



Effects Of Manure Levels On Growth And Yield Of Yellow Corn In Sandy Soil Under Dry Climate

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Abstract A field study was conducted in sandy soil to evaluate the effects of manure levels (0 ton ha⁻¹, 5 ton ha⁻¹, and 10 ton ha⁻¹) on the growth and the yield of yellow corn. Treatments were randomly assigned to nine experimental units (2 m × 2 m) with three replicates. Corn yield, plant height (after 30 days and at harvest), and total organic matter were measured. Results showed that there were not significant effects of manure levels on corn yield or total organic matter at the rate of 5 ton ha⁻¹ and 10 ton ha⁻¹. Results revealed that manure has an effect on plant growth during the early stages of growing but this effect was not observed at harvest. The outcomes of the study suggested that to exploit such soil, chemical fertilizers beside organic amendment should be applied to boost plant growth and yield in the short term.

Keywords: Manure; corn yield; plant height; plant growth. LSD; least significant difference.

تأثير مستويات من السماد البلدي على نمو و حاصل الذرة الصفراء في تربة رملية القوام ضمن المناخ الجاف

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الملخص دراسة حقلية أجريت في تربة رملية لتقييم تأثيرات مستويات مختلفة من السماد البلدي (0 طن/هـ و 5 طن/هـ و 10 طن/هـ) على نمو و إنتاجية الذرة الصفراء. المعاملات وزعت عشوائيا على 9 وحدات تجريبية (2م × 2م) مع ثلاثة مكررات. تم قياس حاصل الذرة و طول النبات (بعد 30 يوم من الغلات و عند الحصاد) بالإضافة إلى حاصل القش الكلي. النتائج بينت انه لا يوجد تأثيرات معنوية لمستويات السماد البلدي (5 طن/هـ و 10 طن/هـ) على حاصل الذرة أو حاصل القش الكلي. كما بينت أن السماد البلدي له تأثير على نمو النبات خلال المراحل الأولى من عمر النبات و لكن هذا التأثير لم يكن ملاحظا عند الحصاد. النتائج اقترحت انه لا يستغل مثل هذا التربة يجب استخدام الأسمدة الكيماوية بجانب السماد البلدي للحصول على نمو و إنتاجية عالية في المدي القصير.

الكلمات المفتاحية: السماد، محصول الذرة، ارتفاع النبات، نمو النبات، الفرق الأقل أهمية.

Introduction

Corn is one of the most staple crops in semiarid regions especially in sub-Saharan

Africa. It has relatively short maturity period, high yielding capacity as well as easy to manage and process compared to other crops (Muhumed et al 2014). Nowadays corn is growing in many countries and becoming the second largest crop producing in the world based on the world's cereal production (Jaliy et al 2008). Globally, third production of corn is being produced by the United States followed by China and Brazil (Shultz, 2008). Initially, corn is produced for many purposes from human consumption as both fresh and processed product to livestock feeding as well as industrial uses such as production of ethanol, starch and cooking oil (Remison, 2005).

To sustain the quality and quantity of the crop production, maintaining and improving soil fertility

is important, which can be accomplished by adding fertilizer either organic or inorganic form. Additions of organic materials such as manure have been reported to increase soil fertility, improve soil aggregation, reduce bulk density, enhance soil water retention and hydraulic conductivity (Chaney and Swift 1986a,b; Mbagwu, 1989; Droogers and Bouma, 1996) as a result increase soil productivity. Nowadays, many farmers turn to organic fertilizer instead of chemical fertilizers to fertile their soil due to the high cost of chemical fertilizers as well as environmental concerns. In Libya, corn is grown partially and has increased due to the increase of the overall agricultural areas. The purpose of this study was to determine if adding manure to sandy soil will increase corn yield and overall organic matter in the short term. We hypothesized that manure will increase corn yield and overall organic matter due

to their effects on soil fertility and overall soil chemical and physical properties.

Materials and methods Study site

The study was established in spring 2016 in the farm of Agriculture faculty, Sebha University, Libya. The experimental site was located of 357 m above

sea level, and at latitude of 27°06'N, and longitude of 14°27'E. The soil was sandy, containing 93.65 % sand, 3.64% silt, 2.8% clay, pH 7.2. Prior to the study, soil site was not planted for about 20 years. Cattle solid manure was obtained from confined piles from a local dairy. Some soil physical and chemical characteristics are presented in Table 1.

Experimental Design

Experimental design was randomized complete design including three levels of manure (0 ton ha⁻¹, 5 ton ha⁻¹, and 10 ton ha⁻¹) with three replicates. Plots were 2 m wide and 2 m long and including 4 planted rows. Solid manure was hand applied and tilled to the depth of about 15 cm. Plots were irrigated every two days.

Soil Analysis

Soil Physical and chemical characteristics were analyzed before planting. Soil pH was determined according to the method of Thomas (1996) using a 1:1 soil:deionized water extract, while electrical conductivity was measured by EC meter. Organic matter was determined by Walkey-Black procedure (Nelson and sommers, 1996). Ca and Mg were determined by titration method, and soil texture was conducted using mechanical analysis.

Table 1. Selected chemical and physical properties of soil site.

Property	Units	Values
pH	----	7.2
EC	dS m ⁻¹	0.48
Total N	%	0.09
Organic Matter	%	1.32
K	mg kg ⁻¹	80
Ca	mg kg ⁻¹	300
Mg	mg kg ⁻¹	1630
Na	mg kg ⁻¹	200
P	mg kg ⁻¹	300
Soil Texture	----	Sandy
Sand	%	93.65
Silt	%	3.64
Clay	%	2.8

Soil analysis were conducted in soil & water lab- Agriculture faculty- Sebha University.

*Total N and P were determined in previous study (Mohammed 2003)

Statistical analysis

All data collected from this study were analyzed using one-way analysis of variance (ANOVA) test for a randomized complete design in R (ver. 3.3.2, a free software environment for statistical computing and graphics). The difference between means was compared using LSD at $\alpha = 0.05$ level.

Results And Discussion Effects of manure on plant growth

Average plant heights were measured in the early

were greater in plots receiving manure as shown in Fig 1A, where 5 and 10 ton ha⁻¹ treatments significantly differ from 0 ton ha⁻¹ treatment ($P < 0.001$), but later at the harvest differences were less noticeable ($P = 0.65$) Fig 1B. Results suggest that manure has increased plant growth during the early stages. This boost is likely related to the input

of essential nutrients such as nitrogen (N) and phosphorus (P), but the amount of

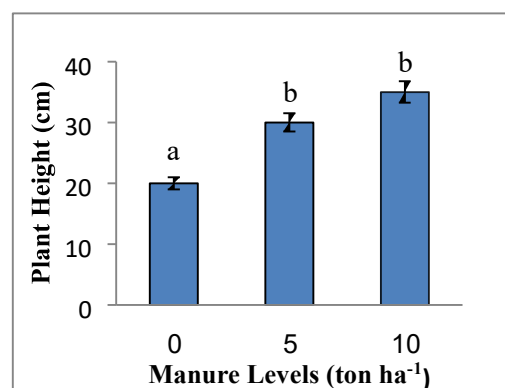


Fig. 1A. The effects of manure levels on corn height (cm) after 30 days from planting (n=8). Histogram bars labeled by the same letter are not significantly different ($\alpha = 0.05$).

these elements were limited to support the requirement of corn for the entire season. Okoroafor et al. (2013) found that application of manure improves the chemical and physical properties of the soil, thereby increasing the growth of maize. Another study reached the same conclusion that manure would affect soil chemical and physical properties, thus improving plant growth.

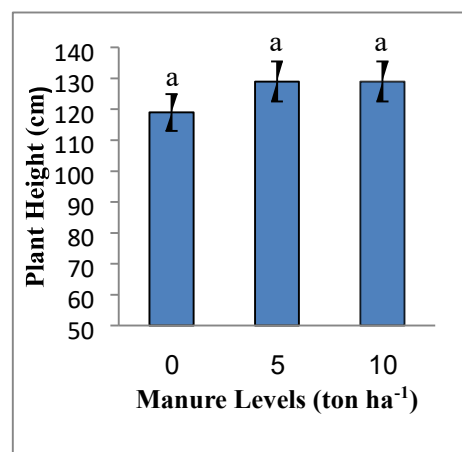


Fig. 1B. The effects of manure levels on corn height (cm) at harvest. Histogram bars labeled by the same letter are not significantly different ($\alpha = 0.05$).

(Arriaga and Lowery 1999). The results of this study partially support our hypothesis that manure increases plant growth in the early stage but it did not hold true at harvest (Fig 1A,B).

Effects of manure on corn yield and total organic matter

Manure levels did not increase corn yield and the results are shown in Table 2. Addition of manure caused a slight increase on corn yield where 5 ton ha⁻¹ and 10 ton ha⁻¹ treatments differ from 0 ton ha⁻¹ by 8.5% and 12.6% respectively, but this increase was not significant ($P=0.39$).

The results indicated that the manure used and /or the rate at which it was applied was not as effective to improve nutrient availability especially nitrogen (N) and phosphorus (P). Other researchers have suggested that manure benefits corn yield by enhancing the physical and chemical characteristics of soil (Dormaar et al., 1988; Larney and Janzen 1996), enhancing the availability of macronutrients as N and P (Agbogidi and Okonmah 2012). It appears that cattle manure may need to be applied for a longer period of time in order to observe a statistically significant increasing on plant productivity. Nevertheless, manure application appears so far to have a neutral effect on corn production at the short term in this soil.

Table 2. Effects of manure levels on corn yield and total organic matter (tonha⁻¹)

Manure Levels (ton ha ⁻¹)	Corn Yield	Total Organic Matter
0	1.93a†	2.83a
5	2.11a	2.93a
10	2.21a	3.00a
LSD	ns*	ns*
Pr> F	0.39	0.07

† Within columns means followed by the same letter are not significantly different at ($\alpha=0.05$).

ns*= not significant.

Result showed that plant total dry organic matter slightly affected by manure levels (Table 2), but this effect was not significant ($P=0.07$). Results indicated that there was an increase on total organic matter with the increase of manure levels. This rise was from 1.93 ton ha⁻¹ in 0 ton ha⁻¹ treatment to 2.11 ton ha⁻¹ and 2.21 ton ha⁻¹ in 5 ton ha⁻¹ and 10 ton ha⁻¹ treatments respectively, but the increase was not significant ($P=0.07$) Table 2.

Conclusion

The aim of this study was to evaluate the effects of manure on the growth and yield of corn in sandy soil. The study demonstrated that additions of manure did not affect the plant yield or plant total organic matter in a sandy soil when applied at 5 or 10 ton ha⁻¹. Therefore the study demonstrated that manure do not always affect plant yield especially in low fertile soil. Land disposal of manure may be an effective means to enhance soil physical and chemical properties at the longer term, but if cultivators wish to grow sandy soil with corn to increase the yield, chemical fertilizer rather than manure would likely be more effective in the short term. More researches are needed to determine the optimum level of cattle manure in sandy soil to give the highest level of corn yield in

the short term.

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