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Comparative Study on the Effect of Fertilizers Source on Yield and Quality of Forage Mixture (Egyptian Clover-Ryegrass) Under Sandy Soil Conditions

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Abstract: 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 Emam Malek Village).Al-Nubaria District, l Behaira Governorate, Egypt.

Experiments aimed to study the effect of different fertilization sources on yield and quality of forage mixtures from Egyptian clover –ryegrass grown under sandy soil conditions.

Each experiment include eight treatments (control (C), organic fertilization (O), bio fertilization (phosphorine and nitrobine) (Bio), mineral fertilization.(N), bio+ organic fertilization (Bio+O), organic +mineral fertilization(O+N), bio fertilization + mineral (N) fertilization(Bio+ N) and bio+organic + mineral fertilization(Bio+ O+ N).

Fresh and dry forage yield/fad. (Fad= Faddan= $4200m^{2)}$ are determined for three cuts (first cut 60 days after sowing, second 50 days from the first while third cut 40 days later). Chemical composition and nutritional evaluation for dry forage yield was conducted. The obtained results showed that treatment of fertilization bio+organic+ mineral fertilization (Bio+ O+ N) was the best treatment in fresh and dry yields for berseem clover – ryegrass mixture as well as chemical components and nutritive evaluation i.e (crude protein, crude fiber, ether extract, nitrogen free extract, ash, digestible crude protein and total digestible nutrient).

Key words: Organic, Bio, Mineral Fertilization, Egyptian clover –ryegrass mixtures Yield, Quality.

Introduction

Fertilizers play an important role in enhancing forage productivity .Based on the production process, it can be roughly categorized into three types: chemical, organic and biofertilizer. Each type of fertilizer has its advantages and disadvantages.

Chemical Fertilizers are soluble and immediately available to the plants; therefore the effect is usually direct and fast, the price is lower and they are quite high in nutrient content;only relatively small amounts are required for crop growth.

Organic Fertilizers enhance soil biological activity, which improves nutrient mobilization from organic and chemical sources and decomposition of toxic substances, they enhance the colonization of mycorrohizae, which improves P supply, enhance root growth due to better soil structure, increase the organic matter content of the soil, improving and the exchange capacity of nutrients. Organic fertilizers seems also to be more

appropriate agronomic practices as it considered the important aspects in agronomic clean farming. Among these organic materials are crop residues, farmyard compost[1,2]**.**

Biofertilizer is defined as a substance which contains living microorganisms and is known to help with expansion of the root system and better seed germination. They are natural, biodegradable, organic and consist of plant remains, organic matter and some special class of micro-organisms.Overall, the significant role of biofertilizers in plant growth productivity and protection against some stresses makes them a vital and powerful tool for organic and sustainable agriculture[2].

These advantages need to be integrated in order to make optimum use of each type of fertilizer and achieve balanced nutrient management for crop growth.

Mixtures of forage crops (cereals and legumes) clearly have many advantages and are superior than their monocultures in providing greater yield and quality[3,4] **.** Egyptian clover (*Trifolium alexandrinum,* L.*)* is considered the main winter forage legume due to its high yield and quality, ryegrass (*Loliummulti floorum,* L.*)* is a native annual winter grass and adapted to a wide varieties of soils and produce quick cover after cutting.

Thus , this study was designed to investigate the effect of different sources of fertilizers on yield, growth behavior and nutritive components of Egyptian clover –ryegrass mixture.

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 effect of different sources of fertilizers on the yield and yield components forage mixture from Egyptian clover (*Trifolium alexandrinum*L.) var. Meskawy and ryegrass (*Loliummulti florum)* var. Gulf under sandy soil conditions.

Each experiment include eight treatments in three replicates which were eight fertilizer sources include (control (C), organic fertilization (O) (20m^3 chicken manure/fad*) the chemical analysis of chicken manure is presented in Table (1)., biofertilization (Bio) (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 (Bio+O) ,organic +mineral (N) fertilization (O+N), bio fertilization + mineral (N) (Bio+N) fertilization and bio+ organic fertilization+mineral(N)fertilization)(Bio+O+N).

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

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.

The experimental design was randomized complete block design with three replicates. Experimental field well prepared through two ploughings and leveling then divided into experimental plots 3 x 3.5 = 10.5 m^2 (1/400 fad) .Phosphorus (P) and potassium (K) were applied to all the experimental plots at the recommended dose. The preceding crop was sunflower in the two seasons.

Egyptian clover and ryegrass mixture were sown on 29 October 2008 and 3 November for the first and second seasons, respectively with the recommended seeding rate for Egyptian clover (20kg seeds/fad.) and ryegrass (12 kg seeds/fad.) in sandy soil of Nobaria region. The mechanical and chemical analyses of the experimental soil according to[5] is presented in Table (2).

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
Ca Co_3%	1.3	Soluble N ppm	8.0
Soil texture	sandy	Available P,ppm	3.0
		Exchan. K ppm	19.8

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.

Total nitrogen percentage was determined according to[6]**.** Crude protein content was estimated by multiplying the analyzed total nitrogen percent by 6.25%.Chemical analysis of feedstuff samples for forage material were analyzed according to[7] method.

The investigated nutritive evaluation of obtained forage material of the different materials included Crude protein (CP), Crude fiber (CF), Ash, Nitrogen free extract (NFE), Ether extract (EE), Digestible crude protein (DCP), Total digestible nutrient (TDN) and Total digestible nutrient yield (TDNY) were determined according to the method described by[8]**.**

Data were statistically analyzed according to[9]**.** The combined analysis was conducted for the data of the two growing seasons, The least significant differences (L.S.D) at the level of 5% significance was used to compare the treatments mean.

Results and Discussion

I. Forage Yield:

1-Fresh forage yield(ton/ fad.):

Table (3):Effect of fertilization on fresh and dry forage yield (ton/fad.) (combined over two seasons 2008/2009 and 2009/2010)

Fertilization treatments	Fresh weight				Dry weight			
	1st cut	2nd cut	3rd cut	Total	1st cut	2nd cut	3rd cut	Total
C	9.387	9.491	7.545	26.422	0.889	1.812	2.742	5.442
O	10.424	11.053	8.372	29.849	0.990	2.004	2.955	5.950
Bio	10.119	10.698	8.007	28.824	0.945	1.913	2.858	5.716
N	12.132	12.896	10.234	35.263	1.174	2.274	3.433	6.881
Bio+ O	11.002	11.843	8.965	31.810	1.061	2.093	3.075	6.228
O + N	13.028	13.681	10.898	37.607	1.269	2.418	3.656	7.342
Bio +N	12.521	13.317	10.581	36.419	1.207	2.340	3.526	7.072
Bio +O + N	13.939	14.136	11.314	39.390	1.350	2.508	3.808	7.666
mean	**11.569**	**12.139**	**9.490**	**33.198**	**1.111**	**2.170**	**3.257**	**6.537**
L.S.D at 5 %	0.360	0.430	0.310	0.650	0.050	0.070	0.090	0.120

Results presented in Table (3) indicate that there were significant differences in produced fresh forage yield by the applied fertilization treatments in each of the subsequent three cuts. Results also indicated that the applied fertilization treatment of Bio +O+N produced the highest fresh forage yield in each of the three cuts. The obtained fresh yield was13.939, 14.136 and 11.314 ton/fad., respectively with a total of 39.39 ton/fad. Superiority of Bio+O+N may be due to integrated slow effect of both organic and bio fertilizers beside the fast effect of mineral fertilizers. Similar results were obtained by10,11,12,**.** Nitrogen fertilization increased E.

clover/ryegrass fresh weight forage[13,14,15]. El-Kramany *et al.,* (2012) [16,] and Soleymani *et al.,* (2012)[17] came to the same conclusion.

2-Dry forage yield (ton/ fad.):

It is also clear from the same Table (3) that Bio+O+N fertilizers significantly surpassed the other fertilization treatments in dry forage yield in all three cuts which was1.350, 2.508, 3.808 ton/ fad.with a total 7.666 ton/ fed, respectively. The lowest dry forage yield was for Bio+N in the three cuts and its total as compared with other fertilizer treatments. This may be due to the ability of biofertilizers to transport major nutrients like N and P besides secreting plant growth promoting substances such as IAA, gibberellins and abscisic acid. An organic acid obtained from organic manures has lead to increase in soil acidity and consequently convert insoluble forms of phosphorus into soluble ones[18,19,17].

II Chemical Constituents and Nutritive Value

1-Crude Protein (CP):

Table (4): Effect of different sources of fertilizers and their combination on CP, CF and NFE yield (kg/fad)of forage mixture from Egyptian clover and ryegrass. (combined over two seasons 2008/2009 and 2009/2010)

Fertilization Treatments	CP			CF			NFE		
	yield kg/fad.			yield kg/fad.			yield kg/fad.		
	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut
C	151.76	276.75	336.33	136.69	318.52	522.92	351.44	756.00	1189.67
O	173.63	310.90	376.23	167.35	381.94	590.62	410.07	859.46	1324.28
Bio	163.55	292.74	357.08	152.38	342.91	551.42	383.96	811.29	1261.33
N	216.84	368.33	463.14	213.89	461.55	751.78	497.44	1014.54	1631.77
Bio+ O	188.22	328.62	395.93	190.24	417.25	660.13	442.28	912.43	1397.34
O + N	238.69	399.02	499.03	243.15	518.56	816.37	548.27	1112.62	1761.42
Bio +N	224.48	382.24	474.81	215.36	468.11	775.99	514.41	1059.37	1683.52
Bio +O + N	256.92	419.79	527.71	265.45	559.97	914.80	586.91	1162.28	1859.48
Mean	**201.76**	**347.30**	**428.78**	**198.06**	**433.60**	**698.00**	**466.85**	**961.00**	**1513.60**
L.S.D at 5 %	8.13	10.76	11.64	8.14	14.26	19.48	25.49	37.69	26.55

Data presented in Table (4) showed that crude protein yield increased progressively from the earlier to the later cuts. Such effect was expected due to the high dry mass of leaves and stem plants in the later cuts than in the earlier one. The same Table also show that there was a clear increase in CP yield by mineral fertilization N and its combination with organic or Bio +O treatments. Such effect of mineral N may be attributed to the available nitrogen in root medium. In general, the highest CP yield was obtained by (Bio +O+N) fertilizer treatment which were 256.92 kg/fad.in the1st cut, 419.79 kg/fad.in the 2nd cut and 527.71 kg/fad.in the 3rd cut. Similar findings were recorded by[20,21,22,14] **.**

2-Crude Fiber (CF):

The effect of different treatments of fertilization as presented in Table (4) clarified a clear increase in crude fiber yield from the 1st to the 3rd cuts. Such effect was clearly identified under different sources of the applied fertilizer treatments. Mineral fertilization treatment exerts high CF yield than the other two sources. However, different combination of mineral N fertilizer with other sources increased CF as compared with sole application of other fertilizers. The highest CF yield kg/fad.produced by the Bio +O+N fertilizer treatment was 265.45 kg/fad.in the 1st cut, 559.97 kg/fad.in the 2nd cut and 914.80 kg/fad.in the 3rd cut. These results were confirmed by the results of [23]**.**

3-Nitrogen free extracts (NFE):

Results clarified in Table (4) clearly indicate that NFE yield increased gradually from the 1st cut up to the 3rd cut. Results also showed that such effect was clearly indicated under different sources of fertilization treatments. Mineral fertilization exerts high NFE content than the other two sources Bio and O. However, the different combination of mineral fertilizers with the other sources obviously promote NFE accumulation as compared with sole application of each fertilizer. The highest NFE content was obtained by Bio + O+ N treatment (586.91, 1162.28 and 1859.48 kg/fed. in the first,second and third cuts ,respectively) . **Hathout *et al.*, (1997) and Cojocariu *et. al*.**[24,25](2008) came to the same conclusion.

4-Ether Extract (EE):

Table (5): Effect of different sources of fertilizers and their combination on EE, Ash and DCP and TDN yield (kg/fad) of forage (mixture from Egyptian clover and ryegrass). (combined over two seasons 2008/2009 and 2009/2010)

	EE			Ash			DCP			TDNY		
Fertilization Treatments	yield kg/fad.			yield kg/fad.			yield kg/fad.			yield kg/fad.		
	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut
C	19.96	37.59	44.55	145.44	263.94	317.29	106.43	188.23	216.73	565.9	1126.2	1684.6
O	25.36	48.67	56.21	170.4	295.78	382.39	124..33	215.35	247.65	652.1	1282.2	1844.3
Bio	22.98	44.13	51.76	157.59	281.69	352.85	115.32	200.09	237.38	615.2	1217.2	1813.2
N	34.63	60.78	71.98	207.14	358.88	466.66	155.9	259.04	310.12	806.7	1513.3	2201.3
Bio+ O	29.26	53.06	60.99	185.5	321.49	405.26	135.05	230.4	262.74	704.6	1348.8	1934
O + N	40.52	67.46	80.01	231.06	417.49	511.76	172.68	282.52	336.27	881.8	1631.4	2372.8
Bio +N	36.58	63.5	75.02	213.79	376.15	488.24	162.33	268.47	321.48	834.9	1569.8	2306.5
Bio +O + N	44.72	72.38	86.23	254.85	444.48	571.63	183.57	293.06	355..58	950.4	1715.5	2511.1
Mean	**31.75**	**55.95**	**65.84**	**195.72**	**344.99**	**437.01**	**144.45**	**242.14**	**285.99**	**751.4**	**1425.6**	**2083.5**
%L.S.D at 5	1.41	1.86	1.88	7.94	11.02	12.42	5.78	7.44	7.69	30.7	46.3	57.8

Data presented in Table (5)) clearly indicate that different sources of fertilizer treatments affect EE content in tissues of forage plants in all cuts . Such effect increased gradually from the first cut through the third one. These results were to be expected since the dry matter of the studied forage mixture increased from the 1st to the 3rdcu. It is worthy to note that the increase in EE content was noticed by applying sole mineral N fertilization or in combination with organic or Bio and O fertilization. These results were clear in all cuts. The obtained data results also show that organic fertilization had more obvious effect on EE yield than bio fertilizers and its effect was also identified in the dual application with mineral and bio fertilization. Similar results were obtained by[24,26]**.**

5- Ash:

The obtained data presented in Table (5) revealed that total ash clearly increased by applying different sources of fertilizers .Such effect was clear in all cuts and gradually increased from the1st cut to the 3rdcut. Such effect may be attributed to the increase in dry matter accumulation by ageing. The highest ash content was obtained by Bio +O + N fertilization treatment which were 254.85, 444.48 and 571.63 kg/fed. in the three cuts, respectively. Similar results were obtained by[14]**.**

6- Digestible Crude Protein (DCP):

The obtained results in Table (5) indicate that the absolute amount of DCP as affected by different sources and combinations of fertilizers was noticed to be highest in the 3rdcut and lowest in the 1st cut. This was true as a result of increasing dry matter accumulation by ageing .It is also clearly noticed that mineral N fertilizer clearly increase in DCP content as N fertilizer present in fertilizer combination. Such effect of mineral N fertilizer on DCP uptake may be due to the increased in concentration of available nitrogen in the roots medium. Similar results were recorded by[24]**.** However, the highest yield of DCP (355.58 kg/fad.) was recorded in the thirc cut by forage plants fertilized with Bio+O+N combination.

7- Total Digestible Nutrient Yield (TDNY):

Data presented in Tble (5) revealed that different sources of fertilizers clearly affected TDNY content in all cuts and progressively increased from the first to the third cut . However, the TDNY content on dry matter basis increased consistently by applying mineral N fertilization and its combinations with the other sources of fertilization. The obtained results also revealed that bio + organic+ mineral treatment surpassed all of the other N and combined fertilization treatments. These results were true over all cuts El. Selaimi (1991) and Hathout *et al.*,(1997) [23,24] came to similar findings.

Conclusion

The findings of this study have clearly showed that combined application **of** Bio +O+N fertilizers where (Bio) Bio fertilization (phosphorine+ nitrobine) +(O) Organic fertilization (20m^3 chicken manure/fad.) + (N) Mineral fertilization (20 kg N/fad. has resulted in obtaining highest forage yield and quality for berseem clover + ryegrass mixture under sandy soil conditions Thus,these advantages need to be integrated in order to make optimum use of each type of fertilizer and achieve balanced nutrient management for crop growth.

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