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The Effectiveness of Two Hydroponically Fodder Production of Alfalfa (*Medicago sativa* L.) as Compared to Open Field System in Mount Lebanon

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Abstract

This work aims to study the effect on the productivity and quality variation of alfalfa using the two different fertilization recipes: F1 and F2 along with two different cultivation method in soilless: coconut fiber bag CF, Nutrient Film Technique (NFT) and in soil So. Number of leaves, stem length, number of flowers, crude protein, fiber and ash content of alfalfa plants were measured during the three cuttings time of the production cycle. In the productivity phase, results showed that during the three cuttings repetition, the number of leaves, stem length and number of flowers of alfalfa were in favor of the treatment of coconut fiber bags and the F1 fertilization recipe (CF1) followed by NFT with a good interaction noticeable at this combination level (CF1) with the cutting 1. As for the quality variation phase, the results showed that the crude protein and ash content are in favor of alfalfa grown in soilless CF2; CF1; NFTF1 and NFTF2. As for fiber content, F1 was the most favorable and NFTF1 reported higher fiber content than coconut fiber bags. Concerning the cutting system, cut 1 had a large impact on chemical composition. In summary, alfalfa grown in soilless is more productive and succeeded in the production cycle and the quality variation of alfalfa.

Keywords: Alfalfa, coconut fiber bag, NFT, fertilization recipe, quality variation, productivity

1. Introduction

The increased livestock production with a total of 200% in the last 54 years (FAOSTAT, 2017) has resulted in an increased demand for feeds and forage supply across the world. To ensure abundant production and high-quality forage in grazing systems, producers increased their interest in growing alfalfa to meet the demand for livestock production (Wang *et al.,* 2016) which provided the majority of the nutrients required by the animals. In 2009, alfalfa was grown on approximately 30 million hectares worldwide. With 9.3 million hectares in the United States which is the major producer of this crop forage (USDA-NASS, 2004) and according to FAO, 2020, fodder crops are grown on approximately 4500 ha locally from a total of 231 000 of agricultural area in Lebanon, 53 137 of which are fallow lands abandoned for years (FAO Ministry of Agriculture, 2010). The multiple crisis Lebanon is passing through since 2019 in addition to the poor feed quality and inadequate feed supply, has resulted in threatening livestock sector which is highly dependent on imported fodder. Consequently, farmers could no longer grow crops to feed their livestock which allow the introduction of a new form growing plants (Weldegerima *et al.,* 2005) that is timidly adapted by Lebanese farmers due to the lack of investment and/or of technical knowledge needed to operate properly (Tabet *et al.,* 2020) and become important to farmers worldwide (Wang *et al.,* 2020) as an alternative to get more output with less resources, especially that it can be helpful to countries that have a zero soil fertility which is not able to sustain agriculture, with an ability to maximize production in limited space (Treftz and Omaye, 2016). Adding hydroponic fodder to the food routine are claimed to have an advantageous way of growing plants in a controlled environment including temperature, light intensity and moisture (Liu *et al.,* 2020). The objective of our study is to compare the productivity of alfalfa in open field and in the two soilless systems which are the Nutrient film technique and coconut fiber bags with their effects on variation of quality.

2. Material and Methods

2.1 Work Description

The experiment took place between April and July 2022 at the Agricultural Research and Training Center (CFRA) of the Faculty of Agronomy, Lebanese University located in Ghazir. This study was carried out in a bi-chapel greenhouse with an area of 256 m2 (16 m x 16 m), containing 12 bags of Coconut Fiber Bag Technique and two units of Nutrient Film Technique system for alfalfa cultivation. The meteorological station located at CRFA-Ghazir recorded a temperature between 17 and 25°C and a relative humidity between 57 and 68%. All the work concerning the proper development of alfalfa crop in terms of fertility requirement and harvest cuts was similar for all the treatments. All plants were irrigated 6-8 times per day. The cultivated alfalfa used in our experiment was the "Legend HayMaker 34".

2.2 Experimental Design

For the two soilless systems, two different fertilization recipes F1 (Samperio-Ruiz, 2009) for the first unit system and F2 (Jones, 2005) for the second unit were used. The experimental design applied in the two different soilless systems is shown in the following figure (Figure 1):

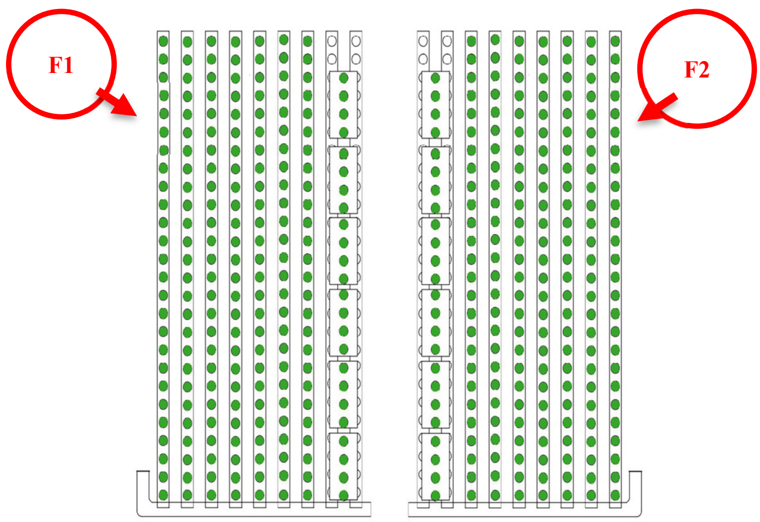


Figure 1. Experimental design of the two soilless cultivation method

2.3 Growing Alfalfa in Soilless System

In the Coconut Fiber Bag cultivation method, alfalfa plants were grown in 12 bags, each containing 4 plants per bag, were divided into groups in order to supply them with the fertilizers relating to each unit. Nutrient solutions F1 and F2 were administered from two different tanks to the bags using pipes (spaghetti tube) connected to a floating pump inside the tanks. Bags filled with substrate are placed in channels to collect drainage solution (Tabet *et al.,* 2020). Indeed, for the NFT technique, it consists of bringing the nutrient solution from two different reservoirs, every one containing the F1 or F2 fertilizers and connected to a separate culture unit composed of two tables each of which contains 7 NFT lines (26 plants/line). Each unit requires 7 rows x 26 = 182 plants. In total, this experimental part involves 364 alfalfa plants (182 x 2 units). To better organize the work, the forty-eight plants used for parameter measurement (24 plants from the Coconut Fiber bag technique and 24 plants from the NFT) were selected, divided into groups and marked with red ribbons and from which monthly measurements were collected.

2.4 Fertilization System

The F1 (Samperio-Ruiz, 2009) and F2 (Jones 2005) fertilization recipes were weighed using a precision balance (S/N 1411208789, 19863-400F, 40kg/5g).

The production cycle for the two soilless systems was divided into two phases:

- Phase I: representing vegetative development (3 weeks) from germination to 15 cm of plant height;
- Phase II: representing flowering set (1-2 weeks) from 15 cm of plant height to cutting at 60 cm of plant height.

The number of plants used in our experiment in the different cultivation methods and in combination with the F1 and F2 were divided into groups of 12 for each treatment NFT and CF (Figure 2).

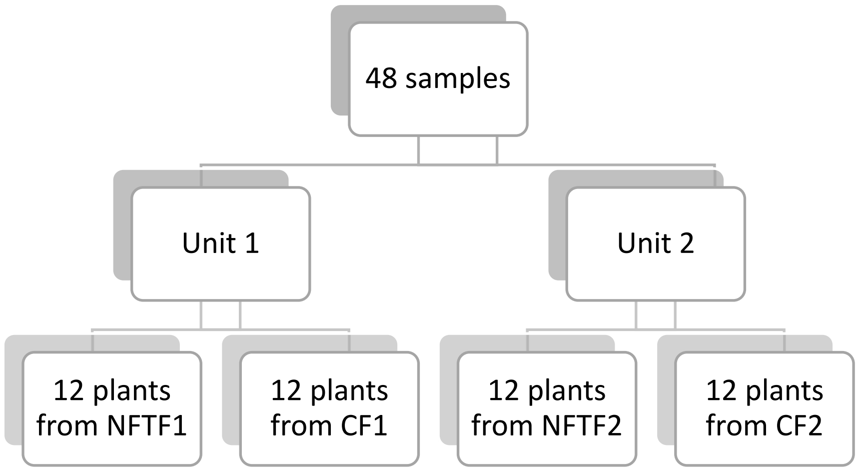


Figure 2. Experimental block design of the number of plants in the different soilless cultivation methods and in combination with the F1 and F2

2.5 Preparation of F1 and F2 Fertilization Solutions

Due to the nutritional requirements of the plants in their different development stages, it was observed that growth improves if a suitable nutrition is supplied. The compositions of the F1 and F2 fertilization solutions used during the two phases, vegetative (Phase I) and flowering (Phase II), are presented in the table below (Table 1).

Table 1. Composition of the two fertilization recipes (F1 and F2) used during phases I and II in g

Stock solution	Stock solution	Phase I		Phase II	
		F1	F2	F1	F2
Tank A	Calcium Nitrate	1100	2500	1710	2500
	Iron	35	35	35	35
Tank B	Magnesium Sulfate	1050	2500	1810	2500
	Fetrilon Combi (Oligo elements)	40	40	40	40
	Potassium Nitrate	2300	2900	2900	2900
	Ammonium Sulfate	500	500	700	500

Based on the literature of Samperio-Ruiz, 2009, F1 fertilization recipe varied, during our experiment, according to the stages of plant development. For the F2 fertilization recipe all the required nutrients were commonly supplied at similar rate during all the stage of development. The micronutrients added to the solution were the same throughout the production cycle.

2.6 Growing Alfalfa in the Soil

The cultivation in the open soil system were carried out in a tunnel greenhouse of dimensions 12 m x 5m. However, plants grown in the soil were fertilized according to the dose adopted by the farmers which is NPK via a venturi system irrigation station with a dosatron. On April 4, 2022, seven hundred twenty-one alfalfa seedlings are grown at 25 cm intervals between plants and 50 cm between rows. Twelve plants intended for the measurement of the parameters were selected randomly and marked with ribbons. They are called So.

The exact amounts and types of fertilizers to be applied after 2 weeks of transplanting are shown in the following table of fertilization program (Table 2).

Table 2. Fertigation of alfalfa grown in the soil using different types of fertilizers

Fertilizers	Formulation	Total Grams needed per 8 weeks	Grams per week added
Monopotassium Phosphate MKP	0-53-34	900	113
Potassium Nitrate KNO	13-0-45	1600	200
Potassium Sulfate KSO	0-0-50	400	50
Monoammonium Phosphate MAP	12-61-0	200	25
20s	20-20-20	100	13

The amount to be applied for 1 week should be repeated it for a period of 8 weeks till first harvesting.

2.7 PH And EC Of Nutrient Solutions

A daily measurement of electro conductivity (EC) using the EC meter (HANNA INSTRUMENTS, EC 215) and pH of nutrient solutions F1 and F2 using the pH meter (OHAUS STARTER 3100) took place in order to control them as best as possible. In general, the pH was maintained between 6.5 and 6.9 while the EC value maintained around 2.5 µS/cm (Trejo-Tellez and Gomez, 2012).

2.8 Harvesting and Sampling

Our study grouped together three cuts of three successive production cycles of 5 weeks each. At each cut, productivity and quality parameters were taken into consideration. The harvesting has been divided into 3 repetitions. 1st repetition: 5 weeks after transplantation of the plants representing the development of vegetative and flowering phase of the plant; 2nd repetition: 5 weeks after the first cut of the plants; 3rd phase: 5 weeks after the second cut.

2.9 Parameters Measured

Parameters measurements are divided into two parts. The productivity part to measure the growth and the development of the alfalfa plants and the quality variation part to measure the different nutrients contents.

2.9.1 Productivity Measurements of Alfalfa

A monthly measurement take place for the majority of the parameters related to the growth of the plants.

Number of Leaves

On day 0, just after each harvest, the number of leaves of alfalfa was counted manually and this for the marked plants of each treatment.

Stem length

At the end of each production cycle, the marked plants were measured, harvested at 5 a.m. and preserved in a packaging of plastic bag numbered according to culture methods and treatments, then taken on the same day of the cutting measurements to the laboratories of Chamber of Commerce Industry and Agriculture of Tripoli where 60 samples were taken for the experiment and dried using the forced – air Drying oven method (Van Soest,1970) at a temperature of 40°C for 6 hours to be dried enough and subjected to the analyzes of the parameters immediately.

Number of flowers

The number of flowers marked already was counted manually with each treatment.

2.9.2 Quality Variation Phase of Alfalfa

During the post-harvest life phase of alfalfa, the parameters were measured at the laboratories on days 19 May; 23 June; and 28 July 2022.

Analysis of Dry Forages with FT-NIR method

A forage analysis consists of multiple parameters such as protein, fiber, ash and moisture content. The BRUKER Optics offers the most comprehensive range of the method of Fourier transforms near-infrared (FT-NIR) spectroscopy that allows the rapid determination of these and more nutrients in dry forages in terms of chemical component.

2.10 Statistical Analysis

The tables and figures are produced using the EXCEL 2013 program, while the statistical analyzes are processed with GLM (General Linear model) using the Sigmastat program. The significant differences are analyzed with Three Way Anova for the productivity and quality phase parameters.

3. Results and Discussion

3.1 Productivity Measurements of Alfalfa

This phase describes the influence of three different cultivation methods and the two fertilization recipes on the productivity of alfalfa during the whole production cycle.

Number of leaves

The effects of variations in fertilization recipes and cultivation methods on the number of leaves of alfalfa are presented in Table 3.

Table 3. Effects of variations in fertilization recipes and cultivation methods on the number of leaves of alfalfa.

Treatments/Cuts	CF1	CF2	NFTF1	NFTF2	So	Mean of cuts
C1	1175^a	1130^a	696^a	662^a	467^a	169^a
C2	1016^a	941^b	577^b	596^b	388^b	133^b
C3	988^a	784^b	499^c	483^b	295^b	113^c
Mean of treatments	1003^a	954^b	590^c	580^c	383^d	-

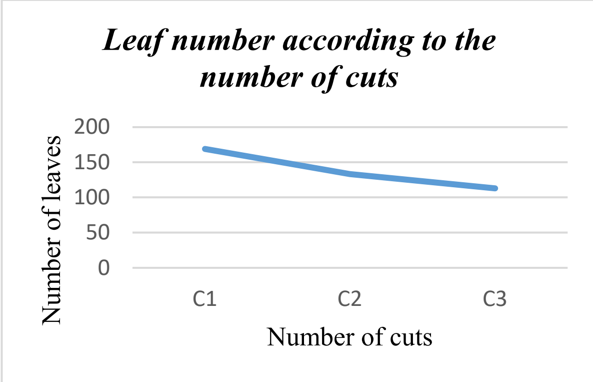
*In columns and rows the numbers with similar exponent represent the absence of a significant difference at p>0.01.

The number of leaves of alfalfa from the group CF1 shows a clear significant difference (P>0.01) compared to the other groups. This proves that the F1 fertilization recipe have almost the highest effect on the number of leaves of alfalfa, which is the case for the cultivation method where the CF is relatively higher than that of the NFT and So group with a significant difference.

For instance, some researchers showed the favorable effect that growing media have on plant growth (Maboko *et al.,* 2013) as it increased the yield of fodder and water retention (Marinou *et al.,* 2013), other researches did not show any difference in the yield (Hallman and Kobryn, 2014).

The results of the analysis of NFT shows that there is no significant effect in treatments when use F1 as compared to F2 for leaf number. Fertilization, however, did not influence this parameter in NFT production. For Pimentel *et al.,* 2016, concentrating the root system in a confined volume of improve substrate and the correct water supply are one of the essential factors for the development of leaves resulted in an increase in the exchanges between the environment and the plant, increasing photosynthesis and can greatly improve the growth of plants which is the basis of the soilless system (Savvas *et al.,* 2018).

The results of statistical analysis for leaf number data according to the number of cuts are presented in Graph 1:



Graph 1. Cutting cycles of alfalfa and variation of leaf number

As shown in Graph 1, the result of the study showed that the leaf number of alfalfas in the first cutting cycle was significantly higher as compared to second and third cuts ($P<0.001$) that rapidly declines. This report quite agreed with Gashaw *et al.,* (2015), and Walie *et al.,* (2016) who showed the values that leaf number decrease from 169 for the first cut till 113 for the third one as the cutting cycle increased for the alfalfa.

These results indicate that first-cutting also has some unique yield characteristics which corresponds to a higher forage content in the leaves than any other cutting (Rankin, 2013).

Stem length

The effects of variations in fertilization recipes and cultivation methods on the stem length of alfalfa are shown in Table 4.

Table 4. Effect of variations in fertilization recipes and cultivation method on the stem length of alfalfa.

Treatments/Cuts	CF1	CF2	NFTF1	NFTF2	So	Mean of cuts
C1	89.5^{a}	82.8^{a}	73^{a}	75^{a}	67^{a}	77^{a}
C2	75.2^{b}	74.6^{b}	66.9^{b}	68^{b}	64^{a}	69^{b}
C3	65.08^{b}	61.7^{c}	58.6^{c}	62^{b}	58^{b}	60^{c}
Mean of treatments	77^{a}	73^{b}	66^{c}	66^{c}	63^{c}	-

*In columns and rows the numbers with similar exponent represent the absence of a significant difference at $p>0.01$.

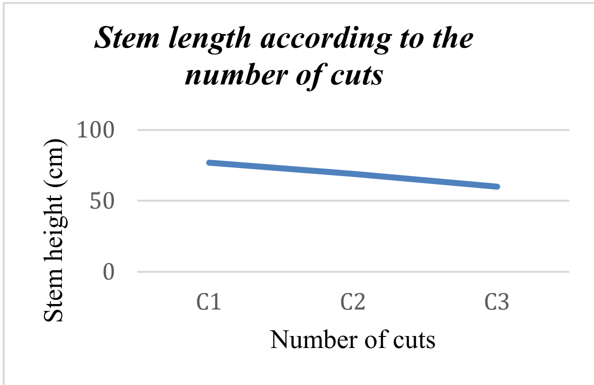
The length of the stem in the treatment of the two groups CF1 and CF2 showed a significant difference ($P>0.01$) compared to the other groups. This can be explained by the high-water retention of CF and the constant availability of water during production which has an effect on the solubility of fertilizers and their availability to plants and is conducive to maintain consistent quality of alfalfa stem length (Liu *et al.,* 2020).

In coconut fiber bags, the stem length showed a tendency to increase following F1 as compared to F2 that have a high nutrient changes in Nitrogen and Phosphorus during the growth of hydroponics fodder.

While in NFT the stem length of plants irrigated by F1 and F2 shows no significant difference ($P>0.01$). This proves that alfalfa can succeed in the NFT under both recipes.

No significant difference was reported between NFT and So. Nevertheless, this result suggested that alfalfa succeed in these two systems but their stem remains relatively minimal. This can explain that providing a suitable medium along with chemical fertilizers increased the length of alfalfa stem which in turn increase number of leaves (Sepahvand *et al.,* 2021).

The results of statistical analysis for stem height data according to the number of cuts are presented in Graph 2:



Graph 2. Cutting cycles of alfalfa and variation of stem length

We recorded an overall mean plant length shown in graph 2 of the first cut that showed a significant superiority ($P>0.01$) as compared to the second cut that was slightly greater than that of the third cut which have a high significant effect ($P <0.01$).

The reason for increasing plant length in the first cut that indicate the high statistical influence is probably affected by the number of cuts (Popovic *et al.,* 2001). However, frequent cuttings of alfalfa may lead to reduction in plant length.

In this context, it can be concluded that the factor with the greatest influence on the plant length was the time of stage of development and cultivation method that was different among the culture across the cutting cycle.

Number of flowers

The effects of variations in fertilization recipes and cultivation methods on the number of flowers of alfalfa are presented in Table 5.

Table 5. Effects of variations in fertilization recipes and cultivation methods on the number of flowers of alfalfa

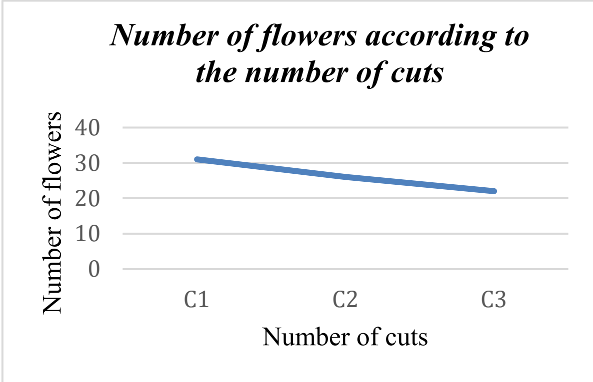
Treatments/Cuts	CF1	CF2	NFTF1	NFTF2	So	Mean of cuts
C1	47^{a}	40^{a}	19^{a}	28^{a}	14^{a}	31^{a}
C2	40^{a}	36^{a}	16^{c}	19^{b}	14^{a}	26^{b}
C3	43^{a}	30^{b}	17^{b}	14^{c}	12^{a}	22^{c}
Mean of treatments	42^{a}	36^{b}	21^{c}	21^{c}	13^{d}	-

*In columns and rows the numbers with similar exponent represent the absence of a significant difference at $p>0.01$.

The number of flowers from the two groups CF1 and CF2 showed a significant difference ($P>0.01$) compared to the groups NFTF1, NFTF2 and So. The high-water retention of CF and the irrigation frequencies are factors that improve flower number and mainly attributed to the support of this results (Fernando *et al.,* 2014). Constitutively, it shows a significant difference ($P<0.01$) in favor of the F1 and F2 with a superiority for F1. This difference in CF can be explained by the adequate amount in F1 compared to F2, particularly with regard to nitrogen, which recalls the studies of Buxton (2010) showing that the decrease in the number of flowers may be due to the excessive quantity of nitrogen.

Indeed, the F1 recipe has a lower phosphorus composition compared to that of Kumarasingue *et al.,* (2016) that recognized the importance of phosphorus by helping flower initiation. Although, NFT treatment was not influenced by the variation in fertilization recipes which is not the case for the cultivation method. We can conclude that the interaction between the different fertilization recipes and the different substrates have a positive effect by its physico-chemical properties and high-water retention.

The results of statistical analysis for flowers number data according to the number of cuts are presented in Graph 3:



Graph 3. Cutting cycles of alfalfa and variation of number of flowers

The results in Graph 3 of flower number showed highest values at the first cutting cycles as compared to the later cuttings ($P<0.001$) that are not as high in initial value.

Resulting in nonlinear responses (Sanderson *et al.,* 2000) the results showed that with increasing frequency of cuttings to three cuttings, number of flowers has been reduced drastically. With the data on number of flowers, if cuts are frequent, number of flowers is affected (Orloff, 2007) in a sharp and significant reduction in all the flower number.

The results of this study revealed the consistent effect of cutting on various flower number and as might be expected, the timing of flowering for plants responsiveness is a major factor in improving quality variation.

3.2 Quality Variation Phase of Alfalfa

This phase describes the influence of the three different cultivation methods and the fertilization recipes on the post-harvest quality of alfalfa.

Crude Protein

The effects of variations in fertilization recipes and cultivation methods on the Protein content of alfalfa are presented in Table 6.

Table 6. Effects of variations in fertilization recipes and cultivation method on the protein content of alfalfa

Treatments/Cuts	CF1	CF2	NFTF1	NFTF2	So	Mean of cuts
C1	28.9^{a}	30.4^{a}	27.7^{b}	25.8^{ab}	27.3^{a}	28.03^{a}
C2	27.4^{b}	28.3^{b}	28.5^{a}	28.1^{a}	27.6^{a}	28.01^{a}
C3	24.3^{c}	24.5^{c}	21^{c}	21^{b}	20.1^{c}	21.7^{b}
Mean of treatments	26.9^{b}	27.7^{a}	25.4^{c}	24.9^{d}	24.5^{e}	-

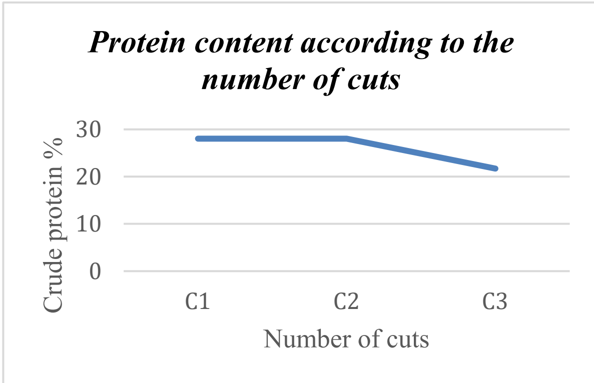
*In columns and rows the numbers with similar exponent represent the absence of a significant difference at $p>0.01$.

A significant difference ($P > 0.01$) among the crude protein contents of alfalfa was reported between the 5 groups that has a slight superiority ($P>0.05$) for the CF2 treatment. This difference can be explained by increasing the nitrogen level in F2 fertilization recipes which improve the alfalfa nutritive value and result in high protein content. This is in agreement with Delevatti *et al.,* 2019 who suggests that Nitrogen application affected the crude protein.

The mode of cultivation in NFT showed a satisfactory and better-quality protein content values of alfalfa that did not differ from that of coconut fiber. This is one of the important outcomes of our study that justifies the search for alternatives for the use in animal feeding.

As reported by El Morsy *et al.,* 2013, alfalfa produced under hydroponic conditions revealed appreciable levels of crude protein and digestibility. In contrast to Fazaeli *et al.,* (2012) and Kılıç (2016) who stated that the quality of protein content decreased in hydroponic green feed and does not substantially change compared to the other treatment.

The results of statistical analysis for protein content data according to the number of cuts are presented in Graph 4:



Graph 4. Cutting cycles of alfalfa and variation of protein content

As shown in Graph 4, the results obtained in the current study was gradually decreasing until third cutting cycle. It is noted that the first and second cut consistently gave the highest protein content with a non-significant effect. This was consistent with Lloveras (2001) who reported the increase in alfalfa protein content from the first cutting and decreased in the third one. Probably the most important characteristic is the change in composition with advance toward maturity. In their study, Fazeli *et al.,* (2012) and Naik *et al.,* (2015) reported that the alfalfa CP content decline following increasing harvest days.

We can conclude that the stage of cutting of plants has come to be recognized as one of the most important considerations in the harvesting of forage crops that had a large impact on protein content.

Fiber

The effects of variations in fertilization recipes and cultivation methods on the fiber content of alfalfa are shown in Table 7.

Table 7. Effects of variations in fertilization recipes and cultivation methods on the fiber content of alfalfa

Treatments/Cuts	CF1	CF2	NFTF1	NFTF2	So	Mean of cuts
C1	14.8^{b}	13.6^{b}	18.1^{b}	16.3^{b}	10.9^{c}	14.8^{c}
C2	17.2^{ab}	14.6^{ab}	21^{ab}	18.2^{ab}	16.3^{b}	17.5^{b}
C3	20.4^{a}	19.2^{a}	28.3^{a}	24^{a}	20.3^{a}	22.7^{a}
Mean of treatments	17.5^{c}	15.8^{d}	22.5^{a}	19.9^{b}	15.8^{d}	-

*In columns and rows the numbers with similar exponent represent the absence of a significant difference at p>0.01

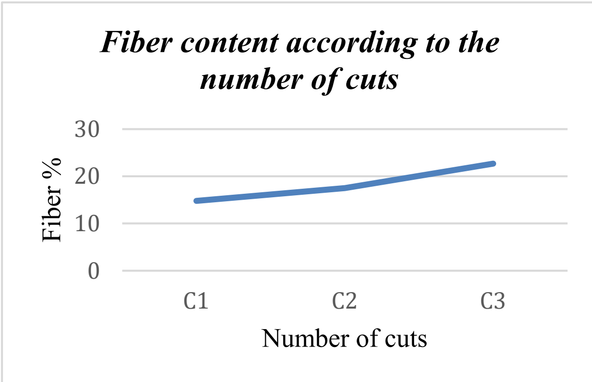
The fiber content of alfalfa from group NFTF1 is significantly higher than the value of the other groups. The results of the fiber content showed a positive effect of the NFT substrate for F1, that is slightly higher than that irrigated by F2, in favor of the coconut fiber bags and soil that showed lower fiber values with no significant difference (P>0.01) reported between CF2 and So. All of these observations may be due to the composition of the substrates and their physical properties (Birle *et al.,* 2008).

The adequate application of nitrogen and phosphorus levels that had the significant effect under NFT treatment (Singh *et al.,* 2003) might be attributed to the highest fiber content in alfalfa.

It can be concluded that hydroponics shown significant nutritional improvements of crude fiber (Almeida *et al.,* 2020).

In support of the present findings, Ndaru *et al.,* 2020 found that the crude fiber content was within a range of 5, 61 – 10, 71%. It is relatively lower than that obtained in our study with a value of 22.5% and 19.9% for F1 and F2 respectively.

The results of statistical analysis for fiber content data according to the number of cuts are presented in Graph 5:



Graph 5. Cutting cycles of alfalfa and variation of fiber content

As shown in Graph 5, the result of the study showed that the fiber content of alfalfa in the third cutting cycle was significantly higher as compared to the first and second cuts (P<0.001). Further, our results were in line with the results of Bandara *et al.,* (2016) reported that crude fiber content of alfalfa in the first cut were 11.63%, and in the second one as 16.9% respectively.

In the case of cutting schedule, fiber content increased with the crop age advancement (Popovic, 2001).

From the performed analyses, it can be observed that among the elements of management of alfalfa cultivation, fertilization and cut had a high statistical influence on investigated crude fiber content. Lamb *et al.,* 2003; Rimi *et al*., 2010).

Ash

The effects of variations in fertilization recipes and cultivation methods on Ash content of alfalfa are shown in Table 8.

Table 8. Effects of variations in fertilization recipes and cultivation methods on Ash content of alfalfa

Treatments/Cuts	CF1	CF2	NFTF1	NFTF2	So	Mean of cuts
C1	13.4^{a}	13.5^{a}	12.48^{a}	12.07^{a}	14.3^{a}	13.2^{a}
C2	8.9^{c}	9.3^{b}	9^{b}	8.7^{c}	9.5^{b}	9.1^{c}
C3	10^{b}	12.4^{a}	9.6^{b}	10.5^{b}	10.5^{ab}	10.7^{b}
Mean of treatments	10.8^{c}	11.9^{a}	10.38^{d}	10.42^{cd}	11.4^{b}	-

*In columns the figures with similar exponent represent the absence of a significant difference at p>0.05.

The number of ashes from the CF2 show a significant difference (P>0.01) compared to the groups CF1, NFTF1, NFTF2 and So.

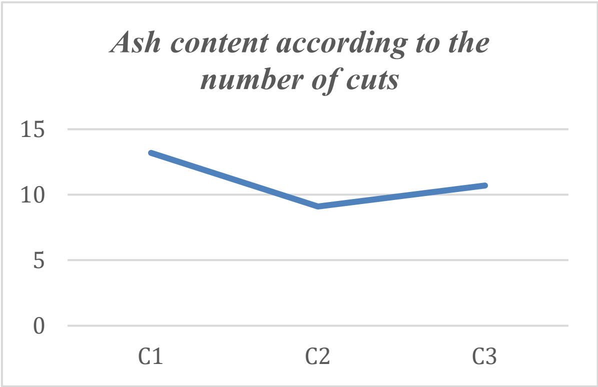
The ash content in CF reported a significant difference than that in NFT and Soil. This probably comes down to the composition of the substrates and their physical properties (Birle *et al.,* 2008).

Notably, the highest ash content (p< 0.01) was recorded in CF was 11.9 with F2 fertilizer and 10.8% in F1 respectively. This can probably due to the sufficient amount of nutrients that ensures favorable conditions for high quality.

The effect of the two fertilization recipes F1 and F2 was negligible when using them in NFT. Kumar *et.al.,* (2021) indicated that not only optimal amounts of nutrients but also their proper balance is significant for proper plant development.

We can conclude that the data acquired shows the characterization and analysis of the ash content depending on a large number of factors including growing conditions and fertilization and it indicated that effectively react on the treatment with fertilizers Platače & Adamovičs, (2014).

The results of statistical analysis for ash content data according to the number of cuts are presented in Graph 6:



Graph 6. Cutting cycles of alfalfa and variation of ash content

As shown in Graph 6, the result of the study showed that the ash content in the first cutting cycle was significantly higher as compared to second cut ($P<0.001$) that rapidly declines while it increases slowly during the third one.

It was revealed that first cutting offers the opportunity for harvesting the highest forage quality of the growing season as compared to subsequent cuttings. Hence, a timely first cut is essential if high forage quality is the primary objective (Rankin, 2013).

As a result, in alfalfa cultivation the higher yield and quality can be obtained only using the proper cutting (Tabacco *et al.,* 2003).

As alfalfa maturity advanced ash content decreased ($P< 0.01$) which agreed with the results of Marković *et al.,* (2009). Generally, cuttings applied more frequently led to a decrease in fresh forage yield (Kallenbach *et al.,* 2002; Ventroni *et al.,* 2010).

These results indicate additional factors such as multi-cutting may affect ash content and composition as well, in particular, the first-cutting can be, and often is higher than any other cutting (Rankin, 2013).

4. Conclusion and Perspectives

Our study shows that the use of two different cultivation methods associated with the two different fertilization recipes used have succeeded in the productivity and quality variation during the three different cuts of alfalfa in Coconut fiber bags followed by NFT system.

Regarding the productivity phase of alfalfa, the results showed that during the three cutting repetition, a good interaction was noticeable at this combination level of coconut fiber cultivation mode and the F1 fertilization recipe (CF1) followed by NFT that positively affecting the number of leaves, flowers and stem of alfalfa with a best cutting found at cut 1.

Concerning the quality variation phase of alfalfa, our results indicate that the crude protein and ash content are in favor of alfalfa grown in soilless CF2. For fiber content, F1 was the most favorable and NFTF1 reported relatively higher fiber values indicating better quality. Regarding the cutting system, cut 1 showed the best results.

In summary, the introduction of hydroponics has become a viable alternative to consider and can be recommended to Lebanese farmers to improve their quality forage and to overcome the Lebanese economic crisis especially since this system is relatively inexpensive.

In perspective, we recommend and plan to pursue complementary work on the effect of different cultivation system and fertilization in alfalfa as well as the study of the effectiveness of different cut. In order to achieve the overall objective, this new interest should become more important during the next years regarding the yield and quality of alfalfa and thus it is an opportunity for livestock to develop in future.

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