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EFFECT OF FOLIAR APPLICATION OF WHEY ON GROWTH TRAITS, GRAINS YIELD AND IT'S COMPONENTS IN SORGHUM (VAR. BOHOOTH 70)

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ABSTRACT

A field experiment was carried out at the experimental Farm-College of Agricultural Engineering Science - University of Baghdad - Iraq during the autumn season of 2018 and spring season of 2019 to study the effect of Whey concentration (0, 25%, 50% and 75%) and three dates of foliar application (spraying after each Irrigation, spraying after twice Irrigation and after three times of Irrigation) was applied one month after emergence on growth traits, grain yield and it's components of Sorghum (var.Bohooth.70) . The experiment was applied using R.C.B.D arranged in split plot with three replication. Foliar application dates were used as main-plots, while whey concentration was used as sub - plots. Results showed that, in both seasons spraying whey at a conc. 75% significantly increase plant height, leaf area, Biological yield, weight of grain per head, number of grains per head. The highest grain yield in both seasons was 7.037 and 6.804 t. ha^{-1} for autumn and spring receptively. Foliar application at the date after each irrigation gave highest mean in all growth traits, grain yield and it's components. The highest grain yield in autumn and spring seasons was 6.527 and 6.118 t. ha^{-1} respectively. Highest grains yield 7.320 and 6.779 t. ha^{-1} can be obtained when sorghum plant were sprayed with whey at conc. 75% after each Irrigation in autumn and spring respectively.

Keywords: Whey, *Foliar application dates, Sorghum*

Introduction

Sorghum (*Sorghum bicolor* L. Moench) is cereal and forage crops that important locally and globally, as it ranks fifth in term of importance and production for cereal crops in the world, after wheat, rice, maize, and barley. In Iraq, it is cultivated spreads at different regions of the world like Asia, Africa, America and spreads at different regions of the world like Asia, Australia. In Iraq, it is cultivated to produce green forge and grains area for grain production amounted to 34050 ha^{-1} and mean production per hactare only 1.896 ton (Department of Agricultural economics, 2016) and the provinces of miss an, Wasit and The-Qar occupied the foreground rank in production sorghum grains are used as human food in many poor countries after mixing it with wheat flour in the percentage of 50% (AL-younis, 1993). It is also consumed as staple food grain and is used for a variety of products like alcohol, edible oil, sugar and waxes. Despite the importance of this crop , it's grains and green forage production was still less than required level and this is due to the limited studies in this field especially new genotype entry and breeding and improvement processes methods done under the Iraqi conditions. wherefore, A new genotype was registered and adopted by the Iraqi Ministry of Agriculture as the best cultivar for it's high productivity in green forage yield and named as Bohooth 70 (Nutional committee for recording and protecting Agricultural varieties, 2016) it was well known that spreading a new cultivar among farmers needs how to produce the grains of this cultivar. Many studies were carried out on this cultivar with in regard to the effect of nutrients and growth regulators on grain yield by (Abood *et al*., 2017) and (AL-Ameny and khrbeet, 2018). But there are some aspects still away from researchers attention such as effect of organic fertilizers as alternative to chemical fertilizers which become well known with their harmful effect on human health by environment pollution which requires the use of organic alternatives such as whey the waste product of cheese factories, it is one of the most, important nutrients in foliar fertilization because it contains water, protein, lactose, nutritional elements and elements and vitamins (Al-Dahan, 1987) whey is added or sprayed as a supplement to the fertilization process in order to reduce the quantities of added chemical fertilizers. This material was used to improve wheat and soybeans when sprayed on the plant. as spring help to increase the growth speed and the absorb nutrients from the soil and increase the leaf content of protein and chlorophyll (Konar and Ariogdiu, 1987), (Haroun and Ibrahim, 2003) so this study was aimed at increasing grain yield by using whey and knowing the best concentration and the suitable date for spraying on sorghum crop.

Materials and Methods

A field experiment was conducted in the field of experiments at Field Crops Department, College of Agricultural Engineering Sciences, University of Baghdad during the autumn season 2018 and the spring season of 2019. Using sorghum Cultivar (Bohooth 70) which is

registered and adopted recently by Iraqi Ministry of Agricultural. Layout of the experiment was R.C.B.D, arranged in split plot with three retributions. Foliar application dates (spraying after each Irrigation, spraying after twice Irrigation and after three Irrigation) were used as main plots, while whey concentration (0, 25%, 50% and 75%) were used as sub-plots. The experimental unit area for both seasons was 6 m^2 with dimension of 2x3 m, 4 lines were opened in each experimental unit with distance of 50 cm between each line and length 3m. The seeds were planted in pits at a distance of 25 cm between each hole by putting 3-5 seed in each hole . The date of planting in autumn season was done on 22-7-208, while spring season was done on 21-3-2019. chemical fertilizers was added as recommended by Ministry of Agricultural, but only 1/3 of the dose at N was applied after two week from planting, and their after the whey conc. were applied according to the treatments. corn borer was controlled by using dyazanone fluied for two times. the first in stage of 3-4 leaves and the second after two weeks of the first control with dyazanone as recommended by Iraqi Ministry of Agriculture (Hamdan, 2006). The solution of whey was prepared according to the required concentration and the whey was obtained from Dairy factory in our college, the components of whey and their properties are shown in table 1.

Table 1 : Components of whey and some chemical properties of nutrients

Whey components	pH	Water	Protein	N	fat	Lactose	Ash	P	K	Ca
%	6.2	93.3	1.14	0.18	0.1	4.42	0.52	0.04	0.13	0.03

The spraying was done after one month of emergence at morning till complete wet of the whole plant according to the determined concentrations whereas control treatment was sprayed with distilled water only .the experiment was harvested on 11-10-2018 and 15-7-2019 for autumn and spring season respectively, and the fellowing traits were studied for both seasons:

1. Plant height (cm)

The plant height was measured by taking five plants randomly from the midline of each treatment starting from the soil surface to the top of the head at maturity (Khrbeet *et al*., 2014).

2. Leaf area (cm^2)

Five plants were selected randomly from the Two mid. Lines at full flowering stage. By measuring leaf length and width for all plant leaves the leaf area was calculated by using the following formula :

$$A = L \times W \times 0.75$$

Where, A= leaf area cm^2, L = leaf length, W= the widest part in leaf (cm) ,

0.75: standard (Liang *et al*., 1973)

3. Yield and it's components

Five heads were selected extracting. their grains and the mean production was measured, and the number of grains per head was also calculated.

The total grain yield ($t.h^{-1}$) was measured from grain weight of one plant x plant density. Biological yield was measured after dring five plants and then harvest index was calculated according to the following formula:

Harvest index = Grain yield / Biological yield x 100 (Rao, 1987)

The data were statistically analyzed according to the analysis of variance and the arithmetic mean was compared using the least significant difference L.S.D at the level of significance 5% (Al- Rawi and Khalaf Allah, 2000).

Results and Discussion

Plant height (cm)

Date presented in Table 2 show that there was significant effect of whey concentration, dates of foliar application and their interaction on this trait for both seasons. There were significant increases in plant height with increase in whey concentration, The percentage of increases at the used of 25%, 50% and 75% compare with control treatment for autumn and spring seasons reached (2.3%, 25.2% and 33%), (6.4%, 20.7% and 25.5%) respectively. This increases in plant height may be due to that whey contain on may nutritional element especially the nitrogen which has arole in the synthesis of amino acid Tryptophane, which forms the basis for ehe synthesis of IAA which lend increase internodes elongation and their by increase plant height. These results are in agreement with results fond by Erman (2011) on cicer, Grosu (2012) on soya bean and Bakry (2016) on flax.

Table 2 show, that, plant sprayed with whey after each irrigation gave highest plant height amounted to 299.2 cm and 220.7 cm for autumn and spring seasons respectively. This increases in plant height may be due to increase the amount of whey after increase frequent spraying which increases the amount of N received by plants and this in turn lead to increase stem elongation. These results agreed with results of saleh and Khrbeet (2020) on sorghum also. In both season, there were significant interaction between the two factor and this infraction could be explained bused on the difference in relative response to whey concentration according to date of spraying.

Leaf area (cm^2)

Results in table 3 show, that leaf area of the plant increases significantly with increases of whey concentration and in both seasons, such percentage of increases after sprayed with 25%, 50% and 75% of whey compare with control treatment in autumn and spring season were reached (0.74%, 6.3% and 10.7%) and (2.2%, 9.56% and 14.96%) respectively. This may be due to the effect of whey on increasing the plant height and their by increasing leaf area and this confirmed by positive correlation value of correlation coefficient between this trait and plant height which reached ($^{+}$0.95 and $^{+}$0.90) in autumn and spring seasons respectively.

Table 3 indicated that there was significant effect of date of spraying on this trait, plant sprayed with whey after each irrigation produced highest leaf area in autumn and spring seasons reached to 9235 and 58411 $cm^2.plant^{-1}$ respectively. This increases in leaf area in plant speyed after

each irrigation nay be due to, that this plant received more quantity of nutrients, since whey contain more nutrients especially Nitrogen (N) which encourage vegetative growth and increase leaf area duration (ABood *et al*.; 2017)

The significant interaction between the two factors was due to the differences in relative response of whey concentration in different spraying dates.

Biological yield (t.ha^{-1})

The results of table 4 indicate that highest biological yield was obtained from plant received high conc. of whey reached 35.08 t.ha^{-1} in the autumn season, and it is significantly differed than all concentrations except the conc. at 50%, while in spring season high conc. of whey was produced highest biological yield amounted to 30.86 t.ha^{-1} and it was significantly differed than all concentration. The increases in biological yield after spraying with whey nay be due to increase in plant height table 2 and leaf area table 3 and this confirmed by positive correlation value of correlation coefficient between these traits and biological yield which reached ($^{+}$0.56 and $^{+}$0.64) in autumn season and ($^{+}$0.84 and $^{+}$0.86) in spring season. This result was agreed with that found by Erman *et al*. (2011), Grosu *et al*. (2012) and Bakry *et al*. (2016).

Table 4 indicated that the highest mean of biological yield were obtained from plants sprayed with whey after each irrigation reached 34.63 and 29.85 t.ha^{-1} in autumn and spring season respectively. this result may be due to increase in plant height and leaf area (Tables 2,3)

The interaction between the two factors was only significant differences in spring season and this interaction probably due to differences in the relative response of biological yield by differences concentration of whey and date of spraying.

Grains weight per head (g)

Table 5 show, that this trait was significantly affected by concentration of whey, dates of spraying and their interaction. it was noted that high conc. of spraying with whey at 75% in both seasons gave the highest grains weight per head reaching 85.54 and 81.11g and it was significantly differed than all concentrations. The reason behind the increase in grains weight with increasing whey concentration may be due to the role of whey in increasing leaf area which lead to absorbed more nutrients especially N which resulted in increase the duration of seed filling and this in turn increase grains weight (Abood *et al*., 2017).

As for date of foliar application of whey, the foliar application after each irrigation produced highest grains weight per head reached 81.59 and 76.46 g for autumn and spring seasons respectively and it was significantly differed compare with other dates. This result probably due to increase leaf area which in turn lend to increase grain filling duration and their by increase grain weight. This result agreed with results found by Peterson (1979**)** on maize and Bakry, *et al*. (2016) on falx.

Cockering the significant interaction between the two factors may be interpreted based on the difference in the relative response of each spraying date and different concentration, so we find that the difference were lower in response among spraying concentration in date of spraying after three time of irrigation compare with other two dates.

Number of grains in head (grain head^{-1})

Table 6 showed that this character was significantly affected by concentration of whey and spraying dates and their interaction. it was noted that the high concentration of spraying with whey at 75% conc. in seasons gave the highest mean of grains in undivided head reaching 3420.8 and 2402.4 in autumn and spring season respectively and significantly different than other concentration, where as number in head reaching 3008.5 and 2043.4 for autumn and spring season respectively and differed significantly from all concentration.

The reason behind the increase in number of grains in head in head with increasing whey concentration may be due to the increase in dry matter (table 4). which began to the transfer to the reproductive parts and this will increase their ability and fertility. This result agreed with results of Erman *et al*. (2011).

Table 6 indicated that date of spraying after each irrigation gave the highest mean in number of grains season respectively and significantly differed from other spraying date, Increase the dry matter in this date probably behind the reason of increase the number of grains per head.

As for interaction between the two factors was due to the differences in relative response of whey concentration in different spraying dates.

Grain yield (t.h^{-1})

The results of table 7 indicated significant effect of whey concentrations, spraying dates and their interaction in both season. it was noted that the highest Mean of grain yield was at spraying with high concentration of whey 75% in both seasons reaching 6.843 and 6.489 t.ha^{-1} for autumn and spring season respectively. spraying whey at the concentration 25%, 50% and 75% caused increase in grains yield compare with control treatment (0.91%, 6.8% and 15.2%) and (0.5%, 5.7% and 14.3%) for autumn and spring season respectively. The increase in grains yield by spraying whey at conc. 25%, 50% and 75% was due to the increase in dry matter, grains weight and number per head (Tables 4, 5, and 6) and this was confirmed by positive correlation value of correlation coefficient between these characters and grains yield which reached ($^{+}$0.68. $^{+}$0.99 and $^{+}$0.89) in autumn season and ($^{+}$0.94, $^{+}$0.99 and $^{+}$0.76) for spring season.

Table 7 show, that , increase the time between date of spraying twice and three times after irrigation caused reduction in grain yield compare with spraying after each irrigation, This reduction also due to reduction in dry matter, grains yield per head and number of grains per head. These result are agreed with that found by Peterson, et al; (1979), Erman *et al*. (2011) and Bakry *et al*. (2016).

There were significant interaction between the two factor for both season, and this interaction could be explained based on the difference in relative response to whey concentration according to date of spraying.

Harvest index (%)

Results in table 8 revealed a signification effect of harvest index with whey concentration for both seasons, form that it was noted that the highest mean of harvest index was at whey concentration of 75% reached (19.48% and 21.01%) for autumn and spring seasons respectively and it was

significantly different to all concentration. where as the lowest mean of harvest index was at control treatment which reached 17.79% and 19.69% for autumn and spring seasons respectively but did not differ significantly from the concentration of 25%.

This may be due to increase in grains yield at the concentration of 50% and 75% of whey and that was clear in high significant positive correlation between harvest index and grain yield reaching $^{+}0.88$ and $^{+}0.92$ in autumn and spring respectively.

Date of spraying affected harvest index significantly in both seasons, delay the spraying after the 2nd and 3nd irrigation reduce the harvest index. This may be due to decrease in grains yield. there was significant interaction between the two factor, but only in autumn season and this interaction probably due to differ in the relative response of concentration when spraying at different dates.

Table 2 : Effect of concentrations and dates of spraying whey and interaction between them on height of plant (cm) Autumn season 2018 and Spring season 2019

Seasons	Date of spraying	whey concentrations %				Mean
		%0	%25	%50	%75	
Autumn	spraying after each Irrigation	256.0	265.3	330.0	345.6	299.2
	spraying after twice Irrigation	250.8	257.1	313.6	341.1	290.6
	Irrigation spraying after three times of	250.6	252.4	305.1	321.7	282.5
L.S.D 5%				9.5		7.5
Mean		252.5	258.3	316.2	336.1	
L.S.D 5%				5.11		
Spring	spraying after each Irrigation	191.3	200.6	241.0	249.8	220.7
	spraying after twice Irrigation	185.0	203.9	231.8	241.4	215.5
	Irrigation spraying after three times of	183.1	190.7	202.4	210.9	196.8
L.S.D 5%				8.5		4.1
Mean		186.5	198.4	225.1	234.0	
L.S.D 5%				5.3		

Table 3 : Effect of concentrations and dates of spraying whey and interaction between them on The leaf area (cm^2) Autumn season 2018 and Spring season 2019.

Seasons	**Date of spraying**	**Whey concentrations %**				**Mean**
		%0	%25	%50	%75	
Autumn	spraying after each Irrigation	8773	8841	9441	9886	9235
	spraying after twice Irrigation	8647	8757	9249	9722	9094
	spraying after three times of Irrigation	8677	8696	9047	9291	8927
L.S.D 5%				154.7		73.9
Mean		8699	8764	9246	9633	
L.S.D 5%				97.5		
Spring	spraying after each Irrigation	5343	5487	6082	6453	5841
	spraying after twice Irrigation	5217	5320	5834	6202	5643
	spraying after three times of Irrigation	5097	5192	5239	5347	5219
L.S.D 5%				214.9		117.4
Mean		5219	5333	5718	6000	
L.S.D 5%				132.5		

Table 4 : Effect of concentrations and dates of spraying whey and interaction between them on Biological yield (t ha^{-1}) Autumn season 2018 and Spring season 2019

Seasons	**Date of spraying**	**whey concentrations %**				**Mean**
		%0	**%25**	**%50**	**%75**	
Autumn	spraying after each Irrigation	33.59	34.22	34.86	35.83	34.63
	spraying after twice Irrigation	33.87	33.74	34.80	35.79	34.55
	spraying after three times of Irrigation	32.79	32.98	33.30	33.60	33.17
L.S.D 5%				N.S		0.36
Mean		33.42	33.65	34.32	35.08	
L.S.D 5%				0.89		
Spring	spraying after each Irrigation	28.55	29.21	29.95	31.70	29.85
	spraying after twice Irrigation	28.73	28.92	29.42	31.57	29.66
	spraying after three times of Irrigation	29.20	28.70	29.02	29.32	29.06
L.S.D 5%				0.38		0.16
Mean		28.83	28.94	29.46	30.86	
L.S.D 5%				0.24		

Table 5 : Effect of concentrations and dates of spraying whey and interaction between them on weight of grains head (g) Autumn season 2018 and Spring season 2019.

Seasons	Date of spraying	whey concentrations %				Mean
		%0	%25	%50	%75	
Autumn	spraying after each Irrigation	75.09	76.28	83.47	91.50	81.59
	spraying after twice Irrigation	74.46	74.95	79.39	89.38	79.55
	spraying after three times of Irrigation	73.10	73.48	74.96	75.74	74.32
L.S.D 5%				2.47		1.16
Mean		74.22	74.91	79.27	85.54	
L.S.D 5%				1.56		
Spring	spraying after each Irrigation	71.44	72.49	77.21	84.74	76.47
	spraying after twice Irrigation	70.32	71.49	75.40	83.53	75.19
	spraying after three times of Irrigation	71.15	70.02	72.48	75.07	72.18
L.S.D 5%				2.47		1.05
Mean		70.97	71.33	75.03	81.11	
L.S.D 5%				1.58		

Table 6 : Effect of concentrations and stages of spraying whey and interaction between them on Number of grains per head (grain head^{-1}) Autumn season 2018 and Spring season 2019

Seasons	Date of spraying	whey concentrations %				Mean
		%0	%25	%50	%75	
Autumn	spraying after each Irrigation	2994.4	3298.6	3337.0	3825.4	3388.9
	spraying after twice Irrigation	3023.2	3033.8	3267.2	3409.2	3183.4
	spraying after three times of Irrigation	3008.0	2903.6	2925.4	3027.7	2966.2
L.S.D 5%				102.66		70.42
Mean		3008.5	3078.7	3209.9	3420.8	
L.S.D 5%				59.33		
Spring	spraying after each Irrigation	2083.4	2278.6	2403.7	2960.4	2431.5
	spraying after twice Irrigation	2046.2	2003.8	2247.2	2209.2	2126.6
	spraying after three times of Irrigation	2000.6	1980.3	2017.0	2037.7	2008.9
L.S.D 5%				85.10		54.20
Mean		2043.4	2087.6	2222.7	2402.4	
L.S.D 5%				50.50		

Table 7 : Effect of concentrations and stages of spraying whey and interaction between them on Grain yield (t ha^{-1}) Autumn season 2018 and Spring season 2019

Seasons	Date of spraying	whey concentrations %				Mean
		%0	%25	%50	%75	
Autumn	spraying after each Irrigation	6.007	6.103	6.678	7.320	6.527
	spraying after twice Irrigation	5.957	5.996	6.351	7.150	6.364
	spraying after three times of Irrigation	5.848	5.878	5.997	6.059	5.946
L.S.D 5%				0.193		0.093
Mean		5.937	5.992	6.342	6.843	
L.S.D 5%				0.125		
Spring	spraying after each Irrigation	5.715	5.799	6.177	6.779	6.118
	spraying after twice Irrigation	5.626	5.719	6.032	6.683	6.015
	spraying after three times of Irrigation	5.692	5.602	5.798	6.005	5.774
L.S.D 5%				0.198		0.084
Mean		5.678	5.707	6.002	6.489	
L.S.D 5%				0.126		

Table 8 : Effect of concentrations and stages of spraying whey and interaction between them on Harvest index (%) Autumn season 2018 and Spring season 2019

Seasons	Date of spraying	whey concentrations mg L^{-1}				Mean
		%0	%25	%50	%75	
Autumn	spraying after each Irrigation	17.91	17.83	19.17	20.43	18.84
	spraying after twice Irrigation	17.60	17.79	18.27	19.98	18.41
	spraying after three times of Irrigation	17.85	17.83	18.02	18.04	17.93
L.S.D 5%		0.99				0.24
Mean		17.79	17.82	18.49	19.48	
L.S.D 5%		0.65				
Spring	spraying after each Irrigation	20.01	19.85	20.62	21.38	20.46
	spraying after twice Irrigation	19.58	19.77	20.49	21.16	20.25
	spraying after three times of Irrigation	19.49	19.51	19.97	20.48	19.86
L.S.D 5%		N.S				0.32
Mean		19.69	19.71	20.36	21.01	
L.S.D 5%		0.42				

References

A.O.A.C. (1975). Association of official analytical Chemists Official meth of A.O.A.C., 10 Thud Republished by A.O.A.C. Washington D. C., U. S. A. 58 (4): pp 115..

Agricultural Economics Research Department. 2016. The statistical brochure of the agricultural crops data (second edition). Agricultural Research Department, Ministry of Agriculture. P. P. 64.

Al-Dahan, A.S. and Al-Khal, K. (1987). Occasional dairy products. Salahaddin University

Al-Nuaimi, S.A.N. (1999). Fertilizers and soil fertility Ministry of Higher Education and Scientific Research. University of Al Mosul. Iraq

Al-Rawi, K.M. and Abdul Aziz Muhammad Khalaf Allah (2000). Design and analysis of agricultural experiments, Dar Al-Kutub Foundation for Printing and Publishing, College of Agriculture, University of Mosul, Ministry of Higher Education and Scientific Research. Iraq.

Al-Younes, A.H.M. (1993). Production and Improvement of Field Crops, Ministry of Higher Education and Scientific Research. University of Baghdad-College of Agriculture, Part 1.

Attia, Hatem Jabbar Atiyah and Khidir Abbas Jadou'. 1999. Plant Growth Regulators Theory and Practice. Ministry of Higher Education and Scientific Research, Baghdad - Printing House for Books

Bakry, A.B.; M.sh. Sadak; Abdallah, M.M.S.; Abd El-Razik, T.M. and Dawood, M.G. (2016). Maximizing the performance, productivity quality traits of two flax cultivars by using some bio-fertilizers under newly reclaimed sandy soil. Res. J. Pharm., Biol. and Chem. Sci. 7(6): 429-441.

Erman, M.; Demir, S.; Ocak, E.; Tüfenkçi, Ş.; Oğuz, F.; and Akköprü, A. (2011). Effects of Rhizobium, arbuscular mycorrhiza and whey applications on some properties in chickpea (*Cicer arietinum* L.) under irrigated and rainfed conditions 1-Yield, yield components, nodulation and AMF colonization. Field Crops Research, 122(1): 14-24.

Grosu, L.; Fernandez, B.; Grigoraş, C.G.; Patriciu, O.I.; Grig-Alexa, I.C.; Nicuță, D. and Fînaru, A. L. (2012). Valorization of whey from dairy industry for agricultural use as fertiliser: effects on plant germination and growth. Environmental Engineering and Management Journal (EEMJ), 11(12).

Hamdan, M.I. (2006). Guidance on the cultivation and production of sorghum. General Authority for Guidance And agricultural cooperation. White Corn Research Development Project, Guideline No. 19.

Khrbeet, H.K. and Ahmed, M.J. (2015). The effect of planting dates and cutting stages on the yield and quality of green fodder for the white seventy corn. 1- Growth characteristics and green fodder yield, Iraqi Journal of Agricultural Sciences. 46(4): 475-483.

Khrbeet, H.K.; Hamid, S. and Hussein, K. (2014). Spray boron, grain and its ingredients in white corn. Iraqi Journal of Agricultural Sciences, 45(5): 470-478.

Liang, G.H.; Chu, C.C.; Reddi, N.S.; Lin, S.S. and Dayton, A.D. (1973). Leaf blade area of sorghum varieties and hybrid. Agron. J. 65: 456-459

Peterson, A.E.; Walker, W.G. and Watson, K.S. (1979). Effect of whey application on chemical properties of soil and crops. J Agric. Food Chem. 27: 654-658.

Rao, M.M.; Govindasamy, R. and Chandrasekeran, S. (1987). Effect of humic acid on sorghum vulgare var. CSH- 9. Current science. 56(24): 1273-1276.

Natioual committee for Recording and protecting Agricultural varieties. (cited 2016 June 8). Ministry of Agricultural – Republic of Iraq.

ABood, N.M.; Khrbeet, H.Kh. and Saleh, A.Kh. (2017). Effect of foliar application of nitrogen on grain yield and it's component in sorghum. The Iraqi. J. Agric. Sci. 48(3): 740-748.

Al-Amery, A.H. and Khrbeet, H.K. (2018). Effect of concatenation and dute of foliar application (Sorghum bicolor). Journal of Education and Scientific Studies, 1(13), 77-92.

Konar, A. and Arioglu, H. (1987). Effect of cheese whey as a fertilizer on the increase of soybean nodules. Soybean Genetics Newsletter, 14: 139-143.

Haroun, S.A. and Ibrahim, A.H. (2003). Whey induced modification in growth, Photosynthetic characteristics, protein patterns and water relations of wheat seedlings. Egypt. J. 2 (2): 141-153.

Salih, H.A. and Khrbeet, H.K.H. (2020). The influence of fuller application of whey and periods of cutting on some growth parameters and forage yield in Sorghum (var.Bohooth.70). Plant Archives, 20(2): 1805-1811.