Zagazig J. Agric. Res., Vol. 49 No. (4) 2022 523-533

Soil Science and Agricultural Engineering

Available online at http://zjar.journals.ekb.eg
http:/www.journals.zu.edu.eg/journalDisplay.aspx?Journalld=1&queryType=Master

RESPONSE OF SUDAN GRASS TO ORGANIC, INORGANIC AND BIO-FERTILIZERS

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Received: 03/07/2022 ; Accepted: 28/08/2022

ABSTRACT: This investigation was carried out at the experimental farm, Faculty of Agriculture, Zagazig University through the growing summer season of 2019. This study was conducted to evaluate the effect of inorganic, organic and bio-fertilization on plant growth and NPK content by successive four cuts of sudan grass plants grown in clayey soils. The most important findings could be summarized as follows: Generally, in most cases, adding any organic sources i.e., chicken manure (CM) or rabbit manure (RM) or Quail manure (QM) or farmyard manure (FYM) at the rate of 0.5% with50 % RD (NPK) plus inoculated by microbien (Mic.) gave the highest significant values of four cuts and accumulative fresh weight as well as N, P and K percentage of sudan grass grown in clay soil compared with control treatment. As a general view, the fresh weight and N percentage of sudan grass grown in clay soil was increased from 1st cut to 2nd one then decreased in 3rd cut followed by last one using the control treatment or 100% RD (NPK) with or without microbien inoculated or 50% RD (NPK) with CM, QM, RM and FYM with microbien inoculated. The same trend was noticed for P% using the microbien inoculated with 50 % RD (NPK) or 50% RD (NPK) alone or control treatment. Also, the fresh weight of sudan grass was increased from 1st cut to 2nd one followed by 3rd cut then decreased in last one by adding the treatment of 50% RD (NPK) with QM or CM. Similar trend was obtained for N% by adding the 100% RD (NPK) with or without microbien inoculated or 50% RD (NPK) with Mic. The same trend was noticed for P% by adding 50% RD (NPK) plus 0.5% of any organic wastes with or without microbien inoculated. Similar trend was obtained for K% by adding 50% RD (NPK) plus 0.5% of any organic wastes with microbien inoculated compared with control treatment. In general, it could be stated that to increase forage production and its quality of sudan grass, mineral with organic and bio-fertilizer can be used at rate of 50% NPK mineral fertilizers with any organic wastes plus bio- fertilizer (microbien)under the same soil conditions.

Key words: Sudan grass, microbien, mineral, organic fertilizer and clayey soil.

INTRODUCTION

Sudan grass is a suitable extra forage source to plug the feed scarcity gap throughout the summer period in arid and semiarid areas **(Al-Suhaibani, 2006)**. Some forage grasses for example sorghum and sudan grass are the most acceptable summer forage crops grown in Egypt to offset the acute shortage in forage production during the summer. In Egypt, the total cultivated area of sudan grass reached about 8340 fed., in 2011 season, producing 190913 Mg, thus the average production was 22.90 Mg fed^{-1} **(El-Nahrawy, 2011).**

Hossain *et al.* (2017) confirmed that the organic manure application helped increase OM content as well as water holding and infiltration capacity, in addition to porosity, hydraulic conductivity and water stable aggregation as well as reduce bulk density and surface crusting. Organic manure improves soil physical properties by improving microbial activity in

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soil. **Onwu *et al.* (2018)** stated that the function of organic manure is to improve soil structure, supply nutrients, raise the soil ability to hold water and nutrients as well as increase the binding between particles. **Putra *et al.* (2020)** concluded that organic fertilizer can replace the role of inorganic fertilizers applied into the cultivation of curly red chili plants on sandy fields. Organic wastes contain bioactive mixtures that can enlargement the suppression capacity against soil-borne diseases and Phyto-parasitic nematode **(Atia *et al.*, 2020)**.

In soils, *Azotobacter* spp. populations are influenced by soil physical and chemical (OM, pH, temperature, soil depth and soil moisture) as well as microbiological (microbial interactions) characteristics. As much as soil physical and chemical properties are worried, frequent studies have focused on the nutrients (P, K, Ca) and organic matter content and their positive impact on populations of *Azotobacter* spp. in soils (**Ridvan, 2009**). The highest value of carbohydrates in stems was recorded by microbien treatment compared with other bio fertilizers and control plants. The bio- fertilizer use as a general leads to an upsurge in crop yield, and decrease disease incidence and environment contamination (**Mia and Shamsuddin 2010**). The beneficial effect of microorganisms could be due to several factors counting enhancement in soil structure, soil health, microbial activity and nutrient availability during a mechanisms variety (**Kammann *et al*., 2012)**. Microbeine is a biofertilizer containing nitrogen fixing bacteria "*Azotobacter* sp, *Azospirillum* sp and *Pseudomonas* sp" as well as phosphate dissolving bacteria "*Bacillus megaterium*" (**Farahat *et al.*, 2014**).

The inorganic N, P and K fertilizers are speedily lost whether by volatilization for N or by leaching or fixed for all; hence, they should be restocked in each cultivation season **(Ali *et al.*, 2007)**. Fertilization can directly or indirectly changes the soil physical, chemical and microbial properties, thus, alter productivity of the soil **(Serrano *et al.*, 2017).** Inorganic fertilizers are known for their high cost and their negative environmental influences if accomplished poorly. **Aboelgoud *et al.* (2021)** established that the mixing organic and bio-fertilizers with inorganic fertilization are economically better than the single addition of recommended mineral fertilization only (100-150-50 mg kg^{-1} N-P-K, respectively). It is probable to replace 25% from NPK with or mixture with organic and bio-fertilization. Thus, this study is aiming to assess the influence of mineral fertilizer and addition of organic wastes with or without microbien inoculation on sudan grass plant grown in clay soils and its NPK contents.

MATERIALS AND METHODS

A pot experiment was conceded out under greenhouse condition at the experimental farm, Faculty of Agriculture, Zagazig University, through the growing summer season 2019. This study was conducted to evaluate the effect of mineral, organic and bio-fertilization on fresh & dry matter and NPK % for successive four cuts of sudan grass plants grown in clayey soil as well as the availability of NPK in soils after the end of the experiment.

Soil sample was collected from Hihia District, El-Sharkia Governorate, Egypt, from the surface soil (0 – 30 cm), air dried, crushed and sieved during 2mm plastic screen, thoroughly mixed and stored in plastic bags for analysis and experimental work. Table (1a and 1b) displays some physio-chemical parameters of the studied soil. Also, some characteristics of organic manures were tabulated in Table 2.

Plastic pots of internal dimensions 20 X 25cm were filled with five kilograms of the clayey soil. Before planting, the treatments of organic wastes and ordinary superphosphate were thoroughly mixed with the soil samples at the previously mentioned rates and replicated four repetite.

The recommended doses (RD) of mineral fertilizer were applied as the following rates: 90kg N fed^{-1} (50% RD) 0.09 g/kg $soil^{-1}$ and 180 kg N fed^{-1} (100% RD) 0.18 g/kg $soil^{-1}$ as ammonium sulphate (20.5% N), 6.6 kg P fed^{-1} (50% RD) and 13.2 kg P fed^{-1} 0.015 g/kg $soil^{-1}$ (100% RD) 0.03 g/kg $soil^{-1}$ as ordinary super phosphate (15.5% P_2O_5) and 25 kg K_2O fed^{-1} (50% RD) and 50 kg k fed^{-1} 0.025 g/kg $soil^{-1}$ (100% RD) 0.05 g/kg $soil^{-1}$ as potassium sulphate (46% K_2O). The organic manures *i.e* farmyard manure (FYM), rabbit manure (RM), quail manure (QM) and chicken manure (CM) were added at the rates of 5 and 10Mg fed^{-1} (0.5 and 1%) and 150g of microbein as bio-fertilizer

Table 1a. Textural class, Field capacity, CaCO3, OM and available NPK of the studied soil

Soil characteristic	Soil particle size distribution			Textural class	Field capacity	$CaCO_3$	Organic matter,	Available ($mg\ kg^{-1}$)		
	Sand, %	Silt, %	Clay, %		%		gKg^{-1}	N	P	K
Value	30.6	20.3	49.1	Clay	32.5	1.21	1.62	50.5	10.5	250

Table 1b. pH, EC and Soluble, ions, mmol L^{-1} of the studied soil

Soil characteristics	pH*	EC, dSm^{-1} (soil paste)	Soluble, ion, mmol L^{-1}							
			Ca^{++}	Mg^{+}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	CL^{-}	$SO_4^{=}$
Value	**8.2**	**2.22**	**7.9**	**6.1**	**6.9**	**0.2**	**-**	**3.8**	**10.9**	**6.4**

* Soil water suspension 1: 2.5

Table 2. Some characteristics of organic manures

Organic manure	Characteristic										
	EC dSm^{-1} (1:5) Soil water extract	pH^{*}	OM, gKg^{-1}	C/N Ratio	Total macronutrient g kg^{-1}			Total micronutrient mkg^{-1}			
					N	P	K	Fe	Mn	Zn	Cu
Farmyard manure	5.30	8.2	399	13.5	17.1	10.5	18.4	23.1	55	187	177
Rabbit manure	7.41	7.34	457	14.7	31.1	6.1	28.1	21.5	44.5	175	112
Quail manure	3.10	7.84	403	9.42	24.8	18.2	2.0	20	22.5	166	125
Chicken manure	6.57	6.18	412	7.42	32.2	9.51	23.2	22	391	316	123

*Organic manure -water suspension 1 : 2.5

was mixed thoroughly with wetting some sudan grass seeds by liquid gum after that the inoculation seeds were left for period half an hour before sowing.

Microbein (Mic.) as bio-fertilizer was obtained from the soil microbiology unit of the Soil, Water and Environment Research Institute of the Agriculture Research Center, Giza, Egypt. Microbien contains non symbiotic N_2-fixing bacteria and free living bacteria (*Bucillus megatherium* 106 Ng^{-1} beat) which dissolves unavailable forms of phosphorus, iron, manganese, zinc and copper to available forms in soil.

The experimental treatments were as follow:

Control (without addition of anything), 100% recommended dose (RD) of mineral firtilizers (NPK), 50% RD (NPK) plus Mic., 100% RD (NPK) + Mic., 1% FYM or RM or QM or CM, 1% FYM + Mic., 1% RM + Mic., 1% QM+ Mic., 1% CM + Mic., 50% RD (NPK) + 0.5% FYM, 50% RD (NPK) + 0.5% RM, 50% RD (NPK) + 0.5% QM, 50% RD (NPK) + 0.5% CM, 50% RD (NPK) + 0.5% FYM + Mic., 50% RD (NPK) + 0.5% RM + Mic., 50% RD (NPK) + 0.5% QM + Mic. and 50% RD (NPK) + 0.5% CM + Mic.

A randomized complete block design was used. After sowing, the applied rates of ammonium sulphate and potassium sulphate were divided into three doses. The first one was added after planting (15days) while, the second and third doses were added after the first and the second cuts, respectively. Twenty seeds of sudan grass (*sorghum vulgare* var. sudanense) were seeded per pot. The pots were daily weighed and the soil moisture content was adjusted to the field capacity. After germination, plants were thinned to ten plants a left to grow for two months. The plants of each pot were cut off, 5cm above the soil surface. Plants were left to grow and successive four cuts were collected each after 60 days. Each of the four cuts were dried at 70°C for 72 hours, weighed and ground in Wiley mill and analyzed for total nitrogen, phosphorus and potassium.

The soil particles size distribution was determined using the method as described by **Piper (1950**). Soil pH was measured using glass electrode pH meter in a 1: 2.5 soil water suspension as well as sodium and potassium were determined using flame photometer as described by **Cottenie *et al.* (1982)**. Soluble cations and anions were determined by **Black *et al.* (1965)**. Organic matter and EC were determined by **Jackson (1973)**. Total nitrogen in plant was determined using the method as described by **Hesse (1971)**. Total phosphorus in plant was determined using the method of **Watanabe and Olsen (1965)**.Available and total potassium in soil and plant, respectively were determined using the method of **Black (1982).**

Obtained data were statistically analyzed using the analysis of variance method according to **Snedecor and Cochran (1980**). Least significant differences method (LSD) was used to differentiate means at the 0.05 level **(Waller and Duncan, 1969).**

RESULTS AND DISCUSSION

Fresh Weight of Sudan Grass

Tabulated data in Table 3 reveal that the 1st, 2nd, 4th cuts and accumulative fresh weight of sudan grass grown in clayey soil were significantly improved by adding 50 % RD of NPK mineral fertilizer with 0.5% chicken manure plus microbien. Similar trend was recorded by 50 % from recommended dose of (NPK) as a mineral fertilizer + 0.5% rabbit manure + microbien for 1st, 2nd and 3rd as well as accumulative fresh weight of sudan grass. While, the treatment of 50% RD of (NPK) mineral fertilizer + 0.5% Quail manure + microbien gave the highest significant values of 3rd and 4th cuts only. On the other hand, the treatment of 50% from RD of (NPK) mineral fertilizer with 0.5% (CM) led to significant decrease in first and second cuts of sudan grass. Whereas, third and fourth cuts as well as accumulative fresh weight were decreased significantly without addition of any fertilizer (control). The superior growth and greater production of sudan grass that detected for chicken, rabbit and quail manure usage could be elucidated by the regular mineralization of organic matter by which macro and micronutrients were available at any plant time of need and influence chemical properties of soil. Moreover, organic matter helps to retain water to maintain water availability, hold ions, which in turns increasing cation exchange capacity, providing nutrients, particularly NPK, after the organic wastes has completely decomposed, helping the soil become more loose or crumbly to improve soil aeration and root system development. These results agree with the finding of **Abass (2007)** who noted that all fertilizers treatment had significant influence on fresh and dry forage yield of (*Sorghum bicolor* L. Moench) and (*Sorghum Sudanese*) compared to control treatment.

Moreover, microbien increased sudan grass, this may be due to the increase in NP content in the soil as result of nitrogen fixation and phosphorus release by phosphate dissolving bacteria, in addition to growth promoting substances for example indole acetic acid and gibberellins produced by organisms used. This might be connected to the enhancement of soil physical conditions provided energy for micro-organisms activity and raise the availability and NPK uptake, which was reflected on fresh weight of Sudan grass. These results were in agreement with the finding of **Labib *et al.* (2019)** found that the treatment of 100%

Table 3. Effect of mineral fertilizers, microbien and some organic wastes on four cuts and accumulative fresh weight (g pot^{-1}) of Sudan grass grown in clayey soil

Treatment	1st cut	2nd cut	3rd cut	4th cut	Accumulative
Control	77.84	86.56	94.22	43.66	302.2
100% Recommended dose (RD) (NPK)	96.47	144.0	111.8	83.62	435.8
50% RD(NPK)+ microbien (Mic.)	112.0	122.5	116.3	77.00	427.9
100%RD+(NPK)+Mic	87.89	100.4	109.4	92.99	390.7
1% Farmyard manure (FYM)	111.4	125.2	109.5	104.3	450.5
1% Rabbit manure (RM)	67.55	80.59	132.6	97.96	353.7
1% Quail manure (QM)	142.7	215.6	120.3	67.61	546.3
1% Chicken manure (CM)	121.6	194.2	156.5	76.21	548.5
1% FYM+ Mic	80.08	87.94	117.5	58.31	343.9
1% RM+ Mic	79.88	88.13	149.5	64.14	381.7
1% Q M+ Mic	76.59	85.42	122.1	70.49	354.6
1% CM+ Mic	111.5	152.8	130.7	82.85	477.9
50% RD (NPK) +0.5% FYM	120.4	140.5	128.4	40.03	429.4
50 % RD (NPK)+ 0.5% RM	147.1	152.2	135.7	47.42	482.4
50 % RD (NPK)+ 0.5% QM	85.23	91.71	152.2	49.94	379.1
50 % RD (NPK)+ 0.5% CM	58.21	75.51	155.6	52.35	341.7
50 % RD (NPK)+ 0.5% FYM+ Mic	117.7	167.8	117.0	80.20	482.7
50 % RD (NPK)+ 0.5% RM+ Mic	210.0	239.0	153.8	76.62	679.4
50 % RD (NPK)+ 0.5% QM+ Mic	158.4	170.5	164.1	88.14	581.2
50 % RD (NPK)+ 0.5% CM+ Mic	216.5	246.4	106.8	144.6	714.3
LSD at 0.05	5.129	5.518	5.401	16.61	10.96

bioformulations in combination with 50% mineral recorded maximum values of plant height, fruiting zone length, seeds number plant^{-1}, seed index and produced a maximum significant value of sesame capsules number plant^{-1}.

N% of Four Cuts for Sudan Grass

Results in Table 4 show that the highest significant values of N% in 1st and 2nd cuts were increased significantly using 50% RD (NPK) plus 0.5% QM with Mic. The treatment of 1% (CM) or (QR) gave the highest significant value of N% in 3rd cut only. Also, data reveal that the N% in 4th cut was increased with 50% RD (NPK) + 0.5% FYM or RM or CM plus Mic. Conversely, the lowest significant values of N% for Sudan grass in four cuts were obtained by control treatment.

These results may be due to the role of organic wastes in soil quality properties as they produce humic substances, which are able to improve some physical and chemical soil properties leading to increasing nutrient availabilities. Moreover, incorporation of organic materials in soils can further increase NPK availability by increasing CO_2 forming H_2CO_3 in the soil solution. Also, improvement

Table 4. Effect of mineral microbien and some organic wastes on N % of four cuts for sudan grass grown in clayey soil

Treatment	1st cut	2nd cut	3rd cut	4th cut
Control	0.825	1.168	0.365	1.313
100% Recommended dose (RD) (NPK)	1.345	1.543	2.580	2.000
50% RD(NPK)+ microbien (Mic.)	1.388	1.332	2.775	1.875
100%RD+(NPK)+Mic	1.575	2.175	2.983	2.207
1% Farmyard manure (FYM)	1.600	2.375	3.158	2.358
1% Rabbit manure (RM)	1.712	2.467	3.590	2.473
1% Quail manure (QM)	2.200	2.580	3.793	2.668
1% Chicken manure (CM)	2.550	2.767	3.987	2.723
1% FYM+ Mic	2.425	3.133	1.085	2.467
1% RM+ Mic	2.650	3.100	1.367	2.245
1% Q M+ Mic	1.132	1.493	1.558	2.150
1% CM+ Mic	1.618	2.225	1.768	2.280
50% RD (NPK) +0.5% FYM	1.525	2.570	2.037	2.612
50 % RD (NPK)+ 0.5% RM	1.767	2.668	2.335	2.565
50 % RD (NPK)+ 0.5% QM	2.175	2.575	2.572	2.787
50 % RD (NPK)+ 0.5% CM	2.475	2.872	2.338	2.775
50 % RD (NPK)+ 0.5% FYM+ Mic	2.473	2.975	3.063	3.237
50 % RD (NPK)+ 0.5% RM+ Mic	2.567	3.275	2.263	3.112
50 % RD (NPK)+ 0.5% QM+ Mic	3.015	3.250	3.250	2.880
50 % RD (NPK)+ 0.5% CM+ Mic	2.390	3.200	2.400	3.158
LSD at 0.05	0.100	0.110	0.134	0.190

of these parameters may be due to the slow and continuous supply of both micro and macro nutrients, which might have helped in the assimilation of carbohydrates. This result may be due to the beneficial effect of dual application on macronutrients availability and uptake by plants. These findings are in arrangement with those stated by **Romero *et al*. (2000)** who demonstrated that the enhancement of N % might be related to the improvement of soil physical conditions providing energy for micro-organisms activity and upsurge the N, P and K availability and uptake, which was reproduced on the growth. However, bio fertilizers produces sufficient quantity of IAA and cytokine, which augmented the surface area per unit root length.

P% of Four Cuts for Sudan Grass

Results in Table 5 demonstrate that the highest significant values of P% in 1st, 2nd and 3rd sudan grass cuts were recorded when the treatment of 100%mineral fertilizer RD was applied. While, either treatments of 50% RD (NPK) with 0.5% QM or CM with Mic., gave the highest one for 3rd and 4th cut. On the other hand, the lowest significant values of P% for sudan grass in four cuts were recorded by control treatment. This increase might be associated to the easy soluble of inorganic fertilizer or positive influence of quail and chicken manure with microbien in raising the root surface area per unit of soil volume and water use efficiency, which directly affects the physiological processes and nutrients uptake. Chicken manure contains as much N as farmyard manure but richer in P and K (**Cook, 1982**). **Anfinrud *et al.* (2013)** reported that there was a significant response in P% with increasing N fertilizer doses. The higher values of P content in sudan grass plants were gotten from fertilizing sudan grass plants by 125 mg N kg^{-1}

Table 5. Ef fect of mineral, microbien and some organic wastes on P % of four cuts for sudan grass grown in clayey soil

Treatment	1st cut	2nd cut	3rd cut	4th cut
Control	0.1660	0.1640	0.1225	0.1002
100% recommended dose RD (NPK)	0.3758	0.4003	0.3950	0.3770
50% RD(NPK)+ microbien (Mic.)	0.3135	0.3625	0.3570	0.3460
100%RD+(NPK)+Mic	0.3483	0.3727	0.3830	0.3700
1% Farmyard manure (FYM)	0.2760	0.3260	0.3370	0.3403
1% Rabbit manure (RM)	0.2630	0.3155	0.3417	0.3405
1% Quail manure (QM)	0.2477	0.3248	0.3385	0.3257
1% Chicken manure (CM)	0.2878	0.3307	0.3553	0.3330
1% FYM+ Mic	0.3097	0.3343	0.3543	0.3410
1% RM+ Mic	0.3115	0.3372	0.3670	0.3432
1% Q M+ Mic	0.3102	0.3403	0.3647	0.3462
1% CM+ Mic	0.3170	0.3435	0.3713	0.3442
50% RD (NPK) +0.5% FYM	0.3313	0.3528	0.3725	0.3532
50 % RD (NPK)+ 0.5% RM	0.3358	0.3475	0.3762	0.3525
50 % RD (NPK)+ 0.5% QM	0.3553	0.3425	0.3735	0.3555
50 % RD (NPK)+ 0.5% CM	0.3650	0.3583	0.3828	0.3600
50 % RD (NPK)+ 0.5% FYM+ Mic	0.3250	0.3602	0.3755	0.3817
50 % RD (NPK)+ 0.5% RM+ Mic	0.3568	0.3645	0.3902	0.3660
50 % RD (NPK)+ 0.5% QM+ Mic	0.3627	0.3702	0.3943	0.3813
50 % RD (NPK)+ 0.5% CM+ Mic	0.3663	0.3713	0.3943	0.3850
LSD at 0.05	0.0014	0.0014	0.0014	0.0014

soil as ammonium sulphate in the first and the second cuttings over both seasons. Moreover, inoculated by bio-fertilizers combined with full dose of compost gave the highest NPK uptake. These results are in harmony with those obtained by **El-Hamdi *et al.* (2017)** concluded that the use of 10 Mg fed^{-1}compost with microbien + phosphosien+ EM, effective microorganisms could significantly enhance the yield, contents of nutrient and quality of cucumber under an organic farming system.

K% of Four Cuts for Sudan Grass

Tabulated data in Table 6 show that the highest significant values of K% of four cuts for sudan grass grown in clay soil were recorded when the treatment of 50% RD (NPK) with 0.5% from any organic wastes plus Mic., in the 1st, 2nd, 3rd and 4th cuts were applied. Also, the seam trend was noticed by the treatment of 100% RD (NPK) with or without microbien inoculated in the 1st, 2nd and 4th cut. On the other hand, the control treatment (without any fertilizer addition) gave the lowest significant values of K for sudan grass in four cuts. As a result significant changes in physico-chemical and biological properties also, soils fertility and productivity have been noticed following application of any organic wastes. These results confirm by those obtained by **Golabai *et al.* (2007)** recorded that the concentration of P, K and S augmented after application of organic matter over control due to the decomposition of organic matter. Moreover, the main and direct purposes of bio-fertilizers application to soil are: to deliver sources of nutrient and respectable soil conditions for the crops growth when used as a live body; to partially substitute and augment the inorganic fertilizer function and then reduce the addition of fertilizers amounts

Table 6. Effect of mineral, microbien and some organic wastes on K% of four cuts for sudan grass grown in clay soil

Treatments	1st cut	2nd cut	3rd cut	4th cut
Control	1.575	1.980	1.645	1.440
100% recommended dose RD (NPK)	2.710	3.017	3.045	2.662
50% RD(NPK)+ microbien (Mic.)	2.510	2.980	2.902	2.592
100%RD+(NPK)+Mic	2.743	2.957	2.935	2.743
1% Farmyard manure (FYM)	1.902	2.298	2.310	2.153
1% Rabbit manure (RM)	1.923	2.290	2.330	2.138
1% Quail manure (QM)	1.852	2.303	2.352	2.162
1% Chicken manure (CM)	1.692	2.313	2.378	2.200
1% FYM+ Mic	2.158	2.463	2.507	2.460
1% RM+ Mic	2.223	2.467	2.560	2.485
1% Q M+ Mic	2.240	2.445	2.530	2.487
1% CM+ Mic	2.285	2.490	2.557	2.500
50% RD (NPK) +0.5% FYM	2.557	2.668	2.707	2.595
50% RD (NPK)+ 0.5% RM	2.527	2.638	2.730	2.610
50% RD (NPK)+ 0.5% QM	2.563	2.673	2.753	2.602
50% RD (NPK)+ 0.5% CM	2.602	2.683	2.735	2.615
50% RD (NPK)+ 0.5% FYM+ Mic	2.763	3.040	3.142	2.717
50% RD (NPK)+ 0.5% RM+ Mic	2.787	3.078	3.168	2.725
50% RD (NPK)+ 0.5% QM+ Mic	2.800	3.053	3.243	2.757
50% RD (NPK)+ 0.5% CM+ Mic	2.795	3.070	3.217	2.737
LSD at 0.05	0.0776	0.110	0.078	0.063

and still maintain the similar crop yields as well as the investment used for making bio-fertilizers is inexpensive than that of inorganic ones and to reduce the harmful effect produced from its .

Alternatively, the indirect purposes of using bio-fertilizers to soil are: to improve the root system growth to rise the water and nutrient uptake crops abilities, spread the root life, neutralize and damage dangerous materials stored in soil, encourage existence seedling efficacy after transplanting and get shorter time for the flower to come out. These results confirm by those obtained by **Rashed (2002)** who reported that bio-fertilizers combined with organic manure increased the NPK content. These results are in harmony with those obtained by **El-Hamdi *et al.* (2017).**

Fainally, it is recommended to use organic, bio and mineral fertilizers simultaneously. In general, it could be stated that to increase forage production and its quality of sudan grass, mineral with organic and bio-fertilizer can be used at rate of 50% NPK mineral fertilizers+ organic wastes + bio- fertilizer (microbien) under the same soil conditions.

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استجابة حشيشة السودان للاسمدة العضوية وغير العضوية والحيوية

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تمت هذه الدراسة في مزرعة كلية الزراعة بجامعة الزقازيق حيث تمت الزراعة فى موسم الصيف سنة 2019 أجريت هذه التجربة لدراسة تأثير كل من التسميد المعدنى والحيوى والعضوى على النمو ومحتوى العناصر الغذائية الكبرى (نتروجين – فسفور – بوتاسيم) لنبات حشيشة السودان النامى فى أرض طينية فى أربع حشات. وكانت اهم النتائج كالآتى: عموما، وفى معظم الحالات، أدى إضافة أى من المخلفات العضوية (مخلفات دواجن- أرانب- سمان بلدى) بمعدل 0.5% مع 50% من الجرعة الموصى بها من السماد المعدنى (نتروجين– فسفور – بوتاسيوم) فى وجود السماد الحيوى الميكروبين الى أعلى القيم معنويا للوزن الرطب فى الاربع حشات والمجموع الكلى وكذلك النسبة المئوية للنتروجين والفوسفور والبوتاسيوم مقارنة بمعاملة الكنترول (بدون معاملة). وبنظرة عامة، زاد الوزن الرطب لحشيشة السودان وكذلك محتواه من النتروجين كنسبة مئوية من الحشة الأولى الى الثانية ثم انخفض فى الحشة الثالثة وبعدها فى الحشة الرابعة وذلك بإضافة 100% من السماد المعدنى مع أو بدون ميكروبين أو باستخدام50% من السماد المعدنى مع أى من ألأسمدة العضوية مع إضافة ميكروبين. لوحظ نفس الاتجاة للفوسفور كنسبة مئوية باضافة 50% من السماد المعدنى مع أو بدون ميكروبين. ايضا تشير النتائج الى زيادة فى الوزن الرطب لحشيشة السودان من الحشة الأولى الى الثانية ثم الثالثة ثم انخفض فى الحشة الرابعة وذلك باضافة 50% من السماد المعدنى، مع مخلفات الدواجن أو السمان. لوحظ نفس الاتجاة للنتروجين كنسبة مئوية باضافة بإضافة 100% من السماد المعدنى مع أو بدون ميكروبين أو باضافة 50% من السماد المعدنى مع الميكروبين. ايضا لوحظ نفس الاتجاة للفوسفور باستخدام 50% من السماد المعدنى مع أى من ألأسمدة العضوية مع أو بدون إضافة ميكروبين. لوحظ نفس الاتجاة للبوتاسيوم كنسبة مئوية باضافة 50% من السماد المعدنى مع أى من ألأسمدة عضوية مع وجود الميكروبين مقارنة بمعاملة الكنترول (بدون تسميد). وعموما، يمكننا القول ان زيادة محصول حشيشة السودان تحت ظروف التجربة حدث باضافة 50% من السماد المعدنى مع أى من ألأسمدة العضوية مع إضافة التسميد الحيوى (ميكروبين) . وكذلك محتواه من النتروجين كنسبة مئوية.

الكلمات الإسترشادية: حشيشة السودان، ميكروبين، معدنى، التسميد عضوى و الارض الطينية.

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