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THE INFLUENCE OF FOLIAR APPLICATION OF WHEY AND PERIODS OF CUTTING ON SOME GROWTH PARAMETERS AND FORAGE YIELD IN SORGHUM (VAR.BOHOOTH 70)

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Abstract

A field experiment was carried out at the experimental farm, Faculty of Agricultural Engineering Science, University of Baghdad, during summer season of 2018, in order to study the influence of the foliar application of whey and periods of cutting on forage yield and its quality of sorghum (var.Bohooth 70). The experiment was designed according to Randomized Complete Block Design (R.C.B.D) using split-plot arrangement with three replicates periods of cutting (45, 55, 65, and 75) days after sowing were used as main plots, while foliar application of Whey and nitrogen (control treatment ,nitrogen as recommended, foliar application of Whey at conc. 50%and foliar application of Whey at conc.75%) referred to T_1,T_2,T_3 and T_4 respectively. Three cutting were obtained during the growing season. Results showed that cutting period after 75 days from sowing was significantly increased the plant height of (149.33, 133.9 and 115.9) cm, and green forage yield of (44.0, 33.37, 24.47) $t.ha^{-1}$, for the three cutting respectively. Moreover, the cutting period after 45 days from sowing has significantly increased the chlorophyll content of leaves by (53.53, 57.27 and 51.56) SPAD and the leaves /steams ratio of (1.68, 1.49, and 1.376) for the three cutting respectively. The treatment of N fertilizer recommendation was superior in plant height by (200.09, 184.9 and 156.2) cm, in leaves /steams ratio (1.45, 1.28, 1.43), in chlorophyll content (50.52, 49.74 and 48.8) SPAD. As well as, green forage yield by (36.52, 30.02 and 22.75) $t.ha^{-1}$, and it did not differ significantly from the treatment of the foliar application of whey at concentration 75% in the green forage yield in first cutting only. Finally, the decrease percentage in the total green forage yield when using whey at concentration 75% compared to the fertilizer recommendation was 4.9%. The results showed that there was a significant interaction between whey and periods of cutting for all the characteristics.

Keywords: Sorghum, Whey, Periods of cutting, Crop growth traits, Green forage.

Introduction

Sorghum (*Sorghum bicolor* L. Moench) is a cereal and forage crops that important locally and globally, as it ranks fifth in terms of importance and production for cereal crops in the world, after wheat, rice, maize, and barley. The cereals for this crop are used as food for humans in many poor countries after mixing with wheat flour at a rate of 50% (Al-Younes, 1993). As for the developed countries, it extracts from sorghum grains the starch and glucose due to the high percentage of carbohydrates in it, which amounts to more than 67%, besides, its grains are a rich source of vitamin B, and the protein content in the grains reaches more than 11%, so it is used in animal feeding. In addition to its importance as a vital crop, this crop is among the most important summer green forage crops that contribute significantly to meeting the need for green forage in summer in Iraq. This crop can withstand drought and salinity, and the number of cutting increases with increasing temperatures (Ottman and Olsen, 2009). Furthermore, it is considered as one of the crops that capable to grow and branch after cutting and can preserve its good quality compared to maize, which provides more cutting during the summer season, as well as low fiber content (Teuksch, 2002; Banks, 2005). Besides, it is capable to grow in a wide range of soil and climate conditions and to withstand high temperatures and droughts, as it gives a good crop in semi-arid regions and is one of the crops that bear salinity (Kharbit and Hashim, 2017). In Iraq, the Sorghum is the first summer forage crop in irrigated areas in central and southern Iraq, by giving many cuttings ranged between 3-4 cuttings during the summer period. However, the number of cutting is affected by the agricultural processes used as cutting periods, which has related to the quality of forage produced and according to its purpose, whether it is to produce green forage, hay or silage (Rahman *et al*., 2003). Additionally, this crop is one of the crops with the highest need for nitrogen, especially when grown for green forage. However, there are caveats against using high doses of nitrogen to increase the yield of green forage, due to increasing the concentration of Hydrogen cyanide HCN toxic to the animal. In addition, the recent recommendation in the possibility of reducing the use of nitrogen fertilizers as they pollute the environment and focus on alternatives from organic fertilizers, and search for safe nutritional sources in the environment that do not have negative effects on humans and animals, and from these organic fertilizers used are the waste of cheese factories (whey). It considered as a by-product of cheese making and one of the most important nutrients in foliar fertilization because it contains water, a percentage of whey proteins, lactose, nutritional elements, and a few vitamins. hey is added or sprayed as a supplement to the fertilization process in order to reduce the quantities of added chemical fertilizers that cause major environmental pollution to plants, people and animals and, and it is used to feed animals and irrigate pastures (Lai, 1983). This material was used to improve wheat and soybeans when sprayed on the plant, as spraying helped to increase the growth speed and increase the ability of plants to absorb nutrients from the soil and increase the leaf content of protein and chlorophyll (Konar and Arioglu, 1987, Haroun and Ibrahim, 2003). Most recent studies and research in the field of plant nutrition indicate that spraying nutrients on the shoot is an effective way to produce the plant nutrients by absorbing them directly by plant tissues. It also indicated the possibility of

compensation for the use of chemical fertilizers and based on the foregoing. The study aimed to provide forage along the time through the appropriate cutting stage, taking into consideration the safe quality of animal health, as well as the possibility of reducing the use of nitrogen by compensation using the whey and determining its best concentration.

Materials and Methods

A field experiment was carried out at the experimental farm, Faculty of Agricultural Engineering Science, University of Baghdad Al-Jadriya during summer season 2018, in order to study the influence of the foliar application of whey. As well as, the periods of cutting on forage yield and it's quality and HCN content of sorghum (var.Bohooth70) newly registered as the best variety for green forage in Iraq. The experiment was carried out according to Randomized Complete Block Design (R.C.B.D) using a split-plot design arrangement with three replicates, as the main-plot included cutting periods after (45,55,65, 75,) days from sowing, where it gave a symbol of (C_1, C_2, C_3, and C_4) respectively. Furthermore, the sub-plot included whey concentrations, which are spraying with distilled water and fertilizing according to recommendations with nitrogen 200 kgN.ha^{-1}, and whey with a concentration of 50% and 75% as (T_1, T_2, T_3, and T_4), where its components and the chemical properties are shown in Table 1 respectively, at the rate of three sprays per cutting. The period between one spray to another was a week, where the spraying was done by dilution with distilled water and according to the concentrations. Spraying was done on the shoot after adding a surfactant such as liquid soap in a small percentage in the early morning until full wetness after irrigating the experiment field before spraying one day to help open the stomata and increase the absorption process.

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	455 ppm	1365 ppm	383.3 ppm

The experiment land was prepared from plowing, harrowing and leveling, then it was divided into experimental units, the area of the experimental unit reached 6 m^2 with dimensions (3 x 2 m). Each experimental unit contained five lines and the distance between one line, another 40 cm, and the length of the line 3 m, the seeding rates amounted to 48 kg.ha^{-1}, where the seeds were distributed inside the single line, then covered well in the soil at a depth of 5 cm. A distance of meter was left between one replicate and another, and meter between the sub-plot, random samples were taken from the experiment land before planting and at a depth of (0-30) cm to estimate some physical and chemical characteristics as shown in Table 2. The experiment was fertilized with phosphate fertilizer mixing with the soil before planting at a level of 100 kg P.ha^{-1} as a triple superphosphate 45% (P_2O_5) in one batch. As for nitrogen fertilizer, it was added at the level of 200 kg N.ha^{-1} in the form of urea (46% N) in batches, the first batch, it was added after two weeks of planting, while the other batches were added after each cutting to ensure the restoration of growth after cutting (Hamdan, 2006). The experiment land was irrigated immediately and immediately after planting to ensure that, the seeds remained in the hole in the planting lines, while the other irrigation was given according to the need and the following characteristics were studied:

Table 2 : Physical and chemical properties of the soil before planting

Elements		Unit	Value
Soil texture		------	Silty clay
Soil separator	Sand	%	26.3
	Silt		35.5
	Clay		38.2
PH			7.12
Ec		Ds.m^{-1}	3.83
Ca		Mg.l^{-1}	18.70
Mg		Mg.l^{-1}	11.22
dissolved K		Mg.l^{-1}	32
Na		Mg.l^{-1}	8.82
Cl		Mg.l^{-1}	23.24
Co_3		Mg.l^{-1}	Nill
$Caco_3$		%	23.45
Om		%	0.52
NPK available	N	ppm	26
	P		13.38
	K		179.26

Plant height (cm): The height of the plant was measured at each cutting according to the cutting periods by randomly selecting ten plants. Their lengths were measured by a wooden ruler in centimeters starting from the surface of the soil until the end of the flag leaf from the two adjacent lines of the two middle lines from each experimental unit.

Leaves/stems ratio (based on dry weight): was calculated based on dry weight, for five plants taken randomly from the two adjacent lines of the two middle lines, and the ratio of leaves/stems was calculated.

Leaf chlorophyll content (SPAD): was measured by the device SPAD 502 for five leaves per experimental unit as an indication of the degree of leaf greenness according to Linchtenthaler method (1987).

Green forage yield for each cutting (ton.ha^{-1}): the midline plants were cutting at each cutting stage and for each cutting at a height of (10-15) cm from the soil surface. An electronic balance weighed the green forage yield immediately after cutting to ensure no loss part of the moisture because of evaporation, and based on that, the green forage yield was calculated for all cutting and all treatments.

Results and Discussion

Plant height (cm)

It was observed from Table 3 that the cutting period after 75 days from sowing exceeded the rest of the other cutting periods for all three cutting and both seasons, as it reached the highest average plant height were 242.86, 226.9 and 193.0 cm. Moreover, the lowest average for this characteristic was at the cutting period after 45 days from sowing were 149.33, 133.90 and 115.90 cm, for all three cutting respectively. The reason for increasing the plant height by the progress of cutting periods because of the plant's continued growth and elongation until the plant reaches full maturity; this result is consistent with the results of (Al-Fahdawi 2011; Al-Dulaimi 2012; Jassem 2014, Hussein and Abdul Amir, 1995). They confirmed that the character of the plant height for Sorghum has been affected by the cutting stages, and the plant height increases from the beginning of the growth stage until the plant is aging. Table 3 showed the superiority of treatment (T_2) in the characteristic of plant height for all the cutting for both seasons, and it differed with the rest of treatments T_1, T_3 respectively. However, it did not differ from treatment (T_4) for the first cutting by giving 198.32 cm, as the treatment of fertilizer recommendation gave 200.09, 184.9 and 156.2 cm for all three cutting, respectively, while treatment T_1 gave the lowest average of 176.07, 161.3 and 133.4 cm for the first, second and third cutting respectively. The reason for increasing the plant height in treatment (T_2) and (T_4) may be due to the role of nitrogen that has increased in the treatments of recommendation and foliar application of whey at high concentration because this element has a role in biological interactions in the Meristematic regions.

Table 3 : The influence of the foliar application of whey and cutting periods and interaction between them for the three cuts on the plant height (cm).

Cutting	Whey and fertilization treatment	Cutting periods				Average
		C1	C2	C3	C4	
First cutting	T1	143.77	157.83	184.67	218.0	176.07
	T2	153.73	183.80	208.67	254.17	200.09
	T3	145.43	174.33	221.00	245.73	196.62
	T4	154.40	181.0	204.33	253.53	198.32
	L.S.D 0.05	7.59				3.80
	Average	149.33	174.24	204.67	242.86	
	L.S.D 0.05	2.13				
Second cutting	T1	128.0	141.7	171.0	204.7	161.3
	T2	138.4	154.7	204.3	242.3	184.9
	T3	133.4	147.1	187.3	232.0	175.0
	T4	135.8	152.5	190.8	228.7	176.9
	L.S.D 0.05	N.S				6.07
	Average	133.9	149.0	188.4	226.9	
	L.S.D 0.05	6.39				
Third cutting	T1	109.5	113.8	138.7	171.6	133.4
	T2	118.9	128.0	170.7	207.2	156.2
	T3	116.9	119.8	155.5	196.8	147.3
	T4	118.1	125.9	157.6	196.6	149.5
	L.S.D 0.05	N.S				6.23
	Average	115.9	121.9	155.6	193	
	L.S.D 0.05	5.92				

As cellular division increases therein, and nitrogen has a role in the synthesis of the amino acid Tryptophan, which forms the basis for the synthesis of the growth hormone TAA, which increases when nitrogen levels increase in the plant (wareaing, 1983). This, in turn, leads to an increase in plant height, and this result is consistent with the findings of (Abood *et al*., 2017 and Mohammad 2009), which they found an increase in the height of the Sorghum plant after the addition of nitrogen. These results in terms of the whey influence are consistent with (Haroun and Ibarhim 2003; Abdel Hamid 2009), confirmed that the whey leads to an increase in plant height compared to not adding it. Table 3 indicates that there was a significant interaction between the two study factors in the first cutting period in the two seasons, and the second in the first season only. Conceivably the reason for this interaction is due to the difference in the relative response to cutting periods with different treatments of fertilizer and foliar application of whey. Furthermore, an increase in the response to plant height is observed at treatment (T_2) whenever the plant is cut by a late age, as the same with treatment (T_4) has shown the same response when delaying plant cutting.

Leaves/stems ratio (based on dry weight)

Table 4 showed that the leaves / stems ratio decreased with the progress of cutting periods, were at the cutting period after 45 days from sowing reached the highest ratio of 1.68, 1.49 and 1.37 for the three cutting respectively. Whereas the lowest ratio was at the cutting period after 75 days from sowing reached 0.81, 0.64, and 0.64 for all three cutting. The reason for the decrease in leaves/stems ratio when the cutting period's progress is due to the plant progress in age and then the vegetative growth slow. As well as, the tendency of the plant towards maturity, unlike the early stages of the plant's life in which the plant is at the peak of its vegetative growth, and then the leaves/stems ratio increase. The production of leaves in the plant stops when the plants begin to flowering, meaning that the number of leaves reaches the maximum level and decreases after the plant reaches the maturity stage. Meaning that the leaves/stems ratio decreases as the plant progresses with maturity, and this result is consistent with (Cumins, Tohnson 1980; Al-Dulaimi, 2012; Hamad, 1986; Jasem, 2014, and Ali, 1975). Table 4 indicates the superiority of treatment (T_2) over the rest of the treatments in the leaves / stems ratio compared to the rest of the treatments, while it did not differ from the treatment (T_3) for the first cutting only. It gave (1.45, 1.28 and 1.43) for all three cutting, respectively, while the treatment T_1 gave the lowest leaves / stems ratio of 0.88, 0.72, and 0.72 for all three cutting, this result is consistent with (Hamad, 1986). The reason for the increase in leaves / stems ratio by adding nitrogen in treatment (T_2) and (T_4) is that nitrogen contributes to increasing the plant parts, including the leaves that contribute to photosynthesis because of its positive impact on the leaf area. In addition to the number of leaves by encouraging it to vegetate growth and increase leaf area, Table 4 showed a significant interaction between the two study factors, and the reason for this may be due to the different response to cutting periods with different treatments of fertilizer. As well as, foliar application of whey, where by both (T_2) and (T_4) excelled and for the first and second instances when cutting plants after 45 days from sowing, then this ratio decreased as the cutting period was delayed due to the fact that plants may determine the number of leaves while the stems remain growing and increasing in diameter.

Table 4 : The influence of the foliar application of whey and cutting periods and interaction between them for the three cutting on leaves / stems ratio

Cutting	Whey and fertilization treatment	Cutting periods				Average
		C1	C2	C3	C4	
First cutting	T1	1.38	0.88	0.63	0.61	0.88
	T2	2.00	1.58	1.24	0.99	1.45
	T3	1.39	0.95	0.72	0.73	0.95
	T4	1.93	1.50	1.36	0.91	1.43
	L.S.D 0.05	0.12				0.06
	Average	1.68	1.23	0.99	0.81	
	L.S.D 0.05	0.06				
Second cutting	T1	1.12	0.79	0.52	0.44	0.72
	T2	1.80	1.4	1.12	0.82	1.28
	T3	1.36	0.83	0.62	0.58	0.85
	T4	1.69	0.88	0.76	0.72	1.01
	L.S.D 0.05	0.08				0.04
	Average	1.49	0.97	0.75	0.64	
	L.S.D 0.05	0.06				
Third cutting	T1	1.09	0.74	0.63	0.41	0.72
	T2	1.73	1.54	1.46	0.97	1.43
	T3	1.25	0.76	0.53	0.51	0.76
	T4	1.42	0.80	0.76	0.65	0.91
	L.S.D 0.05	0.21				0.10
	Average	1.37	0.96	0.84	0.64	
	L.S.D 0.05	0.13				

Leaf chlorophyll content (SPAD)

The leaf chlorophyll content has gradually decreased with the progress of cutting periods as shown in Table 5, where at the cutting period after 45 days from sowing recorded the highest average of 53.53, 51.27 and 51.56 SPAD for the three cutting, respectively. Whereas the lowest average was at the cutting period after 75 days from sowing reached 36.32, 34.18 and 33.65 SPAD for all the three cutting, respectively. The reason for the decrease in chlorophyll content when cutting the plant after 75 days from sowing is due to that the chlorophyll content decreases with the plant ages because of leaves aging, died and gradually losing its chlorophyll dye. As well as, the decrease in the levels of cytokinin responsible for preventing the leaves aging when present in the required quantities, in contrast to cutting the plant after 45 days where an increase in the proportion of leaves thus increase the nitrogen that responsible for the chlorophyll dye, these results are consistent with (Oyier *et al*., 2017). The results of Table 5 showed the superiority of the treatment (T_2) in the characteristic of leaf chlorophyll content compared to the rest of the treatments. It gave the highest average of 50.52, 49.74 and 48.98 SPAD, and did not differ significantly from the treatment (T_4), while the lowest chlorophyll content was in treatment (T_1), as it gave 44.95, 44.78 and 43.79 SPAD for

the three cutting, respectively. The reason for the superiority of treatment (T_2) and (T_4) may be due to the role of nitrogen in forming the chlorophyll and magnesium molecule. It increases the concentration of chlorophyll dye in leaves because the nitrogen is one of the important compounds that involved in the composition of porphirin ring, which is involved in the synthesis of the chlorophyll molecule, and that its high levels have a positive effect on the leaf chlorophyll content (Abu Dahi and Yunus, 1988). These results are consistent with (Wise *et al*., 1990; Al-Taher, Al-Atallah 2018; Faisal *et al*., 2019) findings, which they found an increase in chlorophyll content when adding nitrogen. These results also are consistent with (Ibrahim, Haroun 2003; Konar and Arioglu, 1987), in terms of the whey influence and confirmed that adding the whey leads to an increase in the leaf chlorophyll content compared to not adding it. Table 5 indicates that there was a significant interaction between the two study factors, and the reason for this may be due to the difference in the relative response of the cutting period's influence with different treatments of fertilizer and whey.

Table 5 : The influence of the foliar application of whey and cutting periods and interaction between them for the three cutting on leaf chlorophyll content (SPAD)

Cutting	Whey and fertilization treatment	Cutting periods				Average
		C1	C2	C3	C4	
First cutting	T1	52.45	51.90	47.73	27.73	44.95
	T2	54.33	53.23	53.10	41.40	50.52
	T3	50.55	49.50	49.47	31.03	45.14
	T4	56.80	50.38	45.57	45.13	49.47
	L.S.D0.05	2.54				1.27
	Average	53.53	51.25	48.97	36.32	
	L.S.D0.05	2.09				
Second cutting	T1	51.60	50.53	50.47	26.53	44.78
	T2	52.97	52.17	51.27	42.57	49.74
	T3	48.43	48.77	47.83	30.13	43.79
	T4	52.10	43.03	42.73	37.50	43.84
	L.S.D0.05	2.41				1.20
	Average	51.27	48.62	48.08	34.18	
	L.S.D 0.05	2.71				
Third cutting	T1	51.97	48.60	47.93	26.67	43.79
	T2	53.27	52.07	49.90	40.70	48.98
	T3	49.87	47.27	40.60	30.53	42.07
	T4	51.13	49.40	43.67	36.70	45.23
	L.S.D 0.05	3.73				1.86
	Average	51.56	49.33	45.53	33.65	
	L.S.D 0.05	2.49				

Furthermore, it was observed that whenever the days between one cutting and another increase, the chlorophyll content in leaf decreases, but this decrease in the leaf content of chlorophyll was less in the treatments (T_2) and (T_4), whereas the (T_1) treatment was the most decreasing whenever to increase the cutting periods.

Green forage yield for each cutting (ton.ha^{-1})

It was observed from Table 6 that the cutting periods after 75 days from sowing has significantly outperformed the rest of periods and for all cutting for both seasons by giving the highest average green forage yield of 44.0, 33.37 and 24.47 ton.ha^{-1} for the first, second, and third cutting respectively. As for the cutting period after 45 days from sowing, it gave the lowest average yield was 22.88, 22.14 and 15.71 ton.ha^{-1} for the three cutting respectively. The superiority of the cutting period after 75 days from sowing in the characteristic of green forage yield is due to the increase in plant height as shown in Table 3, and an increase or accumulation of dry matter in the plant maturing stages. In addition to that the green forage yield increases with the plant progress in life as a result of increasing the leaf area and the number of leaves, this is consistent with the results of (Al-Fahdawi, 2011; Jassem, 2014; Al-Dulaimi, 2012, and Ayub, 2002). The same Table showed that the treatment (T_2) was superior over (T_1) and (T_3) treatments in terms of green forage yield for both seasons and all three cutting. It gave the highest average forage yield of 36.52, 30.02 and 22.75 ton.ha^{-1} for the three cutting respectively, while the treatment (T_4) did not differ in this characteristic, whereas the treatment (T_1) recorded the lowest average of 28.5, 23.16 and 17.14 ton.ha^{-1} for the three cutting. The reason for the increase in green forage yield in the treatment (T_2) and (T_4) may be due to the role of nitrogen in increasing the root at the beginning of the plant life and raising the ability of the plant to absorb nutrients. As well as, the role of this element in increasing the plant height as shown in Table 3, in addition to the accumulation of dry matter and the number of leaves, which led to increased photosynthesis and providing food contributing to regrowth after cutting. These results are consistent with the results of (Ayub, 2002 and Afzal, 2012), they showed that the addition of nitrogen fertilizer increases the green forage yield compared to not adding it. Thos results are consistent with (Bakry *et al*., 2016) that observed that adding the whey leads to an increase in green forage compared to not adding it. It was revealed from Table 6 that there was a significant interaction between the two study factors, and the reason for this may be due to the difference in the relative response to cutting periods with the different concentrations of foliar application of whey and the fertilizer

treatments. Also, it was observed that there was an increase in the yield of green forage yield whenever the cutting period is late, however, this increase was obvious at treatment (T_2) as well as the treatment (T_4), while the response was less clear at treatment (T_1) and the treatment (T_3).

Table 6 : The influence of the foliar application of whey and cutting periods and interaction between them for the three cutting on green forage yield (ton.ha^{-1}).

Cutting	Whey and fertilization treatment	Cutting periods				Average
		C1	C2	C3	C4	
First cutting	T1	21.47	24.83	32.5	35.2	28.5
	T2	24.03	31.33	41.67	49.07	36.52
	T3	21.87	33.70	33.83	43.57	33.24
	T4	24.13	35.17	38.2	48.17	36.42
	L.S.D 0.05	3.02				1.51
	Average	22.88	31.26	36.55	44.0	
	L.S.D 0.05	1.51				
Second cutting	T1	21.27	20.6	23.77	27.0	23.16
	T2	22.07	27.4	33.17	37.43	30.02
	T3	20.77	24.87	30.4	33.53	27.39
	T4	24.47	25.53	27.13	35.5	28.16
	L.S.D 0.05	3.36				1.68
	Average	22.14	24.6	28.62	33.37	
	L.S.D 0.05	2.02				
Third cutting	T1	14.2	17.2	18.4	18.77	17.14
	T2	17.6	20.83	24.1	28.47	22.75
	T3	14.77	19.87	22.07	24.4	20.27
	T4	16.27	18.07	20.6	26.27	20.3
	L.S.D 0.05	1.79				0.89
	Average	15.71	18.99	21.29	24.47	
	L.S.D 0.05	1.15				

Total green forage yield (ton.ha^{-1})

The results of Table 7 showed that the cutting period after 75 days from sowing was superior, and it differed from the rest of the periods in terms of total green forage yield. As it gave (101.84) ton.ha^{-1}, while the cutting period after 45 days from sowing gave the lowest average for this characteristic, which amounted to (60.73) ton.ha^{-1}, the reason for the superiority of cutting period after 75 days from sowing is due to its superiority in the green forage yield for all cutting as shown in Table 6. This result is consistent with the results of (Al-Fahdawi, 2011; Al-Dulaimi, 2012 and Jassim, 2014), which indicated that the delay in the cutting period leads to an increase in green forage yield for the cutting. From the results of Table 7, it was evident that the plants harvested for treatment (T_2) gave the highest average for this characteristic, and it was differed from the rest of the treatments and gave (89.29) ton.ha^{-1} for all cutting respectively. Whereas, treatment (T_1) gave the lowest average in total green forage yield reached (68.8) ton.ha^{-}1, the reason for the superiority of treatment (T_2) in this characteristic may be due to its superiority in the plant height as shown in Table 3 and green forage yield in the different cutting as in Table 6. The results of Table 7 also indicated that there was a significant interaction between the two study factors and the reason for that is due to the difference in the relative response to the cutting periods with different treatments of fertilizer and foliar application of whey. The treatment (T_1) showed a weak response whenever the cutting period increased, while the response was significant in the treatment of (T_2) and (T_4) and reached its maximum at cutting period after 75 days for each of them.

Table 7 : The influence of the foliar application of whey and cutting periods and interaction between them for the three cutting on total green forage yield (ton.ha^{-1}) for the agriculture season 2018.

Whey and fertilization treatment	Cutting periods				Average
	C1	C2	C3	C4	
T1	56.93	62.63	74.67	80.97	68.8
T2	63.7	79.57	98.93	114.97	89.29
T3	57.4	78.43	86.3	101.5	80.91
T4	64.87	78.77	85.93	109.93	84.88
L.S.D 0.05	6.17				3.08
Average	60.73	74.85	86.46	101.84	
L.S.D 0.05	2.50				

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