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EVALUATION OF SOME ALFALFA CULTIVARS FORAGE PRODUCTION UNDER DIFFERENT FERTILIZER LEVELS IN SANDY SOILS CONDITIONS

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ABSTRACT

In Egypt, there is a gap between production and demand of green forages, especially during the summer season, where the available forages are limited as a result of the competition with strategic crops on limited arable land. Alfalfa is nominated to be the best crop to overcome this problem as it is the most suitable forage crop to be cultivated in the newly reclaimed land for producing high yields of high quality forage and longevity of stand. The objectives of the research is finding out optimum percentage of mineral fertilizer rates for high green forage production in alfalfa by using five different levels of mineral and biofertilizers and evaluate five alfalfa cultivars (Giza-1, Ismailia-1, Siwa-1, Si-River and WL-528) for forage yield and their components under North Sinai conditions and similar newly reclaimed land regions. The result showed that biofertilizer and 75% mineral treatments led to increase fresh weight (86.65 kg m^{-2}) at means, moreover, Ismailia then Siwa cultivars had higher fresh weights (96.55 and 95.55 kg m^{-2}, respectively). Ismailia variety increased dry weight at means over all cuts (22.89 kg m^{-2}), highest crude protein content was obtained with biofertilizer and 75% mineral (37.41%), the crude fiber content showed that mineral treatment gave the lowest mean values (28.05%). But, biofertilizer and 50% mineral treatments gave the highest mean content (33.36%).

Keywords: evaluation, alfalfa cultivars, forage production, biofertilizer.

INTRODUCTION

Alfalfa is called the queen of forage and is cultivated as the fourth main crop, forage is used in feeding dairy cattle, livestock, fowls and other domestic and field animals and is known as one of the most important crops because of its following abilities: 1. High adaptation and acclimation to climate; 2. Annual fixation of 200 kg N/acre (560 kg/ha); 3. High annual dry forage yield (22 t/ha under low irrigation conditions and 24 t/ha in irrigated conditions); 4. Consuming low energy and growing in some years without replanting and N fertilizer application (up to 5 years in temperate regions) (**Brown *et al*., 2005**); 5. Producing good nutrients with 15-22% protein content and high vitamin and mineral contents (**Wu, 2004**); 6.

Attracting insects by its sweet nectar for honey production; 7. Acting like a barrier and stopping the spread of pests and diseases to the subsequent crops in rotation; 8.

Mitigating soil erosion (alfalfa prevents erosion by 89% and water flow by 94% compared to other crops) (**Liu, 1992**); and 9. Improving soil structure by penetrating its vertical roots which increases its permeability (**Bauchan and Greene,2000**).Chemical fertilizer application is an effective method to increase yields, but is costly and may also lead to environmental problems. In particular, phosphorus fertilizers present a serious risk of cadmium accumulation in soil **(Al-Fayiz *et al.*, 2007).** and the selective accumulation of some chemical elements which is harmful to the environment **(Mukhtar *et al.*, 2013).**

Recently, there has been interest in more environmentally sustainable agricultural practices **(Orson, 1996).** The bacteria used as phosphorus biofertilizers could contribute to increasing the availability of phosphates immobilized in soil and could enhance plant growth by increasing the efficiency of other nutrients **(Kucey *et al.*, 1989).** Indeed, studies on the application of nitrogen fixing and phosphorus solubilizing bacteria were shown to increase yields in alfalfa **(Comakli and Dasci 2009**), clover, wheatgrass, perennial ryegrass **(Holl *et al.*, 1988).**

MATERIALS AND METHODS

This study was carried out at El-Arish Agricultural Research Station, North Sinai during 2011-2014, while the forage mineral composition were analyzed at, the Central Laboratory, Faculty of Agricultural Sciences, Ismailia Governorate, Suez Canal University, Egypt. Seeds of alfalfa cultivars (Giza-1, Ismailia-1, Siwa-1, Si-River and WL-528) were obtained from the Forage Crops Research Department, Agricultural Research Center (ARC), Ministry of Agriculture, Giza, Egypt.

1. Experimental Data:

Expermiment included 25 treatment combinations which were obtained from five fertilization regimes and five alfalfa cultivars.

The field experiment was laid out in split plot design with three replications. Net plot area was 4.5 m^2, main plots were occupied with fertilization regimes, while alfalfa cultivars were arranged in sub-plots. Field soil was ploughed once and 150kg/fed Calcium sulfate, 400 kg/fed superphosphate and 200kg/Fed potassium sulfate were added after that experiment divided as shown in the layout.

There were five different fertilization regimes(mineral fertilizers and biofertilizers) as presented in Table (1) 50g of each biofertilizer (Phosphoren, Potasomag and Rizobactrean) were mixed with 1Kg seeds before sowing.

The biofertilizers were mixed with sugar solution then mixed with seeds and cultivated one time. The seeds of alfalfa cultivars were sown on May 15, 2011. The seeding rate was 7 kg seed / fed. Drip irrigation system was used (4 l/hr) by underground saline water (3500 ppm) pumped from a well. Cutting green forage was done when the crop attained 10 percent flowering. Totally the data of 25 cuts were taken. The following forage yield and quality were determined.

Fresh forage yield (Kg plot^{-1}) :

Was determined by weighting plants in each plot.

Dry forage yield (Kg plot^{-1}):

Was determined by collecting 150g as random samples from each plot, Plant samples were weighted then dried in an electric oven (70 ◦C) for 72 hrs. to determine dry matter percentage.

Crude protein percentage:

The dry material was wet digested with sulphoric-perchloric acids mixture **(Piper, 1974).** Total nitrogen was determined calorimetrically using spectrophotometer **(Model 1600 Jenwoeyco)** as described by **Allen (1959).**

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Table (1): The fertilization regimes.

Fertilization / Name	Biofertilizers	Mineral fertilizers per fed (Kg/fed)		
		Ammonium nitrate	Superphosphate	Potassium sulfate
Bio	100%	Zero	Zero	Zero
Bio +50% mineral	100%	150	125	75
Bio +75% mineral	100%	225	187.5	112.5
Bio +100% mineral	100%	300	250	150
Mineral	Zero %	300	250	150

Crude protein percentage.

It Was calculated by multiply the total nitrogen by factor 6.25 It was determined using the method described in **AOAC (1986).**

RESULTS AND DISCUSSION

Forage Yield:

Fresh forage yield (Kg/plot):

With regard to the effect of mineral and biofertilizer treatments in (Fig. 1) it could be concluded from the data that the fresh weight (kg m^{-2}) increased in all cuts when soil inclusion biofertilizer and 100% mineral treatment, followed by biofertilizer and 75% mineral treatment.

In the same line, biofertilizer and 100% mineral and biofertilizer and 75% mineral treatments increased fresh weight (86.62 and 86.65 kg m^{-2} ,respectively) at means over the 25 cuts, while, mineral treatment exhibited significantly the lowest mean values in all cuts (71.98 kg m^{-2}).

In this respect, data in Fig. 2 revealed that fresh weight (kg m^{-2}) was significantly affected by the cultivars in all cuts. Siwa and Ismailia cultivars achieved significant superiority ($P \leq 0.05$) between all cultivars in fresh weight (kg m^{-2}), followed by Giza variety. But, WL528 variety gave the lowest mean value in all cuts it was (53.06 kg m^{-2}).

Moreover, Ismailia then Siwa and Giza cultivars had fresh weight (96.55, 95.55 and 93.87 kg m^{-2}, respectively) at means over all cuts. Data showed that the interaction between cultivars and fertilization treatments significantly ($P \leq 0.05$) increased fresh weight (kg m^{-2}) in all cuts during the experimental periods.

It could be detectd from that cultivated Giza variety in soil contained combination biofertilizer with 100% mineral gave the highest mean value of fresh weight in over all cuts (115.23 kg m^{-2}), in addition to Ismailia variety cultivated in soil contained combination between biofertilizer with 100% mineral in cuts (6, 7, 9 and 10). And also, data in means over the 25 cuts, the cultivated Si-River variety in soil contained with 100% mineral treatments gave the lowest mean in fresh weight (42.19 kg m^{-2}). Similar results were obtained by **Mousa *et al*., (1996)** and **Benabderrahim *et al*. (2009).**

Dry forage yield (Kg/plot):

No significant differences between all mineral and biofertilizer treatments had been shown in Fig. 3 regarding dry weight (kg m^{-2}) except in cuts No. (2, 5, 9, 14 and 24), where the biofertilizer and 100% mineral treatment increased dry weight (kg m^{-2}). In the same line, biofertilizer and 100% mineral and biofertilizer and 75% mineral treatments led to increasing dry weight (kg m^{-2}) at means over the 25 cuts where (22.61 and 22.18 kg m^{-2} ,respectively). Contrarily, mineral treatment exhibited significantly lowest mean value in all cuts (19.62 kg m^{-2}).

Data in Fig. 4 indicated that, the highest values of dry weight from Giza and Ismailia cultivars that achieved significant superiority ($P \leq 0.05$) between all cultivars. But, Si-River variety gave the lowest mean value in all cuts (21.02 kg m^{-2}). Moreover, Ismailia variety had increased dry weight at means over all cuts (22.89 kg m^{-2}). Concerning, the interaction effect between cultivars and fertilization treatments data reveal that the highest values of dry weight (kg m^{-2}) in cuts No. (4, 5, 9, 15, 16, 18, 20, 22 and 23) came from Giza variety in soil contained combination of biofertilizer with 100% mineral.

In addition, data in means over all the 25 cuts did not differ much, Giza variety in soil contained combination biofertilizer with 100% mineral treatments increased dry weight (23.59 kg m^{-2}). Similar results were obtained by **Mundhe and Shelke, (1991)** where they found that the dry matter production was not affected at different cuts, and the results agree with **Shukla and Menhilal, (2003) and Marino and Berardo, (2005),** in their observation that the dry matter increased significantly with fertilization.

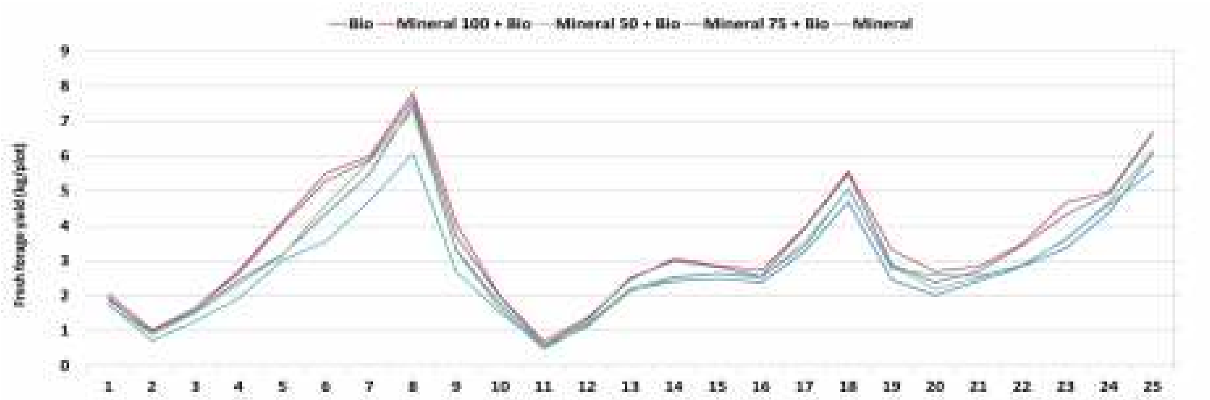

Fig. (1): Effect of fertilization regimes (F) on fresh forage yield (kg/plot) during 2011-2014.

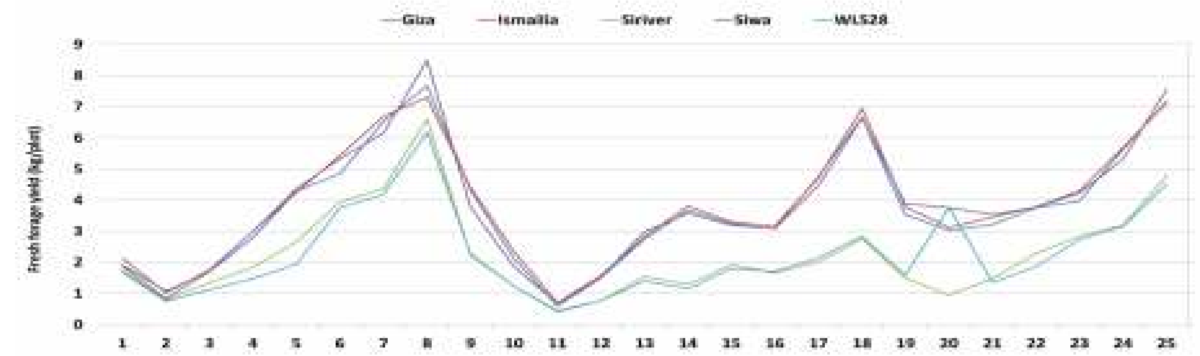

Fig. (2): Effect of alfalfa cultivars (Var.) on fresh forage yield (kg/plot) during 2011-2014.

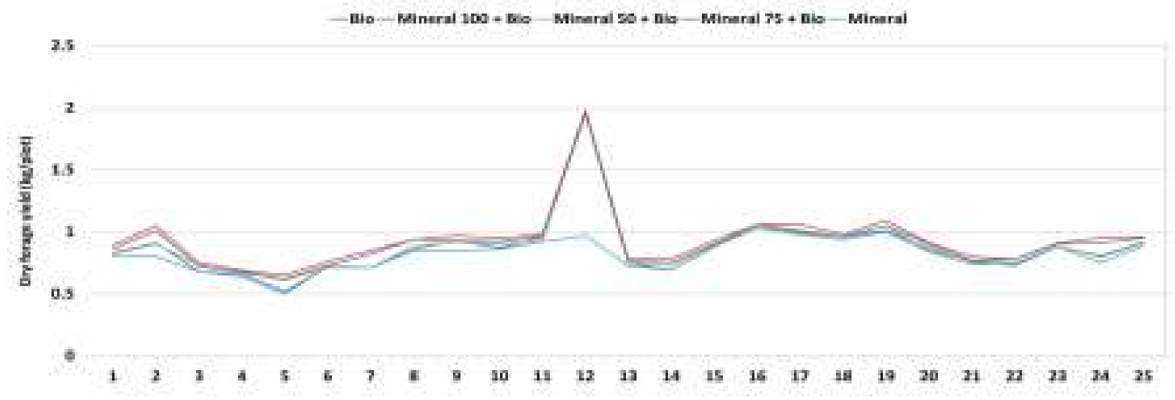

Fig. (3): Effect of fertilization treatments (F) on dry forage yield (kg/plot) during 2011-2014

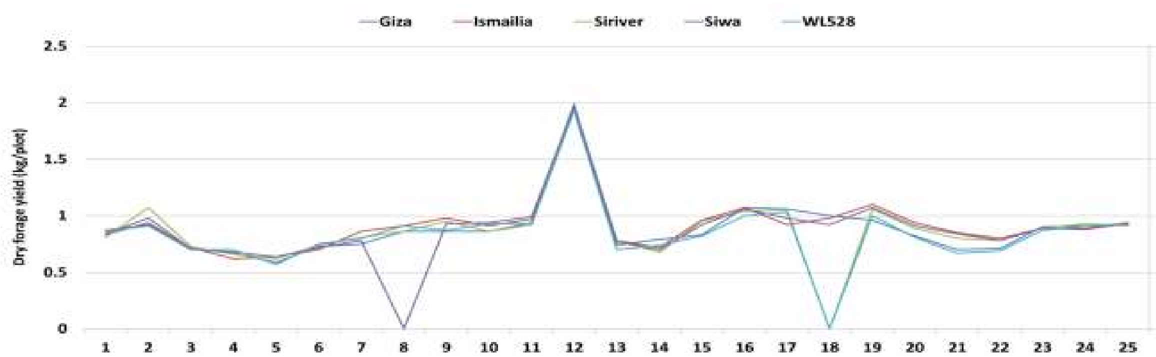

Fig. (4): Effect of alfalfa cultivars (Var.) on dry forage yield (kg/plot) during 2011-2014

Chemical analyses:Crude

protein content (%):

Data in **Fig.5** show that all mineral and biofertilizer regimes increased significantly (P≤0.05) crude protein content in all cuts. Generally, soil inclusion mineral treatment gave the lowest values in all cuts and had no different effect between other fertilization treatments. But, the biofertilizer and 75% or 50% mineral treatment had the highest improved crude protein content in cuts No. (1 and 2). In the same line, biofertilizer and 75% mineral treatments had highest crude protein content (37.41%) at means over all cuts, while mineral fertilization treatment had the lowest mean (31.84%).

Data presented in **Fig**. **6** reveal that crude protein content was significantly affected by alfalfa Siriver cultivar in all cuts. Si-River variety achieved significant superiority (P≤0.05) between all cultivars in crude protein content during growth stages in the cuts No. (3-20) but, Giza variety gave the lowest value in cuts No. (3-20) and also Siwa variety in cuts No. (3-6 and 11-20). Moreover, Si-River variety had the highest crude protein content (37.76 %) at means over the all cuts, but Giza variety had the lowest mean (33.87%).

Data revealed that the interaction between cultivars and fertilization regimes significantly (P≤0.05) led to increasing crude protein content in all cuts during the experimental periods. The data indicated that cultivated Siriver variety in soil

contained combination between biofertilizer with 50% mineral gave the highest crude protein content (40.52 %) in all cuts, in addition to Si-River variety cultivated in soil contained combination between biofertilizer with 75% mineral in cuts No. (3, 4, 11-14 and 16-20). And also, data in means over all cuts the cultivated Giza variety in soil contained mineral treatments had low crude protein mean content (30.60%). Similar results were obtained by **Monteiro *et al.*, (1999)**; **Stavarache *et al.*, (2012) and Kuchenmeister, *et al.*, (2013).**

Crude fiber content (%):

It could be concluded from data in **Fig. 7** that all mineral and biofertilizer treatment significantly (P≤0.05) led to increasing crude fiber content in all cuts. Generally, soil inclusion mineral treatment gave the lowest mean values in all cuts (28.05%) and had no different effect between other fertilization treatments. But, the biofertilizer and 75% or 50% mineral treatments had the highest improved crude fiber content in cuts No. (1 and 2). In the same line, biofertilizer and 50% mineral treatments had the highest crude fiber content (33.36%) at means over all the cuts.

Data in **Fig**. **8** revealed that crude fiber content was significantly affected by the cultivars in all cuts. Si-Rriver variety achieved significant superiority (P≤0.05) between all cultivars in crude fiber content was (33.23%) and during growth stage in the cuts No.(4-9, 11-20) but, Giza variety gave the lowest value in cuts No. (4-17) and also Siwa variety in cuts No. (4-6 and 11-20). Moreover, Giza cultivar had the lowest crude fiber content 29.82 % at means over all cuts.

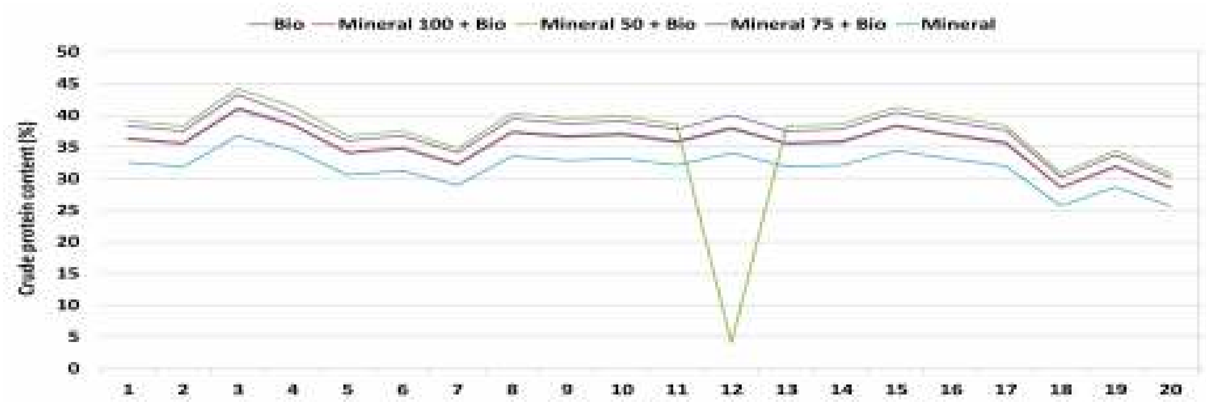

Fig. (5): Effect of fertilization regimes (F) on crude protein content (%)during 2011-2014

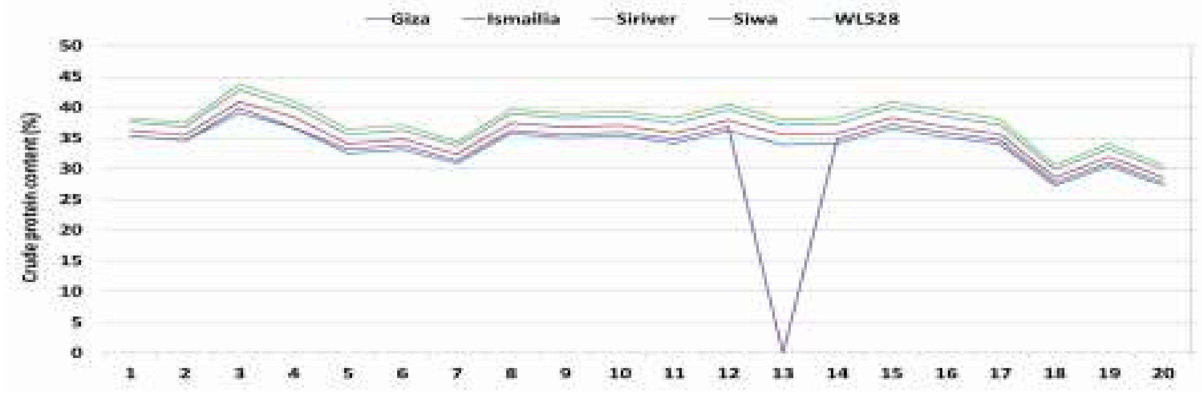

Fig. (6): Effect of alfalfa cultivars (Var.) on crude protein content (%)during 2011-2014.

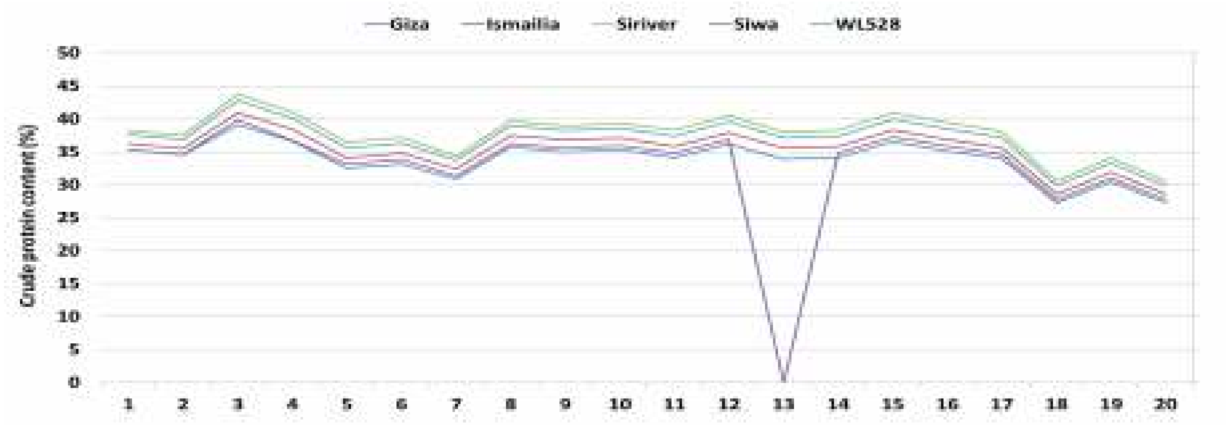

Fig. (7): Effect of fertilization regimes (F) on crude fiber content (%)during 2011-2014.

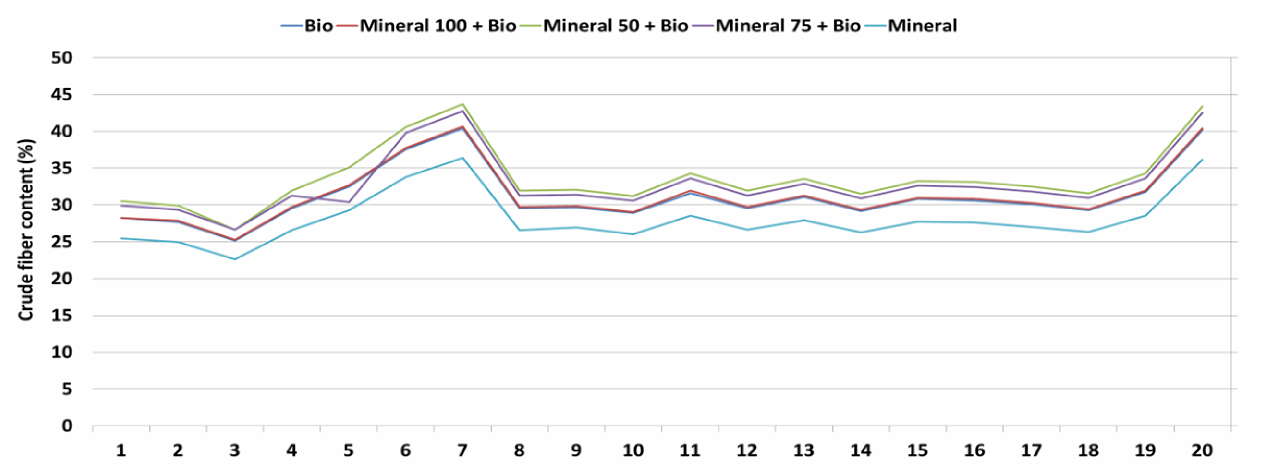

Fig. (8): Effect of alfalfa cultivars on crude fiber content (%) during 2011-2014.

Data revealed that the interaction between cultivars and fertilization regimes significantly (P≤0.05) led to increasing crude fiber content in all cuts during the experimental periods.

The data indicated that cultivated Si-River variety in soil contained combination between biofertilizer with 50% mineral significantly (P≤0.05) led to increasing crude fiber content in cuts No. (1, 2 and 4-20). And also, in means over all with mean (26.58 %), the cultivated Giza cultivar in soil contained mineral treatments led to decreasing crude fiber content with the lowest means (26.58%). Similar results were obtained by **Sengul and Sengul, (2008) and Stavarache *et al*., (2012).**

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الملخص العربى

تقييــم بعـــض أصـــناف البرســـيم الحجازي لإنتـــاج العلـــف تحت ظروف الأراضي الرمـــلية

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تعانى مصر من فجوة بين الإنتاج والإستهلاك في الأعلاف الخضراء، وخصوصاً خلال فصل الصيف، حيث أن الأعلاف المتاحة محدودة نتيجة المنافسة فى الزراعة مع المحاصيل الاستراتيجية على الأراضي الصالحة للزراعة وهى محدودة. ويعد البرسيم الحجازى أفضل المحاصيل للتغلب على هذه المشكلة لأنه من المحاصيل العلفية الأكثر ملاءمة لزراعتها في الأراضي المستصلحة حديثاً نظراً للإنتاج العالي من الأعلاف عالية الجودة وطول بقاءه فى الأرض. ويهدف البحث إلى معرفة المعدل الأمثل من التسميد الحيوي، والأسمدة المعدنية لزيادة إنتاج الأعلاف الخضراء في البرسيم وذلك باستخدام خمسة مستويات مختلفة من الأسمدة المعدنية والأسمدة الحيوية وتقييم خمسة أصناف من البرسيم الحجازى وهى (الجيزة-١، الإسماعيلية-١، سيوة-١، Si-Rive وWL-528) وذلك لإنتاج العلف ومكوناتها في ظل ظروف شمال سيناء ومناطق الأراضي المستصلحة حديثا المماثلة. أظهرت النتائج أن المعاملة بالتسميد الحيوي و ٧٥% من التسميد المعدني أدى إلى زيادة الوزن الطازج (٨٦,٦٥ كجم) في المعاملات، وعلاوة على ذلك، صنف الإسماعيلية ثم صنف سيوة أدى لزيادة الوزن الطازج (٩٦,٥٥ و ٩٥,٥٥ كجم على التوالي)، بالنسبة للوزن الجاف أظهر التسميد الحيوي، و ١٠٠% أسمدة معدنية والتسميد الحيوي ٧٥% أسمدة معدنية زيادة فى متوسط الوزن الجاف على مدى ٢٥ حشة وكان (٢٢,٦١ و٢٢,١٨ كجم على التوالي). على العكس، أظهرت التسميد المعدنى أقل القيم المتوسطة في جميع الحشات (١٩,٦٢ كجم). بالنسبة للبروتين الخام اعطى التسميد الحيوي، والتسميد المعدنى ٧٥% أعلى نسبة للبروتين الخام (٣٧,٤١%) في المتوسط، في حين أن التسميد المعدنى أعطى أدنى متوسط (٣١,٨٤%). أما محتوى الألياف الخام فإن التسميد المعدنى أعطى أعلى تحسين لمحتوى الألياف الخام (٣٣,٣٦%) في متوسط كل الحشات وأعطى التسميد المعدني أدنى القيم المتوسطة في ٢٥ حشة (٢٨,٠٥%).

الكلمات الإسترشادية: البرسيم الحجازى، محصول العلف، التسميد المعدني، التسميد الحيوى.

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