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HERBAGE YIELD RESPONSE OF PENNISETUM GLAUCUM TO SULPHUR FERTILIZATION IN THE HUMID TROPICS OF NIGERIA

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Abstract: **The effect of rates of sulphur (0, 2.5, 5.0, 7.5, 10.0 ppm) on herbage yield of Pennisetum glaucum grass grown on sand culture and arranged in randomized complete block design was investigated. Yield parameters measured were plant height, growth rate, number of leaves, number of tillers and herbage fresh weight. Addition of sulphur favoured plant growth and forage yield. Sulphur doses were positively correlated with herbage fresh weight (r = 0.897*). Herbage fresh weight of plants receiving 2.5 ppm S level was 183% higher than the control, increase in height 58% over the control at the first clipping and 80% by the fourth clipping. Sulphur doses of 2.5 ppm and 7.5 ppm produced leaves 2.6 times and 1.9 times more than the control by the third and fourth clipping respectively. Though plants that receive 10 ppm sulphur produce the highest number of tillers, increasing sulphur levels to 10.0 ppm did not have significant advantage over plants with 2.5 ppm sulphur supply level. Therefore, herbage fresh weight obtained from grasses that received from 2.5 ppm and 10.0 ppm did not have profound differences. Average fresh weight was strongly positively associated with plant height, tiller number and number of leaves produced (0.994**, 0.989** and 0.991**) respectively. Recommended sulphur level for herbage production in Pennisetum glaucum in the humid tropics is 2.5 ppm S equivalent to 5 kg S/ha.**

Keywords: **Pasture Improvement, Forage yield, Sulphur Nutrition, Indigenous grass, Humid Tropics.**

I. INTRODUCTION

Pasture can be considered as the most important single factor in animal productivity. It is the ruminant intake and utilization of forage that is converted to its “edible flesh” or meat. Pasture degradation can occur with inadequate management of pasture, inappropriate cultural practices and lack of soil nutrients [1]. Application of mineral fertilizer is one of the ways recommended to improve pasture; other being, identification of best performing grass species, breeding of high quality grasses, aeration and research in best grass-legume combination [2], [3], [4], [5].

In fertilizer recommendation for pasture establishment or renovation, Sulphur is not usually included. The absence of Sulphur in the recommendation is understandable since fertilizers were traditionally based on normal superphosphate, ammonium sulphate and potash which all contain Sulphur. This incidental Sulphur prevented a deficiency of the element. Since there is now production of higher analysis more refined fertilizers, coupled with intensification of land use which will always result in soil nutrient reduction (Sulphur inclusive), because of harvesting of forage [1], Sulphur deficiency will significantly affect herbage production, hence animal production.

Pennisetum glaucum is a short profusely tillering grass not normally grown for seed but is a suitable forage crop adapted to the humid zone. This pasture grass is therefore a suitable forage test crop to investigate Sulphur deficiency in the humid tropics. The objective of this investigation was to determine the effect of Sulphur nutrition on herbage yield and recommend the optimum Sulphur requirement for P. glaucum.

II. MATERIALS AND METHODS

A. Location:

The experiment was conducted at the teaching and research farm of the Agronomy Department, University of Ibadan, South West, Nigeria.

B. Preparation of culture solution:

One molar stock solution of the different salts were prepared and from this the working solutions were made. The culture solution (Johnson Solution) used was as described by [6]. Salt used for the preparation of the Johnson solution include $NH_4H_3PO_4$, $Ca(NO_3)_2$, $Mg(NO_3)_2$, NH_4NO_3, KCl, H_3BO_3, $MnCl_2$, $ZnCl_2$, H_2MoO_4, Fe-EDTA, the K_2SO_4 concentration used was varies to give the corresponding Sulphur concentration levels.

C. Preparation of Rooting Medium:

Pure river sharp sand obtained from Okitipupa, Ondo State, was used as a rooting medium. The sand was washed twenty times with tap water and finally rinsed with deionized water. Five kilogrammes of sand each was then weighed into the experimental pot.

D. Raising of Seedlings and Transplanting:

Seeds of *P. glaucum* were planted in 4 L plastic pot filled with top soil sieved through a 2 mm mesh and kept in the greenhouse.

Seedlings emerged by the fourth day after planting and allowed to grow. After 39 days of planting, they were cut to 7 cm height, washed to remove soil and transplanted into the experimental pots containing the sharp sand. In order to maintain experimental uniformity, seedlings were cut again 10 cm above ground level 21 days after transplanting. The plants were 60 days old at this time.

E. Treatment and Experimental Design:

The treatments were the five Sulphur levels, (0 ppm, 2.5 ppm, 5.0 ppm, 7.5 ppm, 10.0 ppm) replicated six times to give total experimental units of 30, arranged in a randomized complete block design, using replicates as blocks, thus randomization of treatments were within the blocks, where each treatment replicate was allocated to each block.

Two plants were transplanted into each pot placed on benches in the green house. The surface of the sand was covered with dark polythene to prevent algal growth. The working solutions of the five different Sulphur levels were used to irrigate the appropriate pots daily to field capacity. Uniform volume of culture solution was applied to all pots, from an initial 50 ml and increased later to 80 ml.

F. Measurement and Harvest:

All shoots above 15 cm baseline were clipped at two weeks interval. Tiller and leaf numbers were counted and plant height measured in centimeters from soil surface to the tip of the longest leaf before clipping. After clipping or harvesting, fresh weights of the cut herb were weighed in grammes.

G. Data Analysis:

The association between the herbage yield and sulphur level were determined using correlation coefficient and means were separated using the least significant difference (LSD).

III. RESULTS

A. Plant height:

Table I shows that the plant height or growth rate increased with cutting, with plants receiving the different S-levels producing tall *Pennisetum glaucum* plants at each cutting. For instance, at the first cutting, while plants receiving 2.5 ppm

S had reached a height of 44.30 cm, the height of control plants (0 ppm S) were only 28 cm which represents a 58% increase in growth. However, by the fourth cutting, 2.5 ppm S produced plants 80% taller than those of the control Sulphur supply Increasing S-supply beyond 2.5 ppm did not lead to further increase in height though plant heights were positively correlated to sulphur doses (r = 0.881*).

B. Leaf Production:

Visually, plants that received Sulphur treatment had thicker stems with larger green dark leaves. Table II illustrates the effect of S-supply on leaf number at the different cuttings. Plants receiving S-supply produced more leaves than those without S-supply from the first to fourth cutting.

Increase in leaf production of S-treated plants over control was most pronounced at the second cutting as number of leaves was markedly different between the 0 ppm S treated plants and 2.5 ppm S treated plants. At the fourth cutting increasing S-supply led to further increase in leaves produced; 7.5 ppm S and 10.0 ppm S treated plants had eight and six times more leaves respectively than those receiving 2.5 ppm S. This represents 133.5% and 123% increase respectively over the control. Sulphur was positively correlated with leaf production (r = 0.913*).

TABLE.I: EFFECT OF SULPHUR SUPPLY ON MEAN PLANT HEIGHT (CM) OF *PENNISETUM GLAUCUM*

	Cuttings			
S-levels	**1st**	**2nd**	**3rd**	**4th**
0 ppm	28.00c	30.47c	40.30c	43.33b
2.5 ppm	44.30a	45.57a	64.17a	78.00a
5.0 ppm	38.03b	39.0b	60.17b	75.00a
7.5 ppm	40.10b	40.67b	60.83b	77.33a
10.0 ppm	43.63a	44.00a	64.00a	78.67a

Means with same letters are not significantly different at $P_{.05}$ by LSD

TABLE.II: EFFECT OF SULPHUR SUPPLY ON LEAF PRODUCTION (MEAN LEAF NUMBER) IN *PENNISETUM* GLAUCUM

	Cuttings			
S-levels	**1st**	**2nd**	**3rd**	**4th**
0 ppm	3.3c	5.00c	10.600c	20.30c
2.5 ppm	8.3a	17.00a	27.60a	39.00ab
5.0 ppm	5.6b	12.00b	25.60ab	47.00a
7.5 ppm	7.0ab	13.60ab	25.60ab	47.00a
10.0 ppm	60.6ab	13.00b	25.00ab	45.30ab

Means with same letters are not significantly different at $P_{.05}$ by LSD

C. Tillering:

The response to applied rates of sulphur on tiller production is highlighted in Table III and indicates that tiller production increased with the age and cutting of the grass. However, grasses receiving 2.5 ppm S produced twice as much tiller than those without S-supply both at the second and fourth clipping. There was marked increase in tillers produced at the fourth cutting with grasses supplied with 10 ppm S producing the highest average number of tillers. There was a positive correlation of S-supply with tillers produced (r = 0.839*).

D. Fresh Weight:

The influence of S-supply on herbage production (fresh weight) is illustrated in Table IV. Plants receiving Sulphur treatment produced more herbage fresh weight than the untreated ones at all cuttings. The percent increase in weight from 0 ppm S to 2.5 ppm S at each cutting were 277%, 275% and 150%.

There was a significant increase in herbage fresh weight at the third cutting. Grasses that received 2.5 ppm S produced the highest significant herbage weight difference over the control. S-supply and herbage fresh were significantly correlated (r = 0.897*).

TABLE.III: EFFECT OF S-SUPPLY ON TILLER FORMATION IN *PENNISETUM GLAUCUM*

	Cuttings		
S-levels	**2nd**	**3rd**	**4th**
0 ppm	1.0c	1.0d	2.0d
2.5 ppm	2.0b	3.0c	4.3bc
5.0 ppm	2.6a	3.3bc	3.6c
7.5 ppm	2.6a	3.6ab	4.6b
10.0 ppm	3.0a	4.0a	5.6a

Means with same letters are not significantly different at $P_{.05}$ by LSD

TABLE.IV: INFLUENCE OF S-SUPPLY ON HERBAGE FRESH WEIGHT (g) IN *PENNISETUM GLAUCUM*

	Cuttings			
S-levels	**1st**	**2nd**	**3rd**	**4th**
0 ppm	0.04d	0.04d	2.2c	3.1c
2.5 ppm	0.95a	0.97a	4.9a	8.8a
5.0 ppm	0.67c	0.69c	4.3b	7.4b
7.5 ppm	0.82b	0.83b	4.8ab	8.0ab
10.0 ppm	0.96a	0.96a	4.8ab	8.8a

Means with same letters are not significantly different at $P_{.05}$ by LSD

IV. DISCUSSION

From this study, addition of Sulphur produced taller plants with thicker stems and larger dark green leaves. These gross morphological characteristics of *P. glaucum* conform to the observations made by [7] on marandu palisade grass.

Addition of Sulphur favoured tiller production. In sorghum, production of tillers is suppressed if growth rate falls below its potential [8]. It can be deduced in this study that S-deficiency in *P. glaucum* expressed in reduced growth rate may have suppressed tiller formation. A positive correlation between tiller number and leaf number was obtained in this study. This is in line with the report of [9] which stated that increasing number of tillers resulted in increased numbers of expanded leaves.

This study clearly showed that 2.5 ppm S-level was adequate for growth of *P. glaucum* (58.2% over control). Increasing S-supply beyond this level did not significantly increase plant growth rate, 2.5 ppm S-level is probably within the critical range of Sulphur dose required by the grass.

V. CONCLUSION

Addition of Sulphur favoured plant height, tillering and leaf production and this accounted for higher herbage (fresh weight) observed in this study. Therefore 2.5 ppm S which is equivalent to 5kg/ha S is recommended for Pennisetum glaucum.

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