Giza, Egypt. The experiment was carried out in a glass house on the roof of the Community College, Baha University, Baha, KSA. It was designed by dividing the experiment into three groups; first group was irrigated with zamzam water, second group was irrigated with desalinated water and third group was irrigated with well water. The irrigation was 100% field capacity in all treatment. Field capacity was calculated according to the method described by Abd El-Rahim *et al.*, (1998). Each type of these used water was analyzed by using methods described by Mutwally and Al-Sayaad (2002). Each group was divided into two subgroups; first subgroup was cultivated with broad bean seeds while second subgroup was cultivated with wheat grains. Cultivation was done in black plastic pots (25 cm diameter X 40 cm height). Each pot was filled up to 2/3 (with net weight 250 g) with artificial organic soil produced by Truf Entreprise Company, Germany. The data of the soil properties was tabulated in table (1). Each pot was cultivated with 5 uniformly seeds. Each subgroup had 25 replicates. At the sixth week, all treatments, according to the recommended doses, were fertilized with (1.57 g K<sub>2</sub>HPO<sub>4</sub> + 0.785 g K<sub>2</sub>SO<sub>4</sub>), Koubail and Khodary (2005). At the end of the experiment, each subgroup was divided randomly into five sets each set contained five replicates. The first set was used for morphological yield criteria. The second set was used for carbohydrate analysis according to Naguib (1964). The third set was used for the determination both of the amino acids by application the method of Lee and Takahashi (1966) and total protein by using the method described by Lowry *et al.*, (1951). The forth group was subjected to the method of Farag *et al.*, (1978), for determination of the total fatty acids , while lipids were estimated by the method of Burnes and Blackstock, (1973). The fifth group was used for estimation of some minerals inside the yield seeds (N, P, K, Ca, Mg, S and Fe) by using Perkin Elmer 3030 atomic absorption

while the percentage of the total mineral composition was determined according to Chapman and Pratt (1961) at Occupational Health Department, National Institute of Occupational Safety and Health (NIOSH), Cairo, Egypt. All obtained results were subjected to least significant difference (LSD) test which was carried out by using method of Helwing and Council, (1979).

## Results and discussion

By viewing data in table (2), we can find that, zamzam water contained many important nutritive elements such Ca, Mg, K, Fe, Cu, Nitrates, P, S, Ammonia, Zn and Mn. Each element has its nutritive values, Taiz and Zeiger, (2006). On the other hand, it had some harmful elements such as Na, nitrites, Cl, F and Pb. Although the concentrations of these elements were relatively low and within the safety range Mutwally and Al-Sayaad (2002), this presence may be controlled by the presence of other elements which either retard their absorption or their bad effect. In this connection, K may retard Na, Rush and Epstein, (1981); K may retard Cl, Bloom and Finazzo, (1986); Ca may retard Na, Hamed, (2000); and Ca may retard F, Kauss, (1983). In the case of the Pb, the presence of both K, Sluiter *et al.*, (1977), and P, Axelsen and Palmgren (2001), may retard its toxicity.

Data tabulated in table (3) showed that, the estimated yield criteria were significantly affected by the type of the water used. Zamzam water recorded the best criteria values, followed by well water while, desalinized water recorded the lowest criteria values. Taiz and Zeiger, (2006), discussed that, addition of macro- and micronutrients to plants may lead to improvement of their yield properties. As desalinized water had the lowest concentrations of these nutrients, it gave the lowest yield criteria. Well water gave a medium yield criteria and this may be because it had a medium nutritional concentration.

The effect of the used water type on the soluble and total carbohydrate fractions was shown in table (4). It is noticeable that, these fractions were significantly changed due to the type of water used. Many botanists discussed the effect of these nutrients on the carbohydrate concentrations. Some botanists referred such effect to the enhancement in the photosynthetic rate which occurred either by ammonia, Winter, *et al.*, (1982); by Cu, Delhaize *et al.*, (1986); by Mn, Engelsma, (1972); or by S, Delaporte *et al.*, (1987). Some botanists referred such effect to the enhancement in the photosynthetic pigments either by Fe, Spiller *et al.*, (1982) or by Mn, Taiz and Zeiger, (2006). The increase in the carbohydrate fractions may also be referred to the activity occurred in the

carbohydrate metabolism by the effect of either K, El-Sheikh and Ulrich. (1970); P, Fredeen *et al.*, (1989), or by Ca, Hamed, (2000).

The estimated amino acids and protein contents are displayed on table (5). These contents were increased in zamzam water application more than well water application, while desalinized water recorded the least contents. The effect of the nutritive elements on amino acid and protein biosynthesis may be explained through the effective roles of each element. Bloom and Finazzo,(1986), reported that, ammonia stimulated the metabolic rate of nitrates causing an increase in total amino acids and protein content in barley plants. Guo *et al.*, (2008), explained the positive effect of Cu as it increases metallothioneins biosynthesis and its distribution. Sevilla *et al.*, (1982), explained that, manganese increased amino acids biosynthesis through increasing superoxide dismutases enzyme. Taiz and Zeiger, (2006), discussed suggested that the increasing of amino acids and protein may be due to the enhancement effect of K on the biosynthesis of RNA. Rufty *et al.*, 1990, stated that amino acids and protein contents were increased because P increased the bioconversion of nitrate into amino acids. Tabe and Droux, (2002), demonstrated that, the S stimulated protein biosynthesis through stimulating the conversion of organic sulfur compounds into S- containing amino acids. Goldgur *et al.*, (2007), pointed to the role of Zn in the mechanism of changing protein from unfolded to folded state which led to an increase in the protein biosynthesis.

Table (6) showed the data of total fatty acids and lipids of the two tested plants due to application of the three types of water used. These fractions were positively responded to the treatment applied. Zamzam water gave the best results while desalinized water gave the lowest values. Such increment may be explained due to the positive effect of P role in nucleoprotein biosynthesis and/or ATP biosynthesis Taiz and Zeiger, (2006). Hamed, (2000), demonstrated an increase in fatty acids and total lipids due to Ca application, and he reported that, such increment may be due to an activation in their metabolism. Delaporte *et al.*,(1987), referred the general activation occurred in the plant biosynthesis to the activation occurred in the photosynthetic efficiency as a result of the application of S element.

The concentration of some macro- and micronutrient in the yield of the two tested plants are tabulated in table(7). Broad bean accumulated more nutrients than wheat plants and this result was in agreement with the results obtained by Bloom and Finazzo, (1986), who reported that, the

absorption, translocation and accumulation of the nutrients depends on not only on the species of the plant but also on the genotype of the same species. Rush and Epstein, (1981), found a positive relationship between the concentration accumulated inside the plant and the concentration applied during mineral nutrition, and this positive relation was obvious in the data represented in the table.

Generally, the benefits obtained by application of zamzam water may be due not only to the type of the nutrient existed in the water but also on the ratio between these nutrient which acted as synergetic agents for useful nutrients or antagonistic agents for harmful elements to retard their harmful effects. Finally this work was a trial to throw light on the importance and the benefits of zamzam water.

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## The Tables

Table (1): The general properties of the soil used to compare the effect of zamzam, desalinated and well water on the yield of *Vicia faba* and *Triticum vulgare*.

Item	Value
Nitrogen (N)	2.1%
Phosphorous (P <sub>2</sub> O <sub>5</sub> )	2.7%
Potassium (K <sub>2</sub> O)	1.1%
Magnesium (Mg)	1.2%
Iron (Fe)	1.2%
Manganese (Mn)	247 mg/kg
Zinc (Zn)	11 mg/Kg
Copper (Cu)	40 mg/Kg
Organic matter	65-75%
Moisture content	35 – 55%
pH	5.5 -6.5
E C	1.5 – 1.8 m-mos/cm

Table (2): Some properties of the three types of the used water.

Item	Zamzam water	Desalinized water	Well water	LSD <sub>1%</sub>	LSD <sub>5%</sub>
pH	6.97	6.84	7.92	0.451	0.326
Conductivity Ms/cm	1597.16	219.00	523.67	108.03	78.12
Total hardness (ppm)	360.33	20.00	76.55	10.03	7.25
Total alkalinity (ppm)	29.83	19.67	45.89	6.36	4.60
Calcium (ppm)	112.17	4.62	20.44	3.08	2.22
Magnesium (ppm)	22.45	2.26	7.48	3.63	2.62
Potassium (ppm)	38.83	0.00	3.50	1.91	1.38
Sodium (ppm)	53.0	0.00	41.13	4.66	3.37
Iron (ppm)	0.0015	0.02	0.17	0.004	0.003
Copper (ppm)	24.32	0.005	0.059	0.193	0.267
Chlorides (ppm)	175.01	9.88	80.27	1.50	1.09
Florides (ppm)	0.82	0.00	0.22	0.004	0.003
Nitrates (ppm)	97.9	0.19	3.95	1.33	0.96
Nitrites (ppm)	0.279	0.004	0.0123	0.006	0.005
Phosphate (ppm)	0.2535	0.0013	0.0035	0.006	0.005
Sulphates (ppm)	270.42	0.00	15.63	3.93	2.84
Ammonia (ppm)	0.0013	0.002	0.46	0.05	0.03
Zinc (ppm)	0.13	0.003	0.531	0.25	0.18
Lead (ppm)	0.002	0.006	0.011	0.003	0.002
Manganese (ppm)	<0.07	<0.07	<0.07	---	---
Cadmium (ppm)	<0.025	<0.025	<0.025	---	---
Chromium (ppm)	<0.13	<0.13	<0.13	---	---
Bicarbonates (ppm)	388	46.67	61.11	10.55	7.63
Total suspended solids (ppm)	0.233	0.03	12.67	1.01	0.73
Total dissolved salts (ppm)	781.00	7.33	241.17	38.69	27.98

Table (3): Effect of the irrigation with zamzam, desalinized and well water on some criteria of the yield of *Vicia faba* and *Triticum vulgare*.

Treatment	Item	<i>Vicia faba</i>	<i>Triticum vulgare</i>
Fruit length (cm)	Zamzam water	7.8	11.9
	Desalinized water	5.4	8.2
	Well water	6.3	9.6
	LSD <sub>1%</sub>	0.7	0.9
	LSD <sub>5%</sub>	0.55	0.71
No of fruit/plant	Zamzam water	3.7	12.6
	Desalinized water	2.4	7.4
	Well water	3.1	10.2
	LSD <sub>1%</sub>	0.33	2.11
	LSD <sub>5%</sub>	0.26	1.66
No of seed/plant	Zamzam water	13.2	49
	Desalinized water	7.4	29
	Well water	9.8	39
	LSD <sub>1%</sub>	1.14	8.51
	LSD <sub>5%</sub>	0.90	6.71
Wt of 1000 seeds	Zamzam water	612.63	42.08
	Desalinized water	413.52	27.12
	Well water	534.79	33.81
	LSD <sub>1%</sub>	61.34	2.27
	LSD <sub>5%</sub>	48.38	1.79

Table(4): Effect of the irrigation with zamzam, desalinized and well water on some carbohydrate fractions (mg/g D Wt) of the yield of *Vicia faba* and *Triticum vulgare*.

Treatment	<i>Vicia faba</i>		<i>Triticum vulgare</i>	
	Soluble carbohydrate	Total carbohydrate	Soluble carbohydrate	Total carbohydrate
Zamzam water	384.014	681.642	562.412	822.415
Desalinized water	304.281	524.624	342.815	512.835
Well water	352.875	581.452	429.068	634.714
LSD <sub>1%</sub>	32.821	53.018	32.112	46.112
LSD <sub>5%</sub>	25.889	41.821	15.502	22.260

Table (5): Effect of the irrigation with zamzam, desalinized and well water on total amino acids and total protein (mg/g D Wt) of the yield of *Vicia faba* and *Triticum vulgare*.

Treatment	<i>Vicia faba</i>		<i>Triticum vulgare</i>	
	Total amino acids	Total protein	Total amino acids	Total protein
Zamzam water	44.287	287.173	30.116	214.311
Desalinized water	29.782	234.112	19.537	158.426
Well water	30.479	215.125	24.701	192.115
LSD <sub>1%</sub>	2.416	8.311	2.154	13.108
LSD <sub>5%</sub>	1.905	6.556	1.699	10.339

Table (6): Effect of the irrigation with zamzam, desalinized and well water on total fatty acids and total lipids (mg/g F Wt) of the yield of *Vicia faba* and *Triticum vulgare*.

Treatment	<i>Vicia faba</i>		<i>Triticum vulgare</i>	
	Total fatty acids	Total lipids	Total fatty acids	Total lipids
Zamzam water	1.42	19.121	1.724	23.213
Desalinized water	0.84	9.142	0.93	12.356
Well water	1.07	14.235	1.33	17.984
LSD <sub>1%</sub>	0.29	2.168	0.31	2.962
LSD <sub>5%</sub>	0.23	1.737	0.25	2.373

Table (7): Effect of the irrigation with zamzam, desalinized and well water on elemental composition (ppm) and total mineral matter percentage of the yield of *Vicia faba* and *Triticum vulgare*.

Element (ppm)	Water type	Broad bean	Wheat	Element (ppm)	Water type	Broad bean	Wheat
N	Zamzam	2114	1325	Mg	Zamzam	0.492	0.382
	Desalinized	1812	1132		Desalinized	0.422	0.326
	Well	1985	1256		Well	0.462	0.363
	LSD 1%	22.14	20.64		LSD 1%	0.019	0.009
	LSD 5%	27.66	25.78		LSD 5%	0.024	0.112
P	Zamzam	1.954	1.554	S	Zamzam	0.286	0.234
	Desalinized	1.675	1.328		Desalinized	0.245	0.201
	Well	1.835	1.473		Well	0.269	0.224
	LSD 1%	0.024	0.016		LSD 1%	0.007	0.005
	LSD 5%	0.300	0.020		LSD 5%	0.087	0.006
K	Zamzam	1.411	0.964	Fe	Zamzam	1.837	1.554
	Desalinized	1.209	0.824		Desalinized	1.575	1.328
	Well	1.324	0.914		Well	1.724	1.471
	LSD 1%	0.042	0.017		LSD 1%	0.038	0.029
	LSD 5%	0.052	0.021		LSD 5%	0.047	0.036
Ca	Zamzam	0.052	0.038	Mineral matter percentage	Zamzam	1.94	1.82
	Desalinized	0.042	0.031		Desalinized	1.63	1.56
	Well	0.047	0.034		Well	1.82	1.73
	LSD 1%	0.004	0.003		LSD 1%	0.049	0.023
	LSD 5%	0.005	0.004		LSD 5%	0.061	0.029

## الملخص العربي

بعض الدلالات الفسيولوجية لمحصولي نبات الفول البلدي والقمح المرتوين بماء زمزم  
أو ماء الآبار أو الماء المحلى

بدر الدين عبد العال حامد<sup>1</sup> - حامد محمد عبد القادر متولي<sup>2</sup> - سعيد أحمد محمد عمر<sup>1</sup>

1- قسم العلوم الأساسية - كلية المجتمع - جامعة الباحة - المملكة العربية السعودية.

2- قسم علوم الحياة - كلية العلوم التطبيقية - جامعة أم القرى - المملكة العربية السعودية.

لأن بئر زمزم يعد أشهر بئر ماء عند المسلمين الذين يستهلكون منه كميات هائلة على مدار الساعة مما ينتج عنه أيضاً ذهاب كميات عائلة إلى الصرف الصحي لذا كان هذا البحث محاولة لإلقاء الضوء على أهمية هذا الماء للنبات نظراً لما يحتويه من عناصر غذائية كبرى وصغرى. وقد أجريت هذه التجربة في صوبة زراعية على سطح مبنى كلية المجتمع بجامعة الباحة بالمملكة العربية السعودية، وقد تمت الزراعة على التربة الصناعية التجارية وقد قسمت التجربة إلى ثلاث مجموعات، المجموعة الأولى رويت بماء زمزم والمجموعة الثانية رويت بالماء المحلى بينما رويت المجموعة الأخيرة بماء الآبار والذي يستخدم طبيعياً كماء الري الزراعي. وقد أظهرت النتائج أن محتوى الكربوهيدرات الذائبة والكلية ومحتوى الأحماض الأمينية الكلي والبروتين وكذلك محتوى الأحماض الدهنية الكلي والدهون علاوة على محتوى بعض العناصر الغذائية الكبرى والصغرى وأخيراً النسبة المئوية للمحتوى المعدني لمحصول النباتين قد استجابوا لماء زمزم استجابة إيجابية الذي أعطى أفضل النتائج يليه ماء الآبار بينما سجل الماء المحلى أقل النتائج. هذا وقد عزيت هذه النتيجة إلى سببين أحدهما تواجد الأنواع الكثيرة من العناصر الغذائية في ماء زمزم أما السبب الثاني هو نسبة تواجد هذه العناصر مع بعضها البعض مما جعل هذه العناصر تتأزر فيما ينفع النبات وتتضاد مع العناصر الضارة للنبات. وقد اعتبر الباحثون هذا البحث خطوة مبدئية لإلقاء الضوء على الأهمية الفسيولوجية لماء زمزم بالنسبة للنبات.