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The Impact of Organic and Inorganic Fertilizer on Forage Yield of Sorghum Grown on Soba Saline Sodic Soil

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Abstract:

Field experiments were executed for two consecutive seasons (2017/18 and 2018/19), in Demonstration Farm of Soba, Sudan. To investigate the impact of addition of organic and in organic fertilizers on yield of sorghum. Five different treatments were made with different combination of these fertilizers. The organic fertilizers used were; farm yard manure (FYM) (3ton/feddan), Inoculation, and Di Ammonium Phosphate (DAP) on nutritive value of Abu sabien grass. The chemical fertilizer used in this study was di ammonium phosphate [DAP (50 kg/feddan) and the inoculation [U (100KgN/ha)]. Five different treatments were made with different combination of these fertilizers farmyard manure [FYM], combinations between them (Inocu+FYM and Inocu+FYM +DAP), plus Inoculation only of the seeds and one control treatment with no fertilizer at all. The experiment was arranged in Randomized Complete Block Design (RCBD) with three replicates. The interaction between the two seasons was highly significant ($P< 0.01$) among treatments with the exception of plant height, number of leaves per plant and green matter yield (GMY), which were not significant. The results revealed that all proximate analysis parameters were significantly affected by fertilizers. The interaction effect between FYM addition and other application of micronutrients on quantitative yield characteristics of sorghum forage recorded a significant increase in all studied yield parameters as compared with control treatment.

Keywords Abu Sabien; Grass; Fertilizers; Organic; Inorganic; Sudan

Introduction:

The production of forage crops is very important for livestock production in the Sudan. Forage production and consumption in Sudan is increasing over time due to the increasing rate of livestock population (140 million head) (Ministry of Animal Resources, 2007) and the diminishing amount of fodder produced naturally due to the expansion of rain-fed agriculture on the expenses of range land, also the highway roads , housing, pipelines construction. According to the recent survey conducted by Khair and Salih (2007), the amount of forage crops produced in Sudan was estimated at 971 thousand tons of dry matter which was produced from a cultivated area of 121 thousand hectares. Sudan livestock resources are accounted for more than 20% of total Africa countries and about 39% of the Arab countries. The recent statistics of the ministry of agriculture (2015) showed that the area under forage crops represented 80% of the area cultivated in Khartoum state. This area was almost doubled from (2006) to (2015), from 114513 to 239535 feddans. 81% of the area under forage production was occupied by Abu sabien and alfalfa. The demand for fodder has greatly increased in recent years in the Sudan. In order to meet this rising demand, there are continuous efforts to expand the production of forage crops (Abusuwar, 1981). Sorghum (*Sorghum bicolor* (L) Moench) is the principle cereal that forms an important staple diet throughout the semi-arid Asian and Africa regions (Ahmed *et al.*, 2000). Sorghum species have been utilized worldwide for the production of grain, forage, sugar, and more recently biofuels (Rooney *et al.*, 2007). It ranges Fifth in hectares among the world cereals (Dogget, 1988). Sorghum bicolor locally known as Abu sabien,

classified as a moderate salt tolerant crop and is presently the most widely grown fodder in the Sudan. The crop is grown in tropical, subtropical and warm temperate areas (Lconard and Martin, 1963). It has high feeding value and it's either grazed or used as a green fodder or hay or silage (Kabbashi, 1991). Sorghum is a water efficient crop which makes it an important cereal in semi-arid and arid environments where water is the main limiting factor of production. However, it must compete economically with other cereal crops, and to meet this challenge, the yield of sorghum must increase significantly (Alikhani*et al* 2012). Local production of pulses is not sufficient to meet the increasing demand for human utilization. Therefore, to meet the situation, it is necessary to boost up the production. Inadequate supply of feed in quantity and quality is responsible for the low productivity of animals.

One of the majer problems that limit economically successful agricultural production worldwide is poor soil fertility. Therefore, addition of fertilizers is necessary to correct poor soil fertility by supplying nutrients needed for optimum crop growth (Elsheikh, *et al*., 2005). The most limiting nutrients for plant growth are N and P (Schacht man, *et al*., 1998). The process of nitrogen fixation can be accomplished either biologically by microorganisms or chemically (Merrick, 1992). Biological N2 can be fixed non-symbiotically by different microorganisms such as (HerbaspirillumAcetobacter, Azotobacter, Azospirillum) (Hirsh *et al.,* 2001, Sevilla*et al.,* 2001). Phosphorus is an essential element for plant nutrition. It has to be added to the soil as a fertilizer because of it is deficiency and low solubility. Phosphorus is found in an insoluble form in soil and hence it is unavailable for plants. However, many microorganisms play a great role in solubilizing the inorganic insoluble phosphates in to a soluble form through excretion of various organic acids and also by mineralizing the locked up organic phosphorus through excretion of various enzymes in agricultural soils making readily available forms for plants.

Soil salinity is one of the major environmental problems affecting agricultural production in arid and semi- arid regions of the world, both in irrigated and dry land agriculture. The deleterious effects of salinity on plant growth are associated with low osmotic potential of soil solution causing physiological drought, nutritional imbalances and specific ion toxicity or combination of all these factors. Abiotic stress causes a decline in crop growth and productivity. Reducing the use of chemical fertilizers by adoption of bio-fertilizer technology recently advocated, (Mehdi and Zarabi, *et al,* 2010). The major groups of bacteria that can fix nitrogen non-symbiotically are Azotobacter spp., which are a free living bacterium, indigenous to the soil (plant rhizosphere). Application of inorganic and bio-organic fertilizers can enhance the productivity of soil either by adding mineral nutrients, fixing atmospheric nitrogen, solubilizing soil phosphorus, or by stimulating plant growth through synthesis of growth promoting substances. Sorghum forage on ridge land was better and should be used at the moderately saline soils. Recent studies were focused on improving sorghum forage both quantitatively and qualitatively (Ibrahim, 2012). Hence, the objectives were:

- To study the impact of combination of inoculation, Farm Yard Manure (FYM) and Di Ammonium Phosphate (DAP) on Abu sabien forage grown on Saline Sodic soil.
- To determine the efficiency of Azotobacter on Abu sabien forage yield grown on Saline Sodic soil.
- To look in to the compost effects on crops growth.

Materials & Methods:

The experiment was conducted at the farm of Soba Station, Agricultural Research Corporation, Khartoum State Sudan (Lat.15º 24’ N; Long.32º32’ E; Alt 380 masl), for two consecutive summer seasons (2017/2018-2018/2019).The soil at Soba is hazarded by salinity (ECe =8 – 15 ds/m) and sodicity (ESP =30 -50) with high clay content, low infiltration and permeability, low organic matter and nitrogen and high ph. The climate of the area is semi-desert with average annual rainfall of 160 mm, occurring mostly during July and August (Whiteman, 1971).Average minimum and maximum temperatures range between 14º C and 27º C in January (winter season) and between 25º C and 41º C in May (summer season).The relative humidity ranges between

14%-25% during the dry months and between 31%-51% during the wet months of the year. Solar radiation is high and is always exceeding 450 cal cm-2 in all months of the year.

The plant material used in the study was consisting of the recommended forage sorghum cultivar 'Kambal'. It is improved version of 'Abu Sabien', (*Sorghum bicolor*) the widely grown traditional forage sorghum cultivar (Mohammed *et al.*, 2008). seeds were inoculated before planting by adding 40% (w/v) gum Arabic solution and mixed to wet all seeds then a charcoal-based inoculum of the required Azotobacter was added and mixed until all seeds were coated. Azotobacter was used throughout this study, which they were provided by the Environment and Natural Resources Research Institute (ENRRI), the National Centre for Research, Khartoum, Sudan. Azotobacter was locally isolated. The following main treatments were studied at two seasons:

1- Control: without addition of fertilizers.

2- Inoculation with Azotobacter.

3- Farm yard manure (FYM): equivalent to 3 ton/Fadden.

4- Inoculation +FYM.

5- Inoculation+FYM+DAP (Di Ammonium Phosphate): equivalent to 50 kg/Fadden.

The land was disc ploughed, disc harrowed and leveled by scraper to obtain fine seed bed. Ridging was done at 0.75 m. The plot consisted of four ridges 4m long. Sowing was done manually on the eastern side of the ridge and was carried out on the 15th June. The seed rate applied was 20 kg/fed. The first irrigation was done immediately after sowing same day and then as needed by the plant. Weed population was kept at minimum by hand weeding. Harvesting was practiced two weeks after completion of 50% flowering for each treatment. The treated DAP and FYM were applied before sowing, broadcasted manually on the bottom of the ridges mixed with soil and distributed equally to the entire plot using a hand hoe. The following traits were measured, the yield related traits were plant population, plant height (cm), days to 50 percent flowering, percent of leaves/plant, stem diameter (cm) ,leaf area (cm^2), green matter yield (GMY, t/ha)and dry matter yield (DMY, t/ha).The proximate quality traits were studied on dry matter basis using bulking material from treatments to determine the nutritive value of the fodder (Abu sabien) in term of neutral detergent fiber (NDF) , acid detergent fiber (ADF)and crude protein (CP). The data collected in each of the trials were subjected to single analysis of variance following the standard procedure of analyzing randomized complete block design (RCBD) with three replications. The Duncan's Multiple Range Test at 0.05 probability levels, as used for means separation. Coefficient Variability (C.V.) was obtained.

Results and Discussion:

Performance of the yield component:

The results showed that there were significant differences among treatments in most parameters during the growing period for growth attributes under study. Farm yard manure (FYM), Inoculum, Di Ammonium Phosphate (DAP) and the combined between them, these treatments gave taller plants, high number of leaves per plant, increasing stem thickness, leaf area and increasing the yield of fresh and dry matter compared to the control. These responses may refer to its high content of nitrogen, phosphorus and potassium (Schjegel, 1992). Fertilization suggests that this crop as it is non–leguminous, might have obtained high supply of nitrogen from the soil directly. Another explanation may be due to the effect of FYM on soil fertility and other treatments restored soil fertility. This is in agreement with that of Boateng*et al.* (2006) who reported that potential uses for poultry manure increased plant height. On the other hand, Mullins (2002) reported that poultry litter contains, a considerable amount of organic matter. Chaney and Swift 1984.; Elghball, 2002, and Ali and Adam, 2003 found that organic matter decomposition improved the physical and chemical proprieties of the soil. Effect of treatments on plant height is presented in table (1). No significant differences between treatments in plant height at the first season and interaction between the two seasons were detected. In the second season significant

differences (P< 0.05) were recorded. In the first season, the height of the plant rang from (199.11 to 147.78 cm) which was obtained by the treatment FYM and the treatment control. The treatment inoculum + FYM + DAP recorded 181.34 cm followed by treatment inoculum + FYM (168.00 cm).

In the second season the height of the plant range from (233.11 to 195 cm) which was obtained by the treatment inoculum + FYM + DAP and the treatment control. The treatment inoculum + FYM recorded 221.67cm followed by treatment FYM (215.22 cm). The treatment inoculum recorded 200.00 cm which was taller than control 195.33 cm, but no significant (p< 0.05) differences between them. The second season taller plants for all treatments were recorded in comparison to the first season. This can be attributed mainly to the fertilizer residual in the soil which added in the first season

The interaction between two seasons showed that the height of the plant range from (207.22 to 171.56) which recorded by treatment inoculum + FYM + DAP and the treatment control. The treatmentinoculum + FYM recorded (194.83 cm). The data in Table (1) showed that, the addition of FYM with or without inoculation and DAP increasing plant height. The positive influence of bio fertilizers only and their combination with FYM significantly increased plant height. This agreed with Kapulnik*et al.,* (1981) who stated that, the significant effect of Azospirillum on wheat height was recoded.The source of nitrogen from poultry manure resulted in taller plants because nitrogen was found to increase number of nodes as well as inter node length and consequently plant height. FYM gave taller plants than the control. This is in agreement with Hassan, (2000) who reported that chicken manure fertilizer significantly increased plant height. Fagimi and Odebode (2007), who reported increased plant height of pepper resulting from application of chicken manure, also similar to the finding Abugidri (1985) attributed the cereals stem elongation during the reproductive stage to surrounding available resources. Higher rate of FYM (3 tan/feddan) significantly increased a number of growth attributes of forage sorghum cultivar (Abu sabien), than the control similar result was reported by Boateng*et al* (2006) and Hassen (2000). On the other hand, this agreed with Omer (1998), who reported that manure alone or mixed with the urea resulted in an increase in growth attributes as well as forage yield of two forage maize cultivars than the control the fertilized plots gave higher leaf number per plant than the control, with higher value for the highest chicken manure doze (5 ton chicken manure/ha). It is also similar to the findings of Fagimi and Odebode (2007), who reported increased number of leaves of pepper resulting from application of high rate of chicken manure. Because an increase FYM application was suitable for increasing carbon content, water holding capacity, aggregation of soil and decrease of bulk density, all of which inter play to increase leaf area and total chlorophyll content of wild okra. This is consistent with the findings of Amujoyegbe, *et al.*, (2007) Sharpley, *et al.*, (1991) and Egerszegi (1990) who reported that increased application rate of chicken manure enhanced leaf area, total chlorophyll content, carbon content, water holding capacity, and decreased bulk density of soil which culminate and inter play to promote crop yield. It is obvious that in this study the number of plants per unit area were increased with time but the number declined by third count. This may be attributing to the fact that mortality of plant with time due to competition between plants for growth requirements and hence only stronger ones can survive.

Stem thickness:

Experimental results showed that the effect of fertilizers at treatments had significant effect ($p < 0.05$) on stem diameter, in second season and the interaction between two seasons, while the first season had no significant effect on stem diameter (Table 2). The treatment FYM produced maximum stem thickness at the two seasons and the interaction between them (2.71, 2.63 and 2.67 cm) respectively, followed by the treatment inoculum + FYM + DAP resulted (1.88, 2.36, 2.12 cm). In the first season the treatment inoculum recorded (1.46 cm), followed by the treatment inoculum + FYM (1.08 CM). Opposite results happened in the second season as the treatment inoculum give lower diameter (1.73 cm), than treatment inoculum + FYM which recorded (1.98 cm), but the interaction between two seasons, the treatment inoculum resulted in (1.60 cm) higher than inoculum + FYM (1.53 cm), while minimum stem thickness in the two seasons and interaction were recorded (0.77, 1.44 and 1.11 cm), respectively by the treatment control. The results of this study indicated that, the addition of FYM with or without inoculation and DAP resulted in significant thickness. According to Hassan (2010), chicken

manure is rich in nitrogen and since nitrogen enhances plant growth in general, this increase in stem diameter due high application rate of chicken manure fertilization is expected.

Table 1: Plant height (cm) of Abu Sabien at the different fertilizers of the two seasons and the combined between them at Soba (2017-2018) Khartoum State.

Treatment	Season 2017	Season 2018	Combined
1\ Control	147.78	195.33	171.56
2\ Inoculum	159.89	200.00	179.94
3\ FYM	199.11	215.22	207.17
4\ Inoculum + FYM	168.00	221.67	194.83
5\ Inoculum +FYM +DAP	181.34	233.11	207.22
Grand Mean	171.22	213.07	192.15
SE ±	13.20	9.54	8.17
LSD (%)	43.03	31.11	24.26
CV (%)	13.30	7.80	10.40

Leaf area:

Leaf area recorded after (45 days) of sowing and recorded after (75 days) of sowing which showed significant ($p<0.05$) differences were detected among treatments in the interaction between two seasons and significant ($p<0.05$) differences in the second season. First season showed no significant differences in leaf area after (45 days) and recorded of (75 days) after sowing. Leaf area was highest at the second season than the first season. This indicated that the effect of the residual fertilizer from the first season. The data in the Fig. (1) also showed that, the addition of FYM with or without inoculation and DAP significantly increased leaf area at the two recorded days while lowest leaf area was recorded by inoculation and followed by control. This indicated that nitrogen fertilization increase leaf area. Nitrogen element was reported to increase leaf area through the increase in leaf length and width (Roghe*et al*., 1990) and leaf blade size. This result is in agreement with Omer (1994) and Abaro (1992) reported that leaf area index increased with fertilizers.

Table 2: Stem thickness (cm), of Abu Sabien at the different fertilizers of the two seasons and the combined between them at Soba (2017-2018) Khartoum State.

Treatments	Season 2017	Season 2018	Combined
1\ Control	0.77	1.44	1.11
2\ Inoculum	1.46	1.73	1.60
3\ FYM	2.71	2.63	2.67
4\ Inoculum + FYM	1.08	1.98	1.53
5\ Inoculum +FYM +DAP	1.88	2.36	2.12
Grand Mean	1.58	2.03	1.80
SE ±	0.76	0.19	0.42
LSD (%)	0.25	0.61	0.12
CV (%)	8.30	1.60	5.70

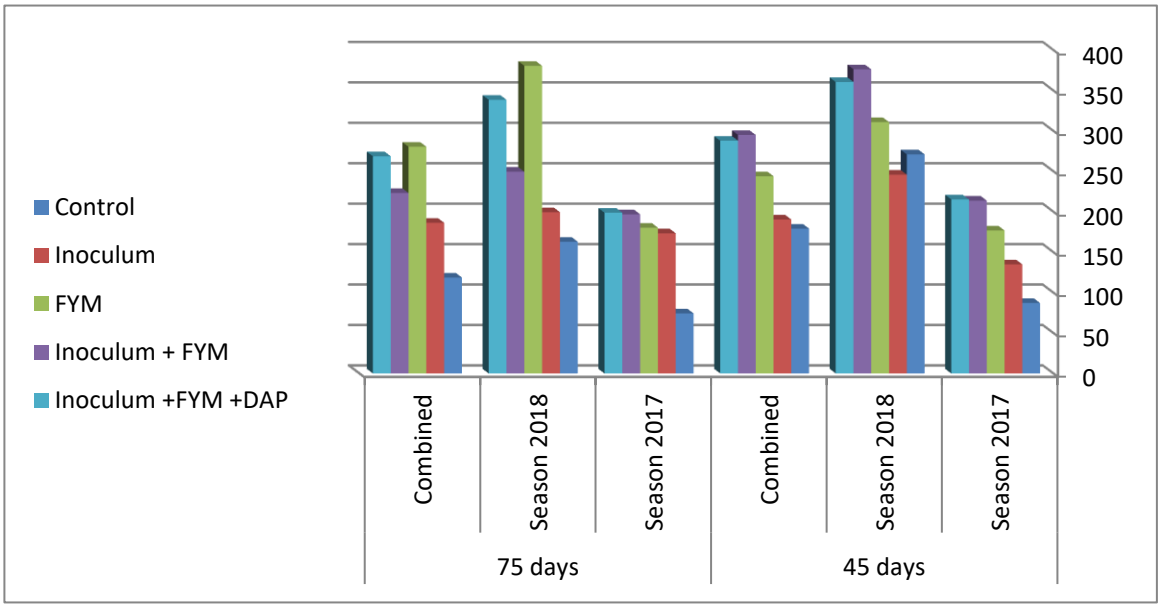

Figure 1. Leaf Area (cm2) recorded at 45 and 75 days after sowing, of Abu Sabien at the different fertilizers of the two seasons and the combined between them at Soba (2017-2018) Khartoum State.

Forage Yield

The results of forage yield (fresh and dry) as affected by FYM and other treatments are representing in Table 3 and 4 Forage yield is always related to growth parameters.

Green matter yields

The data pertaining to forage fresh yield as affected by application of fertilizers as well as their interaction presented in (Table 3), which revealed that significant ($p < 0.05$) differences in forage production were detected between treatments in first season. No significant differences between treatments in second season and the interaction between the two seasons were detected. Green matter yields (GMY), were higher in the second season compared to the first season at all treatment with exception of the control treatment. In the two seasons and the interaction between them the treatment FYM were superior in GMY than all treatments, (54.09, 60.17, and 57.13 t/ha), respectively followed by inoculum + FYM (45.33, and 45.5o t/ha), respectively in the first season and the interaction between the two seasons, whereas inoculum + FYM+DAP followed FYM (50.17 t/ha), in the second season. In the first season, inoculum + FYM + DAP recorded (40.50 t/ha), followed treatment inoculum (37.17 t/ha) with no significant differences between them. Control ranked lowest in GMY at the two seasons and the interaction between the two seasons resulted in (32.67, 32.50 and 32.58 t/ha), respectively. In the second season treatment inoculum + FYM recorded (45.67 t/ha), followed inoculum (38.00 t/ha). On the other hand treatment inoculum + FYM + DAP resulted (45.33 t/ha), followed by inoculum (37.58 t/ha), in the interaction between the two seasons. This result was expected since all forms of fertilizers used contain nitrogen which positively increased growth as well as forage yield. This is in agreement with Reddy *et al.* (1985), and Singh *et al*. (1992)

Dry Matter Yields:

The dry matter yield (DYM) of all treatments tested, were higher in the second season compared to the first season (Table 4). This is expected since growth parameters and green matter yield were superior during the second season. If GMY (yields) is high, DMY is expected also to be high. The yield component affected DMY in this experiment were plant height, stem thickness, plant density and leaf area to plant, in addition to harvesting time of the crops. No significant differences were detected between treatments in the first season and second season. Significant differences were resulted by the interaction between the two seasons. In the two

seasons and the interaction between them the treatment FYM were superior in DMY than all treatments, (9.93, 11.70, and 10.82 t/ha), respectively followed by inoculum + FYM in the two seasons and the interaction (8.10, 9.75 and 8.93 t/ha), respectively. Also the treatment inoculum resulted (5.47, 6.78 and 6.13 t/ha), respectively. Control ranked lowest in DMY at the two seasons and the interaction between the seasons resulted in (3.62, 4.67 and 4.14 t/ha), respectively. The results of this study indicated that, the addition of FYM with or without inoculum and DAP always resulted in high forage during the growing period. All treatments had significant effect on fodder yield (fresh and dry), compared to the control. Fertilization generally increased forage yield. Farm yard manure resulted in an increase in growth attributes as well as forage yield. Farm yard manure, inoculum and DAP produced higher fresh and dry forage at harvest than the control. This is in agreement with Hassan(2002) who found that the highest yield of both Abu sabien and pioneer 988 was obtained with (7.5 tons/fed) chicken manure treatment while the lowest yield was obtained with the (control). On the other hand, GMY and DMY was increased by earlier nitrogen application, hence in this case the increase in the straw yield was due to the addition of organic fertilizers which resulted in increase of the soil nitrogen content. This result was expected since chicken manure contains nitrogen that positively increased growth .Ismael (2007) and Amanullah*et al.* (2006) found that Chicken manure rates significantly increased growth and yield in faba bean. The maximum fresh forage and dry matter produced were recorded under the highest rate of manure applied. Several researchers Irshad*et al*. (2002) reported that nitrogen and phosphorus uptake, as a function of chicken manure application rate, increased progressively with increasing manure rates. The findings of the present study indicated that, the low chemical fertility of the semi- desert plain soils could be corrected through the application of farm yard manure with nitrogen (inoculum) and phosphorus fertilizers. This may be attributed to the fact that, the addition of FYM probably increased the reservoir of mineral nitrogen and many other essential plant nutrients. These results were in accordance with Elaagib (2004). Kulvinder*et al*. (2005), also found that, the application of different organic manures with or without chemical fertilizers improved the soil organic carbon, total nitrogen and phosphorus as well as the potassium status

Forage Quality

The highly significant ($p< 0.01$) differences among treatments tested at both seasons and their interaction in the neutral detergent fiber (NDF), acid detergent fiber (ADF) and crude protein (CP)), indicated that a considerable portion of the variability observed for these trails was due to effect of the different fertilizers to treatments (Table 5). However, the interaction of treatments with fertilizers was highly significant indicating that the treatments performed inconsistently across these factors. Fodder grasses in the tropic are low in quality, while dry matter yield is high. The fodder is deficient in protein and relatively high in fiber. However, the treatments control, FYM + inoculum + DAP and FYM only showed above mean range values for NDF (> 71.1%) and ADF (49.5%). The NDF measures the intake potential (Mertens, 1987) while the ADF predicts digestibility (Mitchell *et al.,* 2001). Lower values are desirable for each measurement. The high yielding treatments FYM, FYM + inoculum + DAP and FYM + inoculum seemed to combine high performance for both forage yield and quality. The former scored the highest protein content and the lowest NDF value whereas the latter exhibited the second lowest NDF and ADF values.

Incidence of stress at any stage may negatively influence the forage digestibility and reduced nutrient intake (Turner *et al*., 1990). The present study revealed that stressed conditions (confound effect of heat, salt and sodic) significantly lowered the nutritive value of forage sorghum in terms of crude protein content, digestibility and intake potential (high ADF and NDF values). Supporting results were reported by (Alien *et al.,* 1992). Who found that drought has enhanced feed value, whereas salinity and heat stresses will have deleterious effect on the spectrum of nutritive elements of forage crops since the confounded effect of these factors will impede nutrient uptake which was reported by Dannhauser, (1991) to play a significant role on the content of crude protein. Wood *et al.* (1993) reported that poultry litter application resulted in increased yield and crude protein content in the Bermuda grass.

Table 3: Green matter yield (t/ha), of Abu Sabien at the different fertilizers of the two seasons and the combined between them at Soba (2017-2018) Khartoum State

Treatments	Seasons 2017	Seasons 2018	Combined
1\ Control	32.67	32.50	32.58
2\ Inoculum	37.17	38.00	37.58
3\ FYM	54.09	60.17	57.13
4\ Inoculum + FYM	45.33	45.67	45.50
5\ Inoculum +FYM +DAP	40.50	50.17	45.33
Grand Mean	41.95	45.30	43.63
SE ±	3.14	1.02	1.56
LSD (%)	6.97	3.34	4.63
CV (%)	8.80	3.00	8.70

Table 4: Dry matter yield (t/ha), of Abu Sabien at the different fertilizers of the two seasons and the combined between them at Soba (2017-2018) Khartoum State.

Treatments	Seasons 2017	Seasons 2018	Combined
1\ Control	3.62	4.67	4.14
2\ Inoculum	5.47	6.78	6.13
3\ FYM	9.93	11.70	10.82
4\ Inoculum + FYM	8.10	9.75	8.93
5\ Inoculum +FYM +DAP	6.99	8.50	7.52
Grand Mean	6.82	8.19	7.51
SE ±	0.95	0.14	0.84
LSD (%)	0.31	0.45	0.25
CV (%)	2.40	2.90	2.70

Table (5): Effect of different fertilizer on cultivar of Abu Sabien (Sorghum bicolor) on neutral detergent fiber (NDF), acid detergent fiber (ADF) and crude protein (CP), at Soba Research Station of Soba Farm (2018).

Treatments	NDF%	ADF%	C.P%
1\ Control	74.33	52.67	6.71
2\ Inoculum	70.23	46.50	8.08
3\ FYM	71.13	51.03	8.30
4\ Inoculum + FYM	67.53	46.03	9.31
5\ Inoculum +FYM +DAP	72.27	51.27	8.28
Grand Mean	71.10	49.50	8.15
SE ±	0.77	0.33	0.21
LSD (%)	0.19	0.11	0.69
CV (%)	0.20	0.10	0.60

NDF: Neutral detergent fiber

ADF: Acid detergent fiber

CP: Crude protein

Summary and Conclusions

Based on the findings of this study the following conclusions can be drawn:

- In semi – desert plain soils which hazarded by salinity and sodicity with high clay content,, farm yard manure, farm yard manure + inoculum and farm yard manure + inoculum + di ammonium phosphate fertilizer have significant effects on sorghum growth and productivity compared to inoculum only.

- The results showed that, the interaction effect between FYM only or addition inoculum and DAP application on quantitative yield characteristic of abusabien forage recorded increase in all studied yield parameters, this could be due to the favorite effect of adding FYM, inoculum and DAP as a good source of plant nutrient.

- In these soils, the application of FYM with or without inoculum and DAP significantly increased quality and yields of forage Abu sabien.

- Farm yard manure resulted in an increase in growth attributes as well as forage yield. Farm yard manure (3 ton/feddan) produced higher fresh and dry forage at harvest than the control, followed by FYM + inoculum + DAP to (50 kg/Fadden) and FYM + inoculum.

- Further research work is needed to obtain more information on the effect of organic fertilizer and bio fertilizer on forage yield quantity and quality.

Recommendations:

Based on forage yield and quality the results of this study we recommend to, application of Farm Yard Manure(3 ton/feddan), produced higher fresh and dry forage at harvest than the control, followed by FYM + inoculum + DAP to (50 kg/Fadden) and FYM + inoculum. Suggested to add to the soil salinity and sodicity as a fertilizer for Soba area.

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