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

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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 CM or RM. 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-Suhailani, 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
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 kilogram 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% P₂O₅) and 25 kg K₂O 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% K₂O). 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 | CaCO3 | Organic matter, % | Available NPK (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 + | CO₃⁻ | HCO₃⁻ | CL⁻ | SO₄²⁻ |
| 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       | 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. Microbein contains non symbiotic N₂-fixing bacteria and free living bacteria (*Bacillus 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 fertilizers (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 clazy 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 gibberelins produced by organisms used. This might be connected to the enhancement of soil physical conditions provided energy for microorganisms 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                                      | 1\(^{st}\) cut | 2\(^{nd}\) cut | 3\(^{rd}\) cut | 4\(^{th}\) 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% QM+ 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 1\(^{st}\) and 2\(^{nd}\) cuts were increased significantly using 50% RD (NPK) + 0.5% QM with Mic. The treatment of 1% (CM) or (QR) gave the highest significant value of N% in 3\(^{rd}\) cut only. Also, data reveal that the N% in 4\(^{th}\) 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\(_2\)CO\(_3\) 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                                    | 1\textsuperscript{st} cut | 2\textsuperscript{nd} cut | 3\textsuperscript{rd} cut | 4\textsuperscript{th} 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 microorganisms 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 1\textsuperscript{st}, 2\textsuperscript{nd} and 3\textsuperscript{rd} 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 3\textsuperscript{rd} and 4\textsuperscript{th} 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\textsuperscript{-1}. 
Table 5. Effect 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 

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 same 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                              | 1<sup>st</sup> cut | 2<sup>nd</sup> cut | 3<sup>rd</sup> cut | 4<sup>th</sup> 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% QM+ 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).

Finally, 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 للأسدمة العضوية وغير العضوية والحيوية

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تتم هذه الدراسة في مزرعة كلية الزراعة بجامعة الزقاقipy حيث تم الزراعة في موسم الصيف سنة 2019 أجريت هذه التجربة لدراسة تأثير كل من التسميد العضوي والحيوي والعصوي على النمو ومقاومة النباتات الفلاحية الكبرى (تترجين – سفور – بوناتسيم) للأشجار الحشيشة السودانية النامي في أرض طينية من أربع حشات، وكانت أهم النتائج كالتالي:

• عموماً، في معظم الحالات، أدت إضافات الأسدمة العضوية (مخلفات دواجن - أرانب - سبام بلدي) بمعدل 0.5% مع 50% من الاعتطا العضوي بها من السماد المتحصل العضوي (تترجين - سفور - بوناتسيم) في وجود السماد الحيوي الميكروبي إلى أعلى قيم معيونية للوزن القياسي في الأربع حشات والمجموع الكلي، وكذلك نسبة النمو الناتجة للنكروجين والفسفور والبوتاسيوم مقارنة بعملية الكتشرول (بدون معاملة)، ونظرية عامة، زاد الوزن القياسي للحشيشة السودانية وكذلك محتواه من النترجين كنسبة مئوية من الحشيشة الأولي إلى الثانية ثم انخفض في الحشيشة الثالثة وبحسب الدراسة، بذلك بنسبة 100% من السماد المعنى مع أو بدون ميكروبيوين أو استخدام 50% من السماد المعنى مع أو بدون ميكروبيوين. نلاحظ نقص الإنتاج للفسفور كنسبة مئوية بالقياس 50% من السماد المعنى مع أو بدون ميكروبيوين في زيادة الوزن القياسي للحشيشة السودانية من الحشيشة الأولي إلى الثانية ثم الثلاثة ثم انخفض في الحشيشة الرابعة وذلك بنسبة 50% من السماد المعنى مع أو بدون ميكروبيوين أو استخدام 50% من السماد المعنى مع أو بدون ميكروبيوين.

• إضافة السماد العضوي مع أو بدون ميكروبيوين. نلاحظ نقص الإنتاج للفسفور كنسبة مئوية بنسبة 50% من السماد المعنى مع أو بدون ميكروبيوين، وأي انشطة عضوية مع أو بدون الإنتاج للفسفور كنسبة مئوية بالقياس 50% من السماد المعنى مع أو بدون ميكروبيوين. نلاحظ نقص الإنتاج للفسفور كنسبة مئوية بنسبة 50% من السماد المعنى مع أو بدون إضافة السماد عضوي مع أو بدون ميكروبيوين في زيادة الوزن القياسي للحشيشة السودانية من الحشيشة الأولي إلى الثانية ثم الثلاثة ثم انخفض في الحشيشة الرابعة وذلك بنسبة 50% من السماد المعنى مع أو بدون ميكروبيوين أو استخدام 50% من السماد المعنى مع أو بدون ميكروبيوين أو استخدام 50% من السماد المعنى مع أو بدون ميكروبيوين.

• إذاً، تشير النتائج إلى زيادة الوزن القياسي للحشيشة السودانية من الحشيشة الأولي إلى الثانية ثم الثالثة ثم انخفض في الحشيشة الرابعة وذلك بنسبة 50% من السماد المعنى مع أو بدون ميكروبيوين أو استخدام 50% من السماد المعنى مع أو بدون ميكروبيوين. نلاحظ نقص الإنتاج للفسفور كنسبة مئوية بنسبة 50% من السماد المعنى مع أو بدون ميكروبيوين، وأي انشطة عضوية مع أو بدون إنتاج للفسفور كنسبة مئوية بالقياس 50% من السماد المعنى مع أو بدون ميكروبيوين. نلاحظ نقص الإنتاج للفسفور كنسبة مئوية بنسبة 50% من السماد المعنى مع أو بدون إضافة السماد عضوي مع أو بدون ميكروبيوين،焼き الخشوشة حشيشة السياقية: حشيشة السودان، ميكروبيوين، هدف، التسميد عضوي والطينية.

الكلمات الإرشادية: حشيشة السودان، ميكروبيوين، هدف، التسميد عضوي والطينية.

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