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Effect of Fertilizer Treatments on the Agronomic Indices and Nutritive Value of Maize

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Target audience: Forage scientist and pastoralist

Abstract

The study evaluated the effect of fertilizer treatments on the agronomic indices and nutritive value of maize in a completely randomized design experiment. The primary tillage operations were done and maize was then planted at the spacing of 25 cm by 75 cm. Thinning and weeding was also carried out four weeks after planting. Fertilizers were applied; Control (No fertilizer), Urea fertilizer, Nat-soil fertilizer and Wonder fertilizer. The agronomic parameters estimated include number of leaves, plant height, plant width, leaf length, leaf width, number of cob, and cob weight. The results indicated that the agronomic indices of the fertilizer treatments were significantly better ($p<0.05$) than the control treatment. The control had the highest DM value (29.95 %) while wonder had the least DM value (27.50 %). Wonder had the highest CP value (12.19 %) while Urea and Nat soil had relatively the same CP value (10.6 % and 10.64 % respectively) as the least CP value was recorded in Control. The CF value was higher in Control and Wonder (32.32 % and 32.40 % respectively) as the least CF value (30.34 %) was recorded in Nat soil. Urea had the highest ADF value (43.21 %) while Wonder had the least ADF value (35.85 %). Nat soil had the highest NDF value while Control had the least value. It could be concluded that maize treated with fertilizers had better agronomic indices as well as nutritive value.

Keywords: Agronomy, Forage, Herbage, Nutrients, Response

Description of problem

The quality of fodder determines to a large extent the productivity of ruminant animals. The non-availability of high yielding quality fodder round the year aggravates the problem of sustainable animal farming [1]. In Nigeria, fodder scarcity is considered a major limiting factor to the livestock industry. This has made imperative efforts to increase production of fodder through application of fertilizers. Nitrogen is an essential element for fodder production [2]. Maize as green forage, particularly when it contains the leaves, ears and stalks, is an energy-rich source of feed for ruminant livestock. Maize forage is usually ensiled as silage in cooler

regions, while is conserved as hay in the tropics during the dry season [3]. Maize is a short duration fodder with potential for high yields on small plots; however its productivity is limited by the low nitrogen content of African soils [4]. This can be corrected through application of nitrogen fertilizer which most frequently is the soil nutrient that determines yield of fodder maize. The soil nutrient not only affects the forage production, but also improves the quality of forage from the view point of its protein content [5]. Maize fodder is a valuable feed for ruminants in terms of yield and nutritive value and its use for animal feeding is becoming very important on small scale mixed farms in the tropics [6], which has been achieved with the use of nitrogen fertilizer to improve plant yield. Therefore this study was thus aimed at assessing the agronomic indices and nutritive value of maize cultivated with different fertilizer treatments.

Materials and Methods

Experimental site

The experiment was carried out at the Teaching and Research Farm, The Oke-Ogun Polytechnic Saki located at the longitude 8.6275ºN and latitude 3.4058ºE and at 1500m above sea level.

Experimental design

The experiment was laid out in a completely randomized design with four replicate plots per treatment. The fertilizer treatments include T1 (Control), T2 (Urea fertilizer), T3 (Nat soil fertilizer), T4 (Wonder fertilizer) which were purchased from commercial stores.

Cultural practices

The experimental field was cleared, ploughed twice and harrowed and then laid out according to the experimental design. Maize (P4226 variety) was planted at the rate of 2 seeds per hole with 3cm depth at the spacing of 25 cm by 75 cm. Re-supplying was also done five days after planting. Thinning and weeding was also carried out four weeks after planting. Fertilizers were applied; Control (No fertilizer), Urea fertilizer (7.22 g per stand), Nat-soil fertilizer (3.8 g per stand) and Wonder fertilizer (1.9 g per stand). The fertilizer rates applied were calculated based on the nitrogen contents of each fertilizer and applied by side placement at 4 weeks after planting. Fertilization was done once.

Hay making

Maize plants were harvested at bloom stage (tasseling stage) at 6 weeks, allowed to wilt on the field for about 2 hours, the plants were chopped into 4 cm bits, spread and air-dried on a concrete floor under a shed for a period of 4 - 6 weeks until desirable moisture content was achieved, sub-samples weighing 100 g were taken from the hay produced oven dried and kept for analysis.

Laboratory analysis

Samples of hay from all treatments were taken to the laboratory for proximate and fibre analysis according to the procedure of [7].

Data collection and analysis

Data collected include plant height, plant width, leaf number, leaf length, leaf width, stem girth, number of cobs and weight of

cobs. The data collected were subjected to one way analysis of variance procedure of the general linear model [8]. The means were separated using the Duncan's Multiple Range Test.

Results and Discussion

There were significant differences ($p<0.05$) in the means of all the agronomic parameters of forage maize (Table 1). The result of this experiment indicated that maize treated with wonder was significantly higher ($p<0.05$) in plant height, plant width, leave number, leaf length, leaf width, stem girt and yield parameters compared to other fertilizer treatments. However, the agronomic indices of all the fertilizer treatments were far better than the control treatment. An optimum plant height is claimed to be positively correlated with productivity of plant [9]. Wonder was recorded with the highest plant height value indicating that the plant height was influenced by the fertilizer giving it optimum chance of growth. The number of leaves per plant was dependent on fertilizer used this study was in line with the view of [10] who reported that fertilizer application resulted in luxuriant growth with excessive leaves. Higher stem girth value recorded in wonder also indicated that there proper retention of appropriate amount of assimilate in the stem for leaf production thereby indicating the proper supply uptake and utilization of applied fertilizer. Photosynthesis is the most important source of weight for grain yield during the grain filling period [11] as this study indicates that the highest weight of cob and number of cob was recorded in wonder and this shows that there is proper supply and utilization of nutrient by the plant through photosynthesis. [11] added that nitrogen is needed by plants during their vegetative growth period, such as the effect on the formation of wider and longer leaves. As it was observed in this study that wonder has the highest plant width, leaf length and leaf width value indicated optimum nitrogen was supplied by the fertilizer. .

The dry matter content of maize hay on control was numerically higher than those on fertilizer treatments (Table 2). However, the crude protein and the ether extract contents of fertilizer treated hays were higher than the control hay. The crude fibre and carbohydrate fractions of control were slightly higher than the fertilizer treated hays. The Acid detergent fibre and neutral detergent fibre contents were higher than that of the control hay. The dry matter (DM) content was within the range for maize fodder cited by [12]) as 12.6 – 47.6 %. The crude protein content in this study was lower than 17.51 – 25.52 [2]. However, increased nitrogen fertilization in this study was in accordance with the finding of [13] that the increase in protein contents with increasing fertilizer levels may be as a result of enhancement in amino acid formation due to fertilization. [14] also reported that the increasing nitrogen dose indicated better nitrogen up take by the fodder maize plants, signifying the escalating trend of chlorophyll content resulting to more greenish leaves which was also observed among the treatment groups with wonder having greener leaves than other treatments. Acid Detergent Fibre was slightly higher than 32.20 - 35.70 % reported by

Table 1: Agronomic parameters of forage maize

Parameters	Control	Urea	Nat soil	Wonder	SEM	Pvalue
Plant height (cm)	66.43^{d}	71.90^{c}	75.13^{b}	94.80^{a}	1.31	<0.0001
Plant width (cm)	50.75^{c}	55.40^{b}	46.83^{d}	71.48^{a}	1.13	<0.0001
Leave number (cm)	7.98^{d}	8.98^{c}	9.98^{b}	10.38^{a}	0.12	<0.0001
Leaf length (cm)	54.63^{c}	52.65^{d}	65.15^{b}	68.25^{a}	1.03	<0.0001
Leaf width (cm)	5.67^{c}	6.99^{b}	7.17^{b}	8.10^{a}	0.11	<0.0001
Stem girth (cm)	3.21^{c}	3.46^{b}	3.69^{b}	5.45^{a}	0.08	<0.0001
Number of cobs	761.00^{c}	833.00^{b}	868.00^{b}	914.00^{a}	50.91	<0.0001
Weight of cobs	74.00^{c}	80.00^{b}	85.00^{b}	90.00^{a}	1.23	<0.0001

^{abc} Means with different superscripts are significantly different ($p<0.05$)

[2]and according to [15] forages with less than 40 % ADF was categorized as high quality forages while those greater than 40 % was categorized as poor quality forage. Therefore, based on this assertion, maize fodder fertilizer by wonder, Nat soil and control could be classified as high quality forage.

Table 2: Proximate and fibre fractions of maize hay

Parameters (%)	Control	Urea	Nat soil	Wonder
Dry matter	29.95	28.60	27.80	27.50
Crude protein	9.65	10.67	10.64	12.19
Ether extract	0.28	0.31	0.96	0.57
Crude fibre	32.32	31.95	30.34	32.40
Ash	11.00	10.40	11.62	10.21
Carbohydrate fraction	37.10	36.12	35.94	34.63
Acid detergent fibre	37.91	43.21	39.29	35.85
Neutral detergent fibre	72.62	76.92	81.86	79.03

Conclusion and Application

It could be concluded that, maize treated with fertilizers had superior agronomic indices as well as nutritive value. However, maize treated with wonder fertilizer gave outstanding responses.

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