

Research Application Summary

Effect of nitrogen and phosphorous rates and sources on grain and forage yield of maize in river Nile State

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Abstract

The study was conducted at two locations, namely, Hudeiba Research Station Farm (moderately fertile soil) and Matera (poor soil) in River Nile State for two seasons between 2008-2010. The objective of the study was to investigate the effect of phosphorous fertilizer source, nitrogen source and rate on forage and grain yields of maize. Two sources of phosphorous, namely, triple super phosphate (TSP) and diammonium phosphate (DAP) and two nitrogen sources (urea and ammonium nitrate) at three rates, 0.0, 43 and 86 kg N/ha were used in the study. The design used was a split-split-plot with three replicates. Phosphorous sources were applied to the main plots and nitrogen sources and rates were assigned to the split and split plots, respectively. The results showed that phosphorous and nitrogen sources had no significant effects on both forage and grain yields of maize at the two locations in the two seasons. However, nitrogen rate had significant effects on yields of maize. Application of nitrogen at 86 kg N/ha increased the forage and grain yields of maize over the 0.0 N treatments by 5, 0.6 t/ha and by 700, 444 kg/ha at Hudeiba and Matera, respectively, in the first season. Whereas in the second season it increased both forage and grain yields of maize by 7, 6 t/ha and 1175, 1017 kg/ha at Hudeiba and Matera, respectively. In conclusion, application of nitrogen fertilizers in the two forms significantly increased maize in yields in the two soils types and should be promoted in the study areas.

Key words: Ammonium nitrate, diammonium phosphate, soil fertility, triple super phosphate, urea

Résumé

L'étude a été menée à deux endroits, à savoir, à la Station de recherche agricole Hudeiba (sols moyennement fertiles) et à Matera (sols pauvres) dans l'État du Nil pendant deux saisons entre 2008-2010. L'objectif était d'étudier l'effet de la source d'engrais au phosphore, source d'azote et le taux de fourrage et des rendements de grains de maïs. Deux sources de phosphore, à savoir, phosphate super triple (TSP) et phosphate

diammonique (DAP), et deux sources d'azote (urée et nitrate d'ammonium) à trois taux, 0,0, 43 et 86 kg N / ha ont été utilisés dans l'étude. Le plan utilisé était des champs « split-split-plot » avec trois répétitions. Les sources de phosphore ont été appliquées aux parcelles principales et les sources d'azote et les taux ont été attribués aux parcelles split-splitt, respectivement. Les résultats ont montré que les sources de phosphore en azote n'ont eu aucun effet significatif sur les rendements de fourrage et de grains de maïs dans les deux sites pendant les deux saisons. Toutefois, le taux d'azote ont des effets significatifs sur les rendements de maïs. L'application d'azote à 86 kg N / ha a augmenté les fourrages et les rendements en grains de maïs au cours des traitements N 0.0 par 5, 0,6 t / ha et de 700, 444 kg / ha à Hudeiba et Matera, respectivement, dans la première saison. Considérant que, dans la deuxième saison il y a eu augmentation à la fois du fourrage et des rendements des céréales de maïs de 7, 6 t / ha et 1175, 1017 kg / ha à Hudeiba et Matera, respectivement. En conclusion, l'application d'engrais azotés dans les deux formes a augmenté de façon significative dans les rendements du maïs dans les deux types de sols et devrait être encouragée dans les régions étudiées.

Mots clés: Nitrate d'ammonium, le phosphate diammonique, la fertilité du sol, triple super phosphate, de l'urée

Background

Maize (*Zea mays* L.) is the world's third cereal crop after wheat and rice in consumption and production. However, the crop has a wide range of uses than all cultivated cereals as a primary staple food in many tropical and sub tropical countries and feed and forage crop. Maize also has many industrial products such as glucose, starch, papers, insulators and vegetable oil for human consumption (Fisher and Palmer, 1984). In Sudan, maize ranks fourth after sorghum, wheat and millet (Hassan 2004). In Sudan, maize is grown as a subsistent rain-fed crop around villages in Nuba Mountains, southern Sudan and the Blue Nile State. The crop is also grown under irrigation in central, eastern and northern Sudan. Recently, maize has gained more importance as a forage and food crop especially in River Nile State where the crop is successfully grown by irrigation in late summer and winter seasons (Mohammed, 2006). In fact, three soil types, gurier (high/y fertile), karu (moderately fertile) and high terrace (poor soils) are used to produce different crops. These in addition vary in their other soil characters, and the farmers in the State usually prefer to grow high value crops in gurier and karu soils. As maize cannot compete with these high value crops, it is

increasingly being produced in the high terrace poor soils where yields are low. Very little or no research work had been done regarding maize fertilization in high terrace poor soils. The objective of this study, therefore was to investigate the effects of phosphorous and nitrogen sources and application rate on growth and yield of maize in two soil types in River Nile State.

Literature Summary

Research on maize in this part of the country started in early sixties at Hudeiba Research Station which at that time focused more on breeding rather than crop management (Imam, 1962). Different workers had examined the effect of phosphorous and nitrogen rate using triple super phosphate and urea in clay and moderately fertile soils in central Sudan. They recommended application of 86 kg N/ha (Babiker, 1998; Lazim and Nour, 2000). Recently, other forms of nitrogen and phosphorous have been tested and found to be inferior to the traditional urea and TSP (Mohammed *et al.*, 2007). These however could be useful in the poor or marginal soils in northern Sudan. Much research work had been done in wheat regarding nitrogen and phosphorous fertilization in poor high terrace soils in River Nile Stat (Ibrahim, 1995). However, no such research work had been done on maize as in wheat.

Study Description

Trials were set up at two locations, i.e., Hudeiba Research Station farm (HRSF) and Matera. The land at both sites was prepared by disc ploughing, harrowing, leveling and ridging to 60 cm apart. Seeds of an open- pollinated maize cultivar (Hudeiba-2) were sown in holes at 30 cm intra- row spacing in the third week of October at the two sites in the two seasons. The two phosphorous sources (TSP and DAP) were hand broadcast at the side of the ridge in rows and covered with soil before sowing. Nitrogen was applied as urea or ammonium nitrate and was applied in two equal splits at sowing after four weeks. The application rates of N investigated were 0.0, 43.0 and 86.0 kg N/ha. The experiment was kept free from weeds and irrigated every 7 and 10 days till maturity at the second and first location, respectively.

Research Application

The results presented in Table 1. Indicated that phosphorous and nitrogen sources had no significant effects on maize forage yield at the two locations in the two seasons. Application of nitrogen fertilizer at 86 kg N/ha significantly increased maize forage yield by 5 and 0.6 t/ha at the first and second location respectively, in the first season over the control treatments, and by 7 and 6 t/ha in the second season. On the other hand,

Table 1. Effects of phosphorous and nitrogen sources and nitrogen rate on forage yield (t/ha) of maize grown at Hudieba Research Station farm (HRSF) and Matera in two seasons.

Treatment	Location			
	HRSF		Matera	
	1 st season	2 nd season	1 st season	2 nd season
P sources	15.28	23.59	9.68	10.55
TSP				
DAP	14.35	26.44	9.5	11.93
SE±	0.93	2.744	0.963	1.14
N sources				
Urea	14.58	24.71	9.64	10.76
AN	15.05	25.33	9.54	11.71
SE±	1.04	0.473	0.903	0.26
N rates (kg/ha)				
0.0	12.43	21.37	9.82	8.3
43	15.03	25.42	8.59	11.64
86	16.98	28.27	10.36	13.78
SE±	1.27	0.579	1.106	0.319
Mean	14.81	25.02	9.59	11.24

Table 2. Effects of phosphorous and nitrogen rats on grain yield (kg/ha) of maize grown at Hudieba Research Station farm and Matera in the two seasons).

Treatment	Location			
	HRSF		Matera	
	1 st season	2 nd season	1 st season	2 nd season
P sources	1687.65	2878.93	990.12	1359.79
TSP				
DAP	1484.19	3057.38	1017.88	1481.82
SE±	100.5	461.073	97.52	206.985
N sources				
Urea	1582.11	2818.18	1121.6	1533.88
AN	1590.74	3118.13	886.41	1307.73
SE±	104.67	125.811	109.16	64.909
N rates (kg/ha)				
0.0	1357.42	2408.37	837.02	864.9
43	1334.26	2912.95	894.44	1515.62
86	2067.59	3583.15	1280.55	1881.9
SE±	128.2	154.086	133.7	79.497
Mean	1586.42	2968.16	1004	1420.81

application of 86 kg N/ha gave greater maize grain yields at the two locations and in the two seasons (Table 2). The increases in maize grain yields were about 700 and 444 kg/ha at Hudeiba and Matera, respectively, in 2008, while in 2009 the increases amounted to 1175 and 1017 kg/ha at Hudeiba and Matera, respectively (Table 2).

Recommendation

It can be recommended that to obtain high forage and grain yields of maize, the crop should receive 86 kg N/ha in the moderate fertile (karu) soils and the poor high terrace soils.

Acknowledgement

I thank SCARDA, PICO TEAM, and Agricultural Research Corporation for their role in this work. Thanks also go to D. Kamal Sedig, D. Ibrahim Eldikhri, my supervisor Abd elrhman Ahmed Mohammed for their contribution. I also acknowledge support of my family and friends.

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