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Yield and Quality Response of Ryegrass, Egyptian Clover and Their Mixtures to Different Sources of Fertilizers

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Abstract

Two field experiments were conducted during two successive winter seasons of 2008/2009 and 2009/2010 to investigate the potentialities of mixing Egyptian clover with ryegrass under bio, organic and mineral fertilization treatments and their combination to increase forage yield and quality grown under sandy soil conditions. The experiment included the combination of five mixing ratios (Egyptian clover alone, ryegrass alone, 75% Egyptian clover: 25% ryegrass, 50% Egyptian clover: 50% ryegrass and 25% Egyptian clover: 75% ryegrass) and eight fertilizer sources, which include control, organic fertilization, bio fertilization, chemical fertilizer, organic + bio fertilizer, organic + chemical fertilizer, bio + chemical fertilizer and combination of organic and chemical and bio fertilizers. The obtained results indicate the superiority of 75% E. clover: 25% ryegrass mixture fertilized by Bio + O + N in fresh and dry forage production. On the other hand, it reported the lowest dry weight of weeds g/m^2. Chemical analysis of forage plants showed that the mixture of 75% E. clover: 25% ryegrass surpassed that of other treatments yield for crude protein, ether extract and ash. The results also revealed that the highest record of DCP, crude fiber and TDNY was obtained by forage mixture of 75% E. clover: 25% ryegrass fertilized with Bio + O + N. Such higher yield of these characters has secured a balanced ratio which is really needed for ruminants ration.

Keywords

Rye Grass, Egyptian Clover, Forage Mixing Ratios, Organic, Bio and Chemical Fertilizers

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1. Introduction

Mixtures of forage crops (cereals and legumes) clearly have many advantages and are superior to their monocultures in providing greater yield and quality. In this respect grass-legume mixtures have high crude protein concentration and low fiber concentration than pure grass stand (Hamdollah *et al.* [1]).

Egyptian clover (*Trifolium alexandrinum*, L.) is considered the main winter forage legume in old and new lands of Egypt. This is due to its high yield and quality especially crude protein content. Ryegrass (*Loliummulti floorum*, L.) is a native annual winter grass and adapted to a wide varieties of soils and produce quick cover after cutting, of high production and quality. Thus, the principal benefits of mixing ryegrass (*Loliummulti floorum*, L.) with Egyptian clover (*Trifolium alexndrinum*, L.) are the increase of total dry matter production and forage quality [2]-[4].

Organic and bio fertilizers seem to be more appropriate agronomic practices as they are considered the important aspects in agronomic clean farming. Among these organic materials are crop residues, farmyard compost, green manure and bio fertilizer as microbial fertilizers and rhizobium, blue green algae and azolla. These are used to improve soil health and increased the yield which plays an important role for minimizing the harmful effect of pesticides and herbicides [5].

Thus, this study was designed to investigate the effect of different fertilization sources on forage yield, growth behavior and nutritive components of ryegrass, Egyptian clover and their mixtures at different ratios.

2. Materials and Methods

Two field experiments were conducted during two successive winter seasons of 2008/2009 and 2009/2010 in Research and Production Station, National Research Centre, Al-Nubaria District, Al Behaira Governorate, Egypt.

Experiments were conducted to investigate the response of the yield and yield components of Egyptian clover (*Trifolium alexandrinum* L.) var. Meskawy and ryegrass (*Loliummulti florum*) and their mixture in different rates to different sources of fertilizers under sandy soil conditions.

This experiment include forty treatments in three replicates which were combination of five mixing ratio (Egyptian clover alone, ryegrass alone, 75% Egyptian clover: 25% ryegrass, 50% Egyptian clover: 50% ryegrass and 25% Egyptian clover: 75% ryegrass) and eight fertilizer sources include (control, organic fertilization {20 m^3 chicken manure/fad.* (*fad. = feddan = 4200 m^2)} the chemical analysis of chicken manure is presented in **Table 1**, bio fertilization phosphorine and nitrobine) are commercial products of biofertilizers produced by General Organization of Agriculture Equalization Fund (GOAEF) oversight of Ministry of Agriculture, Egypt, mineral fertilization (N) 20 kg N/fad., bio + organic fertilization, organic + mineral (N) fertilization, bio fertilization + mineral (N) fertilization and bio + organic fertilization + mineral (N) fertilization.

Organic manure was mixed with the soil surface layer three days before sowing. Mineral Nitrogen fertilizer was added as ammonium sulfate (20.6% N) at a rate of 100 kg/fad. The nitrogen fertilizer was divided into three equal portions, the first was added before seeding and the second after the first cut while the third portion was added after the second cut.

Split plot design was used in three replicates where the mixture systems in the main plots and fertilization treatments in the sub plots. Phosphorus (P) and potassium (K) were applied to all the experimental plots at the recommended dose. Experimental field well prepared through two plouging and leveling then divided into experimental plots $3 \times 3.5 = 10.5$ m^2 (1/400 fad.).

Egyptian clover and ryegrass, and their mixtures were sown on 29 October 2008 and 3 November for the first and second seasons respectively. with the recommended seeding rate for Egyptian clover (20 kg seeds/fad.) and ryegrass (12 kg seeds/fad.) in sandy soil of district of Al-Nubaria region. The proceeding crop was sunflower in the two seasons the mechanical and chemical analyses of the experimental soil according to [6] are presented in **Table 2**.

E. clover seeds were inoculated with the specific *Rhizobium* strain. Three cuts were taken from each of the two seasons. First cut was at 60 days from seeding date, the second after 50 days from the first one and third cut was taken after 40 days from the second cut.

Samples of twenty randomly selected plants of E. clover and ryegrass and their mixtures were taken from each experimental plot from one m^2 just before each cut to determine fresh and dry forage yields (kg/fed.), dry weight of weeds (gm/m^2). Chemical analysis of forage quality components on dry weight basis was conducted

Table 1. Chemical composition of the chicken manure used (average of 2008/2009 and 2009/2010 seasons).

Organic matter %	Organic carbon %	C/N ratio	pH	EC mmhos/cm^3	N %	P ppm	K ppm
50.35	29.20	14.4	7.6	8.20	2.08	118	108

Table 2. Mechanical and chemical analyses of the experimental soil (average of 2008/2009 and 2009/2010 seasons).

Mechanical analysis		Chemical analysis	
Sand %	92.3	Organic matter %	0.3
Silt %	3.1	E. C. mmhos/cm^3	0.3
Clay %	4.6	pH	7.4
$CaCO_3$ %	1.3	Soluble N, ppm	8.0
Soil texture	Sandy	Available P, ppm	3.0
		Exchan. K, ppm	19.8

for each treatment to determine crude protein. Total nitrogen percentage was determined according to [7] and the crude protein content was estimated by multiplying the analyzed total nitrogen percent by 6.25% for clover pure; by 6.125% for clover 75%: 25% ryegrass mixture, by 6.00% for 50% clover: 50% ryegrass mixture, by 5.875% for 25% clover: 75% ryegrass and by 5.75% for ryegrass pure. Crude fiber, ether extract (EE): (crude fats) and ash were estimated according to A.O.A.C [8].

Nutritive evaluation of feedstuff samples for forage material of the different treatments was also estimated. Digestible Crude Protein (DCP) and Total Digestible Nutrients (TDN) were calculated according to the equation of [9].

Data were statistically analyzed according to [10] the combined analysis was conducted for the data of the two growing seasons, the least significant differences (LSD) at the level of 5% significance was used to compare the treatments mean [11].

3. Results and Discussion

3.1. Forage Yield (ton/fad.)

3.1.1. Fresh and Dry Yield

Fresh forage yield as affected by the different E. clover, ryegrass and their mixtures fertilized with the applied treatments is presented in **Table 3**. Results indicated the superiority of 75% E. clover: 25% ryegrass mixture, fertilized by Bio + O + N in fresh forage production. The same effect of the interaction was obtained with dry forage yield. The highest fresh forage yield was 16.598, 16.120 and 13.15 ton/fad. and the highest dry forage yield from such interaction effect was 1.560, 2.758 and 4.110 ton/fad. for the subsequent three cuts respectively. These results were similar to those obtained by [3] [12]-[14]. These results may be due to the effect of *Rhizobium* bacteria on nodules of E. clover roots and its effect in fixing nitrogen from the ambient air beside the integrated effect of Bio + O + N fertilizers. In this respect, [15] found that E. clover-ryegrass mixture inoculated with *Rhizobium* and mixture of N-fixing bacteria produced higher fresh yield. [16] added that the application of organic fertilizer increased the obtained green and dry mass by 20.43 more than the untreated standard crop.

3.1.2. Dry Weight of Weeds

It is clear from data in **Table 3** that dry weight of weeds g/m^2 were decreased through the subsequent three cuts either in mono culture or their mixtures of E. clover and ryegrass. Treatment of Bio + O + N recorded the lowest dry weight of weeds g/m^2.

The least dry weight (g/m^2) was obtained for mono culture of ryegrass fertilized with Bio + O + N. The low intensity of weed infection could be due to the highest competition of pure ryegrass than the invaded weed, due to heaviest covering of ryegrass which shades the invaded weed and limits it growth and survival.

The same above fertilizer treatment produced more dry weed intensity in E. clover pure stand as compared

Table 3. Effect of Interaction of berseem, ryegrass, their mixtures and fertilization on fresh and dry forage yield and dry weeds (combined over two seasons 2008/2009 and 2009/2010).

Mixing system	Berseem only (B)			Ryegrass only®			75% B:25% R			50% B:50% R			25% B:75% R		
Fertilizers	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut
Fresh forage yield (ton/fed.)															
Control	9.06	10.73	7.70	5.94	6.67	6.20	11.65	11.80	8.77	10.93	10.27	8.10	9.43	9.16	7.00
Organic	10.81	11.75	8.83	7.06	7.70	7.01	12.17	13.47	9.52	11.72	11.36	8.91	10.36	10.43	7.64
Bio-fertilizer	10.30	11.18	8.48	6.54	7.09	6.72	12.09	12.67	9.10	11.73	11.52	8.49	9.94	10.47	7.29
Chemical	12.55	14.12	11.05	9.50	9.40	8.08	12.86	13.85	10.35	13.06	13.77	10.20	11.44	12.20	9.67
Bio + Organic	11.87	12.67	9.17	7.80	8.08	7.14	14.11	14.43	11.88	12.02	12.53	9.57	10.47	11.53	8.64
Organic + Chem.	13.28	15.03	11.79	10.09	10.33	8.94	15.94	14.91	12.20	13.83	14.37	11.15	12.00	13.22	10.45
Bio + Chemical	12.88	14.20	11.41	9.68	9.87	8.72	15.54	14.90	12.00	13.11	14.20	10.88	11.40	12.86	9.94
Bio + Org. + Chem.	14.03	15.64	12.36	11.51	11.27	9.37	16.60	16.12	13.15	15.04	15.98	10.97	12.52	13.87	10.77
Mean	**11.85**	**13.16**	**10.10**	**8.52**	**8.80**	**7.77**	**13.87**	**14.02**	**10.87**	**12.68**	**13.00**	**9.78**	**10.94**	**11.72**	**8.92**
LSD	**0.81**	**N.S**	**N.S**	**0.810**	**N.S**	**N.S**	**0.810**	**N.S**	**N.S**	**0.810**	**N.S**	**N.S**	**0.810**	**N.S**	**N.S**
Dry forage yield (ton/fed.)															
Control	0.73	1.74	2.52	0.71	1.52	2.34	1.07	2.10	3.13	1.03	1.93	2.96	0.90	1.75	2.75
Organic	0.87	1.97	2.80	0.82	1.67	2.59	1.17	2.31	3.28	1.11	2.12	3.16	0.99	1.95	2.94
Bio-fertilizer	0.82	1.87	2.74	0.76	1.59	2.48	1.13	2.20	3.23	1.06	2.03	3.04	0.95	1.87	2.80
Chemical	1.07	2.25	3.32	1.08	1.87	3.20	1.23	2.36	3.41	1.24	2.45	3.58	1.10	2.27	3.38
Bio + Organic	0.94	2.08	2.94	0.89	1.74	2.65	1.38	2.53	3.69	1.17	2.23	3.31	1.06	2.05	3.05
Organic + Chem.	1.14	2.38	3.61	1.19	2.02	3.46	1.50	2.67	3.93	1.35	2.58	3.71	1.17	2.45	3.57
Bio + Chemical	1.10	2.31	3.45	1.12	1.98	3.31	1.41	2.60	3.76	1.29	2.46	3.66	1.12	2.35	3.45
Bio + Org. + Chem.	1.19	2.46	3.83	1.30	2.10	3.60	1.56	2.76	4.11	1.39	2.68	3.82	1.31	2.54	3.68
Mean	**0.98**	**2.13**	**3.15**	**0.98**	**1.81**	**2.96**	**1.30**	**2.44**	**3.57**	**1.21**	**2.31**	**3.41**	**1.08**	**2.15**	**3.20**
LSD 5%	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**
Dry weed (gm/m^2)															
Control	170.2	124.8	85.3	129.1	92.2	56.2	153.3	136.4	78.9	146.3	128.1	64.8	118.6	109.1	283.1
Organic	154.6	112.5	79.1	105.4	86.0	51.7	143.2	127.0	76.3	134.0	121.3	60.8	111.3	102.5	266.8
Bio-fertilizer	164.3	119.3	81.1	110.7	89.2	51.5	143.3	130.3	76.0	132.4	121.4	63.5	115.0	102.5	271.9
Chemical	128.7	101.0	67.1	87.4	76.3	46.8	123.3	112.2	66.3	118.1	103.1	54.1	102.5	87.8	236.3
Bio + Organic	141.3	109.3	74.6	99.4	83.0	49.2	130.8	122.8	72.3	124.4	115.2	58.5	109.9	96.7	258.4
Organic + Chem.	116.0	96.2	60.6	79.4	69.9	43.9	118.1	111.7	62.2	108.2	102.5	50.1	97.2	82.5	223.8
Bio + Chemical	120.3	98.3	63.0	81.8	71.6	41.9	126.6	111.8	61.9	113.6	101.2	51.6	97.9	83.0	225.5
Bio + Org. + Chem.	99.8	92.9	55.4	70.6	66.4	38.3	111.6	103.6	58.2	103.2	94.7	48.0	88.9	78.2	207.1
Mean	**136.9**	**106.8**	**70.7**	**95.5**	**79.3**	**47.4**	**131.2**	**119.5**	**69.0**	**122.5**	**110.9**	**56.4**	**105.2**	**92.8**	**246.6**
LSD 5%	**9.5**	**N.S**	**N.S**	**9.5**	**N.S**	**N.S**	**9.5**	**N.S**	**N.S**	**9.5**	**N.S**	**N.S**	**9.5**	**N.S**	**N.S**

with ryegrass in the pure stand as it is clear in **Table 3**. So, the competition of E. clover in its pure stand was not as much as ryegrass in its pure stand. [17] came to the same results.

3.2. Chemical Constituents and Nutritive Value of Forage Plants

A—Crude Protein (CP)

The effect of the interaction between forage mixtures and different sources of fertilizer on the crude protein (kg/fad.) is shown in **Table 4**. The obtained results showed that more CP content was detected in all forage plants under experimentation for their later cuts than earlier ones. The obtained results also showed that the mixture of 75% E. clover: 25% ryegrass surpassed that other mixtures under different sources of fertilization treatments. Similar results were reported by [18] [19].

The highest of the CP yield (578 kg/fad.) recorded by E. clover fertilized with combination of Bio + Org. + Chem. fertilizer treatment. Such increase of CP yield under different sources of fertilizers may be attributed to the increase in the concentration of available nitrogen in root medium as a result of mineral N fertilizer. Similar findings were recorded by [20]-[22].

B—Crude Fiber

The obtained results in **Table 4** indicated CF yield (kg/fad.). Data clarified that, in general, CF yield (kg/fad.) of the proposed binary forage mixtures was higher for the later cut (third cut) than the earlier cuts. These results were true under applications of chemical types of fertilizer and their combinations. Here it is noticed that the highest CF content (910.29 kg/fad.) was obtained by forage mixture of 75% E. clover: 25% ryegrass under fertilization with Bio + Org. + Chem. Such effect may be attributed to the grasses with its nature of stemming structure. In this respect, [23] and [24] reported that grasses have much higher hemicellulose. Similar results were recorded by [25] and [26]. Such higher yield of CF of 75% E. clover: 25% ryegrass mixture under the combined source of fertilizers is responsible for a number of benefits beside the higher production of yield and quality as securing balanced ratio concerning crude protein and energy which is really needed for ruminants ration.

C—Ash Content

It is clear from **Table 4** that ash content increased obviously from the earlier cut to later one. Such effect may be attributed to the increase in dry matter accumulation by ageing. The obtained results also showed that 75% E. clover: 25% ryegrass (629.62 kg/fad.) surpassed that of other mixture treatment under the combined sources of fertilizers. Results obtained by [27] and [26] are similar to those findings in this work.

D—Ether Extract (EE)

It should notice that EE content represent slightly smaller values of narrow ignorable ranges. Meanwhile, the obtained results were fluctuating with no specific trend as its clear for **Table 5**. But, it is generally noticed that the interaction of Bio + O + N fertilization treatment produced higher EE content for the mixture of 75% E. clover: 25% ryegrass with significantly in the last two cuts. These results are in agreement with those obtained by [27] [28].

E—DCP Yield

Data of digestible crude protein DCP yield of the proposed forage mixtures for all cuts under various fertilizers are presented in **Table 5**. The obtained results revealed that DCP content obviously increased from the earlier to the latest cuts. These results were confirmed for all forage plants mixtures and under all sources of fertilizers. However, the highest record of DCP yield (390.24 kg/fad.) was obtained by forage mixture 75% E. clover: 25% ryegrass fertilized with Bio + O + N in the third cut. These results could be used in upgrading quality of the assigned forage mixture through selecting the appropriate association of botanical components. Similar results obtained by [29] and [22].

F—Total Digestible Nutrient Yield (TDNY)

Data presented in **Table 5** revealed that TDNY of the pure stand of either ryegrass or E. clover and their mixture of forage under the different fertilization treatments were noticeably higher for the earlier than the later cuts. This could be due to the higher leaf/ stem ratio of such forage plants for early cuts compared by the leaf/stem ratio of the later cuts. These results could be due to the prevailing environmental factors and plants age which play an important role in reducing the TDNY of the forage resulting from more deposited fibers and/or lignin with some of the other anti-quality components (as lignin) that may reduce TDNY (kg/fad.) of the obtained forages. Data also show that the highest TDNY content (kg/fad.) was recorded by forage mixture of 75% E. clover: 25% ryegrass under Bio + O + N treatment. These results were confirmed by [29] and [22].

Table 4. Effect of Interaction of berseem, ryegrass, their mixtures and fertilization on crude protein, crude fiber and fiber content (combined over two seasons 2008/2009 and 2009/2010).

Mixing system	Berseem only (B)			Ryegrass only®			75% B:25% R			50% B:50% R			25% B:75% R		
Fertilizers	**1st cut**	**2nd cut**	**3rd cut**	**1st cut**	**2nd cut**	**3rd cut**	**1st cut**	**2nd cut**	**3rd cut**	**1st cut**	**2nd cut**	**3rd cut**	**1st cut**	**2nd cut**	**3rd cut**
A—Crude protein content (kg/fed.)															
Control	143.11	323.06	385.98	93.66	187.30	226.77	198.58	354.17	386.37	185.40	270.40	351.16	143.17	231.43	308.17
Organic	174.82	376.52	448.66	114.74	210.64	259.97	228.38	394.08	423.18	203.26	311.63	391.13	149.90	262.12	348.80
Bio-fertilizer	160.03	349.57	430.21	104.28	196.21	289.28	215.05	374.16	406.52	188.84	284.51	364.65	142.99	247.01	317.58
Chemical	223.72	454.91	559.93	164.61	250.28	357.15	275.06	454.35	505.28	236.95	374.65	471.81	183.44	317.36	414.03
Bio + Organic	192.17	402.73	467.27	131.35	222.38	282.82	244.10	411.24	449.74	214.96	329.79	414.58	161.52	278.39	363.42
Organic + Chem.	248.64	487.71	612.89	187.67	272.05	394.01	304.80	494.48	550.06	258.37	408.04	496.99	199.62	348.63	442.19
Bio + Chemical	234.76	468.47	574.03	175.02	261.99	404.11	282.90	472.15	517.35	246.65	378.03	482.74	186.95	332.35	420.56
Bio + Org. + Chem.	258.04	512.52	657.50	207.32	285.49	419.83	317.89	498.36	578.01	266.97	431.70	518.66	220.81	371.26	458.06
Mean	**204.41**	**421.94**	**517.06**	**147.33**	**235.79**	**329.24**	**258.34**	**431.62**	**477.06**	**225.17**	**348.59**	**436.46**	**173.55**	**298.57**	**384.10**
LSD	**18.17**	**24.05**	**26.04**	**18.17**	**24.05**	**26.04**	**18.17**	**24.05**	**26.04**	**18.17**	**24.05**	**26.04**	**18.17**	**24.05**	**26.04**
B—Crude fiber content (kg/fed.)															
Control	97.24	265.06	428.31	118.72	295.57	470.69	161.18	390.72	596.60	157.96	345.53	565.46	145.67	310.71	529.31
Organic	138.57	343.20	518.41	154.94	335.16	532.16	193.56	454.13	673.25	194.00	412.78	631.87	169.41	349.34	611.05
Bio-fertilizer	121.52	346.78	523.18	136.50	315.57	597.84	184.56	420.59	633.38	179.07	392.80	628.11	158.16	324.76	595.56
Chemical	179.74	438.61	676.94	201.09	379.50	716.43	243.70	513.91	766.90	224.29	494.73	782.92	205.55	481.88	742.06
Bio + Organic	143.20	401.83	587.76	163.75	341.82	560.17	213.67	474.72	678.09	207.53	436.23	696.79	193.71	427.47	669.26
Organic + Chem.	207.51	469.70	772.07	236.00	445.18	806.75	276.61	550.00	877.93	251.90	528.74	836.71	230.10	528.21	788.87
Bio + Chemical	197.83	430.74	734.78	219.90	428.10	850.65	244.24	505.40	822.12	239.18	526.40	810.38	210.00	489.33	777.33
Bio + Org. + Chem.	228.39	499.11	849.82	258.48	487.79	881.39	280.96	555.73	910.29	274.48	579.35	853.99	271.88	557.11	870.57
Mean	**164.25**	**399.38**	**636.41**	**186.17**	**378.59**	**677.01**	**224.81**	**483.15**	**744.82**	**216.05**	**464.57**	**725.78**	**198.06**	**433.60**	**698.00**
LSD 5%	**18.20**	**31.88**	**43.56**	**18.20**	**31.88**	**43.56**	**18.20**	**31.88**	**43.56**	**18.20**	**31.88**	**43.56**	**18.20**	**31.88**	**43.56**
C—Ash content (kg/fed.)															
Control	124.61	255.27	293.74	107.03	206.27	251.36	183.44	288.96	385.76	168.07	276.25	330.47	147.48	240.65	273.36
Organic	154.40	301.24	391.74	142.56	246.61	330.85	191.76	335.89	389.71	188.26	317.99	418.22	164.29	278.47	343.51
Bio-fertilizer	141.52	269.07	356.38	116.35	236.21	330.33	191.13	333.53	419.55	169.10	307.28	371.69	155.40	260.74	320.53
Chemical	192.49	378.64	431.86	183.10	281.92	413.32	259.87	413.14	523.31	221.67	396.13	508.69	191.25	372.86	432.00
Bio + Organic	181.44	318.37	435.53	147.35	259.69	330.89	208.59	374.71	468.25	205.37	355.31	442.33	182.99	311.27	378.71
Organic + Chem.	217.89	419.87	540.04	214.94	334.25	453.57	282.64	450.95	617.18	246.15	423.03	532.27	210.71	414.91	464.82
Bio + Chemical	197.19	400.72	528.31	192.68	315.84	491.74	240.11	455.97	548.55	233.46	409.68	517.37	196.89	392.32	438.23
Bio + Org. + Chem.	220.45	460.90	606.00	239.90	340.98	498.00	308.30	497.97	629.62	263.99	456.90	575.43	248.26	429.01	487.81
Mean	**178.75**	**350.51**	**447.95**	**167.99**	**277.72**	**387.51**	**233.23**	**393.89**	**497.74**	**212.01**	**367.82**	**462.06**	**187.16**	**337.53**	**392.37**
LSD 5%	**17.74**	**24.65**	**27.76**	**17.74**	**24.65**	**27.76**	**17.74**	**24.65**	**27.76**	**17.74**	**24.65**	**27.76**	**17.74**	**24.65**	**27.76**

Table 5. Effect of Interaction of berseem, ryegrass, their mixtures and fertilization on total digestible nutrient TDN, digestible crude protein and ether extract content (combined over two seasons 2008/2009 and 2009/2010).

Mixing system	Berseem only (B)			Ryegrass only®			75% B:25% R			50% B:50% R			25% B:75% R		
Fertilizers	**1st cut**	**2nd cut**	**3rd cut**	**1st cut**	**2nd cut**	**3rd cut**	**1st cut**	**2nd cut**	**3rd cut**	**1st cut**	**2nd cut**	**3rd cut**	**1st cut**	**2nd cut**	**3rd cut**
D—Ether extract content (kg/fed.)															
Control	13.73	36.25	32.65	16.03	33.09	36.51	24.51	37.51	46.49	20.61	46.36	32.36	20.26	35.51	42.22
Organic	20.41	46.51	38.67	24.20	49.32	45.56	29.60	46.90	51.06	24.52	46.66	54.86	24.65	45.82	54.17
Bio-fertilizer	17.69	42.07	36.44	18.92	43.76	57.64	27.27	44.40	51.24	22.73	43.33	48.47	23.35	43.53	51.40
Chemical	29.88	53.85	63.70	40.09	61.79	75.44	40.35	70.19	71.60	30.87	62.63	73.44	35.41	62.13	71.55
Bio + Organic	23.13	51.93	54.78	24.32	52.00	57.58	31.96	55.37	59.27	27.78	52.69	64.15	30.46	51.30	60.65
Organic + Chem.	35.17	61.05	72.64	45.84	57.27	103.05	45.41	76.80	83.01	38.84	67.29	86.17	39.94	72.52	86.51
Bio + Chemical	27.60	51.83	67.98	44.53	54.55	105.06	43.78	75.15	77.87	34.48	68.30	79.14	37.30	68.82	73.45
Bio + Org. + Chem.	34.83	66.29	79.06	53.97	56.82	114.13	53.34	81.08	91.80	40.58	88.42	91.25	51.38	77.00	90.38
Mean	**25.31**	**51.22**	**55.74**	**33.49**	**51.07**	**74.37**	**37.03**	**60.93**	**66.54**	**30.05**	**59.46**	**66.23**	**32.84**	**57.08**	**66.29**
LSD 5%	**3.16**	**4.15**	**4.20**	**3.16**	**4.15**	**4.20**	**3.16**	**4.15**	**4.20**	**3.16**	**4.15**	**4.20**	**3.16**	**4.15**	**4.20**
e—Digestible crude protein content (kg/fed.)															
Control	104.35	232.55	267.62	63.30	121.98	143.91	143.17	249.48	251.81	132.05	183.16	226.00	89.28	154.00	194.29
Organic	127.80	272.16	313.88	78.43	138.11	165.89	166.02	277.78	279.46	145.13	213.59	255.01	104.25	175.11	224.03
Bio-fertilizer	116.52	251.70	299.62	71.06	127.84	184.46	155.66	263.89	266.48	134.25	192.75	235.45	99.12	164.28	200.90
Chemical	164.35	331.76	395.58	114.32	166.80	233.12	200.45	323.84	338.93	170.62	258.72	313.07	129.76	214.06	269.89
Bio + Organic	140.81	291.72	326.19	90.78	146.33	183.78	177.86	301.25	298.72	153.68	226.23	271.25	112.14	186.45	233.78
Organic + Chem.	183.83	356.41	433.38	128.94	181.50	258.12	222.75	354.44	370.99	186.10	284.06	331.12	141.78	236.18	287.74
Bio + Chemical	173.03	341.88	404.17	122.30	174.04	263.16	206.42	337.22	347.42	177.63	264.45	320.43	132.27	224.78	272.21
Bio + Org. + Chem.	190.52	375.52	465.73	145.15	191.00	276.45	232.36	344.03	390.24	193.56	301.63	347.05	156.29	253.11	298.45
Mean	**150.15**	**306.71**	**363.27**	**101.78**	**155.95**	**213.61**	**188.09**	**306.49**	**318.01**	**161.63**	**240.57**	**287.42**	**120.61**	**201.00**	**247.66**
LSD 5%	**N.S**	**16.64**	**17.20**	**N.S**	**16.64**	**17.20**	**N.S**	**16.64**	**17.20**	**N.S**	**16.64**	**17.20**	**N.S**	**16.64**	**17.20**
F—Total digestible nutrient TDN content (kg/fed.)															
Control	456.40	1063.31	1524.98	452.06	955.32	1444.37	677.42	1301.27	1914.15	661.93	1218.60	1830.17	581.67	1092.53	1709.40
Organic	558.76	1228.98	1730.40	545.10	1075.48	1643.61	755.94	1462.81	2027.86	737.15	1370.47	1972.79	663.55	1273.35	1846.76
Bio-fertilizer	521.27	1158.93	1686.33	501.94	1017.36	1757.82	725.12	1386.33	1983.70	690.22	1306.20	1888.75	637.68	1217.18	1749.44
Chemical	713.58	1474.99	2082.64	762.21	1274.87	2117.60	942.95	1666.13	2320.83	849.03	1628.27	2301.58	719.52	1349.72	1944.99
Bio + Organic	611.05	1306.86	1825.30	599.28	1133.26	1693.62	811.68	1503.20	2126.48	781.68	1451.17	2079.84	765.68	1522.26	2183.82
Organic + Chem.	769.04	1575.20	2285.31	846.86	1401.48	2325.99	1035.30	1792.10	2503.41	934.74	1729.12	2412.43	822.81	1659.14	2337.10
Bio + Chemical	737.50	1524.60	2169.71	793.86	1367.29	2383.74	969.16	1733.94	2378.20	889.97	1642.17	2361.62	784.05	1580.96	2239.22
Bio + Org + Chem.	819.73	1662.35	2471.50	943.48	1471.37	2454.94	1085.06	1908.13	2673.14	976.06	1806.32	2515.66	927.43	1729.36	2440.39
Mean	**648.42**	**1374.40**	**1972.02**	**680.60**	**1212.05**	**1977.71**	**875.33**	**1594.24**	**2240.97**	**815.10**	**1519.04**	**2170.35**	**737.80**	**1428.06**	**2056.39**
LSD	**N.S**	**N.S**	**129.17**	**N.S**	**N.S**	**129.17**	**N.S**	**N.S**	**129.17**	**N.S**	**N.S**	**129.17**	**N.S**	**N.S**	**129.17**

4. Conclusion

From the obtained results, it could be concluded that mixing 75% E. clover with 25% ryegrass and fertilized with Bio + O + N fertilizers could be recommended for better forage quantity and quality. Thus, it is beneficial in future to increase areas of such forage mixing ratio under the combined three fertilizers in sandy soils for many reasons which include saving good soils for other crops, improving soil properties as a result of Egyptian clover cultivation, and obtaining better forage in quantity and quality for animal feeding.

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