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Research Application Summary

Maize yield in Sudan as influenced by inorganic and organic fertilizers

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Abstract

The main objective of this research was to investigate the effect of chemical fertilizer, organic fertilizer and a combination of the two on maize (*Zea mays* L.) yield in Sudan. Three levels of fertilizer: 86 kgN/ha, 4 tonnes chicken manure/ha. and a combination of 43 kg N/ha. + 2-ton chicken manure/ha were applied on cultivar Mogtama 45. Field experiments were conducted for two consecutive seasons, 2010/11 and 2011/12 at the Experimental farm, Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Gezira State (Sudan). The results showed that maximum plant population and yield were obtained on application of a combination of the two types of fertilizers in both seasons. In addition, the highest plant height, head weight, 100-seed weight and grain yield were obtained when a combination was used. These results will indirectly encourage farmers to keep poultry.

Key words: Chicken manure, Gezira State, nitrogen, poultry, *Zea mays*

Résumé

L'objectif principal de cette recherche était d'étudier l'effet des engrais chimiques, des engrais organiques et une combinaison de deux sur le rendement du maïs (Zeamays L.) au Soudan. Trois niveaux d'engrais: 86 kgN / ha, 4 tonnes de fumier de poule/ ha et une combinaison de 43 kg N / ha. + 2 tonnes de fumier de poule / ha, ont été appliqués sur le cultivar Mogtama 45. Des expériences sur le terrain ont été menées pendant deux saisons consécutives, 2010/11 et 2011/12 à la ferme expérimentale de la Faculté des Sciences Agronomiques, Université de Gezira, WadMedani, dans l'État de Gezira (Soudan). Les résultats ont montré que la population maximum et le rendement maximum des plantes ont été obtenus en appliquant une combinaison de deux types d'engrais dans les deux saisons. De plus, on a obtenu la hauteur la plus élevée de la plante, le poids de la tête, le poids de 100 graines et le rendement en grains lorsqu'une combinaison a été utilisée. Ces résultats encourageront indirectement les agriculteurs à conserver la volaille.

Mots clés: Fumier de poulet, État de Gezira, azote, volaille, Zeamays

Background

Maize (*Zea mays*) is a cereal crop grown widely throughout the world and in a wide range of agro-ecological environments. Maize was introduced into Africa in the 1500s and has since become one of Africa's dominant food crops. In the Sudan, maize is grown on a small scale in different locations under rain-fed, and irrigated conditions. Like in many other regions, maize is often consumed as a vegetable although it is a grain crop. The grains are rich in vitamins A, C and E, carbohydrates, and essential minerals, and contain 9% protein. They are also rich in dietary fiber and calories which are a good source of energy. Maize is perhaps the most important cereal crop in sub-Saharan Africa (SSA) and an important staple food for more than 1.2 billion people in SSA and Latin America. All parts of the crop can be used for food and non-food products. In industrialized countries, maize is largely used as livestock feed and as a raw material for industrial products. Maize accounts for 30−50% of low-income household expenditures in Eastern and Southern Africa.

Most maize production in Africa is rain-fed. Irregular rainfall can trigger famine during occasional drought. According to FAO (2007) estimates, 158 million hectares of maize were harvested worldwide, and Africa harvested 29 million hectares. Africa as a whole uses 95% of the maize produced as food compared to other world regions that use most of its maize as animal feed. Ninety percent of white maize consumption is in Africa and Central America. It fetches premium prices in Southern Africa where it represents the main staple food. Yellow maize is preferred in most parts of South America and the Caribbean. It is also the preferred animal feed in many regions as it gives a yellow color to poultry egg yolks and animal fat. Maize is processed and prepared in various forms depending on the country. In all parts of Africa, green (fresh) maize is boiled or roasted on its cob and served as a snack. Popcorn is also a popular snack.

Nitrogen is a major plant growth and yield determining nutrient required for maize production (Manzoor *et al.,* 1999). Thus lack of Nitrogen in soil constrains crop production. Other maize production constraints in Sudan include drought, diseases and pests, poor adaptation of some varieties, socio-economic factors such as limited access to external inputs especially seed of improved varieties and fertilizers. These constraints are compounded by poor linkages among actors in commodity value chains, poor crop management practices, limited processing capacity, postharvest losses, poor infrastructure and limited access to markets (Kimani *et al.,* 2005). An integrated system based on improved crop varieties and appropriate agronomic and postharvest management practices is probably the most effective strategy for enhancing crop productivity. Maize production can be integrated with poultry production, where the former provides feeds to poultry, and the latter providing poultry manure. The objective of this study was to examine possibility of integrating chemical ferterlizer and poultry manure to enhance maize productivity.

Study description

Field experiments were conducted for two consecutive seasons; 2010/11 and 2011/12, at

the Experimental farm of the Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Gezira State (Sudan). The soil at the site is a cracking heavy clay Vertisols classified as fine, smectitic, isohyperthermic, Typic Haplusterts (Soil Survey Staff, 1996) with 40 – 60% clay, very slow water permeability, pH 8.5, low in organic matter, and deficient in nitrogen (300 – 400mg/kg). It has a high CEC of 50 – 66 cmol (+)/kg soil. Three levels of fertilizers were used: 86 kgN/ha, 4 ton chicken manure/ha, and a combination of 43 kgN/ha + 2 ton chicken manure/ha. Cultivar Mogtama 45 was used as a test crop because it is a high yielder, stable, matures early, is medium height, resistant to shattering and lodging, tolerant to heat, moisture stress and has good baking quality. Sowing was done manually on July 4th 2010 and July 6th 2011 for the first and second season, respectively with 2 seeds/hole at 0.3m inter row spacing and 0.6m between rows, thinned to one seedling two weeks later. The experiment was carried out in a randomized complete block design with three replications. Each plot consisted of 12 rows, each 5 m long. Both nitrogen and chicken manure fertilizers were applied at planting time. The experiment was irrigated after sowing, and then every 14 days unless it rained. Weed control was done every 15 days. The recommended agronomic practices for maize were followed throughout the course of the study. Data were collected for plant height, head (spike) weight, 100 seed weight, number of seed/head and grain yield. Economic evaluation of the effect of the two fertilizer types was done.

Research application

The effect of different types of fertilizers on grain yield and other growth parameters of maize are presented in Tables 1 – 3 for season 2010/11 and 2011/12.

Table 1: The effect of different fertilizers on maize plant height at elongation and maturity stage

Treatments	Average plant height (cm)			
	Elongation stage		maturity stage	
	2010/2011	2011/2012	2010/2011	2011/2012
Nitrogen (N)	45	54	144	148
Chicken manure (CM)	40	45	142	144
N + CM	50	58	152	158
Control	38	39		

Table 2: The effect of different fertilizers on maize yield (kg/ha) and 100 seed weight (gm) (2010/11 and 2011/12)

Treatments	Yield kg/ha)		100 seed wgt (gm)	
	Season 2010/2011	Season 2011/2012	Season 2010/2011	Season 2011/2012
Nitrogen (N)	4200	4500	30	33
Chicken manure (CM)	3600	3800	25	28
N +CM	5300	5700	37	42
Control	2300	2500	22	24

Table 3: The effect of different fertilizers on number of maize seeds/head

Treatments	Number of seeds/head	
	2010/2011	2011/2012
Nitrogen (N)	430	480
Chicken manure (CM)	350	370
N +CM	520*	550*
Control	300	330

* Significant yield at P<0.05

The results showed that combined inorganic and organic fertilizers was more efficient and resulted in the highest grain yield. This is likely because the combination improves both soil physical and chemical properties. In this study, application of nitrogen significantly increased dry matter production, uptake of nitrogen and economic yield. The positive effect of the use of poultry manure in this study, especially in combination with nitrogen, implies that farmers will be encouraged to take up both maize and poultry production. Ultimately, there will be improved productivity of both commodities at a reduced cost.

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