Scholars Journal of Agriculture and Veterinary Sciences **e-ISSN 2348–1854**
Sch J Agric Vet Sci 2015; 2(4A):319-323 **p-ISSN 2348–8883**

(An International Publisher for Academic and Scientific Resources) DOI: 10.36347/sjavs.2015.v02i04.010

Effect of Cattle Manure on the Growth and Yield Performance of Vegetable Maize (*Zea mays* Saccharata) Varieties under Irrigation

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Abstract: Field trials were conducted at the Teaching and Research Farm of Abubakar Tafawa Balewa University, Bauchi, Nigeria during the dry seasons of 2005/2006 and 2006/2007 to evaluate the performance of vegetable maize using cow dung. Treatments consisted of four application rates (0, 5, 10, and 15t/ha) of cow dung and three local varieties of vegetable maize, namely, *Bataji*, *Choci* and *Dan-Bauchi*. All treatments were factorially combined and laid out in a randomized split-plot design. Results indicated that growth and yield parameters and final yields, all increased significantly ($P \leq 0.05$) with additional rates of cattle manure. Application of 15 t/ha increased plant height by 24%, leaf area by 27% and fresh husked cob weight by 13% among other parameters. Irrespective of application rates, *Bataji* performed significantly better than *Dan-Bauchi* and *Choci* in most of the parameters with the exception of kernel density and 1000 seed weight where *Choci* perfomed significantly better than the other two varieties. The use of *Bataji* variety with 15 t/ha is therefore recommended for good performance of vegetable maize in Bauchi and its environs.
Keywords: growth, yield, vegetable maize, variety, cow dung

INTRODUCTION

Cow dung is an important source of nitrogen for crop production in the small holder sector. It helps farmers reduce inputs of commercial fertilizer, thereby increasing the profit margin of the farmer. Nutrients contained in organic manures are released more slowly and are stored for a longer time in the soil, thereby ensuring a long residual effect [1] thus supporting better root development, leading to higher crop yields [2]. Improvements of environmental conditions as well as public health are also important reasons for advocating increased use of organic materials [3]. Maintenance of soil fertility is essential for optimum and sustained production. Inorganic fertilizers can be used to replenish soil nutrients and increase crop yields, but are too costly for the peasant farmers. The use of mineral fertilizers has been associated with increased soil acidity, nutrient imbalance and soil degradation [4]. This has necessitated research on the use of organic manures.

Recently, sweet corn is gaining popularity among nutritive and health conscious urban masses with an immense potential in domestic and international market [5]. It is highly prized by corn fanciers due to its succulent and tender kernels with sweet flavour. Sweet corn is marketed fresh, roasted or boiled and canned for future use. Due to its extra sweetness (14-20% sugar), short duration and impressive returns sweet corn is gaining attractiveness and ample awareness has been created among the farming community. Although increased levels of production can be achieved by increased use of inorganic fertilizers alone but it may lead to deterioration in soil quality besides pollution problem.

The use of organic materials has been proposed as one of the main pillars of sustainable agriculture as they provide large amounts of macro and micro nutrients for crop growth and eco-friendly besides being renewable alternatives to mineral fertilizers.

MATERIALS AND METHODS

Field trials were conducted at the Teaching and Research Farm of Abubakar Tafawa Balewa University, Bauchi, Nigeria during the dry seasons of 2005/2006 and 2006/2007 to evaluate the performance of vegetable maize using cow dung. Treatments consisted of four application rates (0, 5, 10, and 15t/ha) of cow dung and three local varieties of vegetable maize, namely, *Bataji*, *Choci* and *Dan-Bauchi*. All treatments were factorially combined and laid out in a randomized split-plot design, assigning manure to the main plot and variety to the sub-plot replicated three times. At the beginning of the experimental year, soil samples were randomly collected from the experimental site at 0-30 cm soil depth and analysed for physico-chemical properties (Table 1).

Rectangular basins of 5m x 3.75m separated by a border of 0.5 m path and 2 m between each replication were raised. Water was applied to the basins at two or three day intervals depending on the availability of soil moisture. Properly decomposed cow dung was incorporated into the soil four weeks before sowing at a spacing distance of 25 cm by 75 cm. A sample of the manure was analysed for its chemical composition (Table 2). Two weeks after seedling emergence, they were thinned to one plant per stand. Weeds were controlled by hoeing and occasional hand-pulling.

Growth parameters were assessed at 3, 6, 9 and 12 weekly intervals and at each sampling five plants in the inner rows of each plot were randomly selected for recording, while yield and yield components were assessed at harvest time.

Data collected were subjected to analysis of variance (ANOVA) using the Mstat-C software and means that showed significant ($P \leq 0.05$) differences were separated using the Students –Neuman-Keul's Test (SNKT) as described by Freed [14].

RESULTS AND DISCUSSION

Data pertaining to plant height revealed that the application of cow dung during the period of investigation significantly influenced maize plant height (Table 3). Application of 15 t/ha of cow dung gave the tallest plant height (140.4 cm) which was an increase of about 24% compared with the no treatment plots. Hunju *et al.* [15] similarly reported that application of cattle manure increased plant growth and stalk diameter, silage and dry matter yields.

An increase or decrease in the number of leaves per plant has a significant effect on the yield of crops. Data regarding number of leaves per plant as influenced by cattle manure is presented (Table 3). The widest leaf area ($345cm^2$) per plant was recorded in treatment where 15 t/ha of cattle manure was applied. An increase in the number of leaves per plant of maize was reported by Makinde [7] when cattle manure was incorporated into the soil before sowing. Barsukou [7] similarly stated that the application of cattle manure compost on a sandy soil experiment, increased leaf area and invariably fresh forage yields of maize plant by more than 26% compared with the control.

Cow dung application gave plants that achieved 50% tasselling significantly earlier than the control. The control plots achieved 50% tasselling in about 60 days while the treated plots achieved 50% tasselling in lesser days and with the application of 15 t/ha of cow dung 50% days to tasselling was achieved in about 57 days (Table 3). Cob length is an important yield contributing parameter of maize. It substantially contributes to grain yield of maize by influencing both numbers of grains per cob and grain size. Cob length was significantly affected by the application of cow dung (Table 3). Similar observations were reported by Falaki et al. [8] who reported significant increases in maize yield components with the addition of organic manure.

Among the various parameters contributing to the economic yield of a crop, 1000 grain weight is of prime importance. It directly relates with the yield of crop [9]. One thousand grain weight was significantly influenced by the application of cow dung (Table 3). Data revealed that maximum and minimum 1000 grain weight was 169.3 and 147.6 g from 15 t/ha and control treatments, respectively. The maximum 1000 grain weight might be due to availability of N and other nutrients in the cow dung, while the minimum 1000 grain weight might be attributed to deficiency of macro-nutrients throughout the plant life especially at the time of flowering and seed setting. Similar results were recorded by Shah et al. [9] who reported that 1000 grain weight was significantly affected by combined application of inorganic fertilizer in combination with farm yard manure.

Significant response of maize plant in terms of number of kernels per cob was recorded in Table 3. Results indicated that the application of 15 t/ha of cow dung produced the highest number of kernels per cob (169.3) compared with the lowest number of grains per cob (147.6) produced on plots with no treatment. The increase in number of grains per cob might be due to availability of N at proper time, which is required for better growth and development of plants and improvement in moisture retention and soil structure by cattle manure. Our result is similar to the findings of Shah et al. [9], Shah and Ahmad [10] and Laekemariam and Gidago [11] who concluded the significant effect of N fertilizer and farm yard manure had on number of kernels per cob.

Kernel density was significantly influenced by the application of cattle manure in this study (Table 3). Application of 15 t/ha of cow dung produced maize kernels with the highest density (1.60 g/cm^2) about 11% more than the control treatment (1.42 g/cm^2)

Kernel yield is the end result of many complex morphological and physiological processes occurring during the growth and development of crop [16]. The data regarding kernel yield of maize as influenced by cow dung is given in Table 3. The maximum kernel yield (3215 kg/ha) was attained with the application of 15 t/ha of cow dung which is about 55% more than the control treatment. The better kernel yield with application of cow dung could be attributed to better growth, yield attributing components, kernel development and nutrient use efficiencies. Our results are similar to the findings of Shah et al. [9] who revealed that kernel yield was significantly affected by N fertilizer in combination with farm yard manure.

Vegetable maize is generally harvested for its fresh husked cob at about 70-78% moisture content[17]. Fresh husked yield was significantly influenced by the application of cow dung (Table 3). Application of 15 t/ha of cow dung yielded 6, 336 kg/ha of fresh husked cob which is about 13% more than the control treatment.

There are significant effects of variety on the growth and yield of vegetable maize as revealed in this study. The *Bataji* variety significantly performed better than the other two varieties in almost all the growth, yield and yield parameters with exception in 1000 seed weight and kernel density (Table 4). This significant performance by the *Bataji* variety was not unexpected because wider leaf area and stalk diameter, translates to more photosynthetic activities and invariably more crop growth and higher dry matter production. In a similar vein, Asrar G *et al.*[18] reported that increased in total leaf area and leaf area index of maize plant, results in longer photosynthetic apparatus which influences assimilate production, known to have bearing over dry matter production per plant per unit area.

Additionally, the *Bataji* variety with wider and bigger stem diameter is likely to withstand lodging than the other two varieties. Lodging of plants, according to Harper [12], is often a result of wind and may indirectly change the structure of the leaf canopy, thus making it inefficient in photosynthesis.

With respect to kernel density and 1000 kernel weight the *Chochi* variety performed significantly better, followed by *Bataji* and Dan-Bauchi, producing the densest kernel (1.60 g/cm^3) and the heaviest 1000 kernel weight (160.2g).Gustin et al. [13] have reported a significant kernel density correlation with bulk test weight (r =0.080), suggesting that selection of dense kernels can translate to improved agronomic performance.

Table-1: Physico-chemical properties of soil at the experimental site in 2005/2006 before the start of the xperiment

Soil property	Soil depth (0-30cm)
Clay (%)	16.2
Silt (%)	14.7
Sand (%)	69.1
Textural class	Sandy loam
Soil pH:	
(1:2.5 H^20)	6.4
(1.25 $CaCl_2$)	5.2
Organic carbon (g/kg)	6.5
Total nitrogen (g/kg)	0.71
Available phosphorus (mg/kg)	7.12
C.EC. (meq/100g soil)	4.66
Exchangeable cations (meq/kg)	
Ca	3.51
Mg	0.79
K	0.25
Na	0.13
S and micronutrients (mg/kg)	
S	34.6
Cu	0.74
Zn	1.5
Mn	17.3
Fe	14.1
Mo	0.08

Table 2: Mean chemical composition of cow dung used for the experiment

Nutrient	Weight (g/kg)
Available nitrogen	8
Total nitrogen	22
Phosphorus (P_20_5)	19
Potassium (K_20)	25
Calcium (Ca)	3
Magnesium (Mg)	1
Sulphur	0.9

Table-3: Effect of cow dung on growth, yield and yield parameters of vegetable maize (pooled over 2 years)

Treatment plant	Parameters							
	leaf area height (cm) at 9 WAS	Number of (cm^2) at 9 WAS	fresh husked days to tasselling	dry kernel cob yield (kg/ha)	number yield (kg/ha)	1000 of kernels per cob	kernel kernel weight (g)	density (g/cm^2)
Control	106.2 g	252 i	60.0 c	5553 i	1446 g	375.5 d	147.6 k	1.45 k
5t/ha	123.1 e	266 h	59. 0 d	5904 g	1675 f	386.4 cd	155.4 g	1.60 h
10t/ha	134.5 c	303 f	59.0 d	6139 e	2051 d	394.1 cd	160.1 f	1.76 e
15t/ha	140.4 b	345 c	57.0 f	6366 c	3215 b	407.9 c	169.3 c	1.88 b
SE±	7.52	20.80.37	174	393	6.81	21.4	0.09	

Means in the same column followed by the same alphabet are not significantly different (P≤ 0.05) using SNKT

Table-4: Effect of variety on growth, yield and yield parameters of vegetable maize (pooled over 2 years)

Variety	Parameters							
	plant height (cm) at 9 WAS	leaf area at (cm^2) at 9 WAS	Number of days to tasselling	fresh husked cob yield (kg/ha)	dry kernel yield (kg/ha)	number of kernels per cob	1000 kernel weight (g)	kernel density (g/cm^2)
Dan-Bauchi	132.0 b	312 b	59 b	6039.1 b	1905 b	378.1 b	152.1 c	1.42 c
Bataji	136.2 a	339 a	58 a	6194.1 a	2104 a	387.4 a	158.4 b	1.54 b
Choci	127.0 c	292 c	60 c	5865.2 c	1721 c	370.4 c	161.2 a	1.60 a
SE±	2.65	13.5	0.51	94.9	110.5	4.91	2.80	52.8

Means in the same column followed by the same alphabet are not significantly different (P≤ 0.05) using SNKT]

CONCLUSION

Based on the findings from this study, it can therefore be concluded that, the use of cow dung has significant effect on the growth and yield performance of vegetable maize and the application of 15 t/ha using the *Bataji* local variety of vegetable maize has produced the overall best result in almost all the parameters including the final yield.

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