

Introduction

- Smallholder farmers widely use nitrogen (N), phosphorus (P) and potassium (K) fertilizers for maize production in northern Ghana and Benin
- NPK fertilizer-induced yield increases appears to have plateaued, making it necessary to reevaluate other soil nutrients for their potential to boost crop yield. The objective of this study is to evaluate the effect of Zn and B on maize grain yield in a typical open parkland systems dominated by shea trees (*Vitellaria paradoxa* C. F. Gaertn)

Methods

- In a farmer – researcher trial shea trees were divided into zones: 0 m (under canopy), 3 m, 10 m and 20 m away from the canopy (Fig. 1, Fig. 2, Table 1)
- Each zone was sub-divided to implement different fertilizer applications: (i) farmer's practice without fertilizer application (FP) (ii) sole NPK fertilizer (national recommended rate (NR): 60 kg N ha⁻¹, 13 kg P ha⁻¹, 25 kg K ha⁻¹) (iii) NR plus 7.5 kg Zn ha⁻¹ (NRZn), and (iv) NR plus 1.5 kg B ha⁻¹ (NRB)



Figure 1. Maize plants under tree canopy (A), maize plants outside tree shade in Ghana (B)

Results & Discussion

- Maize grain yield increased ($p < 0.05$) from zone 0 m to 20 m in Ghana and Benin (Fig. 3)
- Zone and fertilizer application interaction increased ($p < 0.05$) grain yield of NPK plus Zn in zone 20 m in Ghana. It was 2.8 times larger than FP in zone 0 m (Fig. 3)
- Fertilizer use efficiency (FUE) increased ($p < 0.05$) from 0 m to 20 m zones in both Ghana and Benin

Table 1. Soil chemical properties under zones in Ghana and Benin

Zone	Busunu (Ghana)				Wewe (Benin)			
	pH	Bray P mg kg ⁻¹	Ex. K cmol kg ⁻¹	Zn mg kg ⁻¹	pH	Bray P mg kg ⁻¹	Ex. K cmol kg ⁻¹	Zn mg kg ⁻¹
0	6.41	4.82	0.19	0.7	6.44	4.92	0.15	0.56
3	6.43	4.06	0.16	0.69	6.25	4.65	0.15	0.52
10	6.52	3.22	0.15	0.54	6.18	4.69	0.15	0.51
20	6.48	3.01	0.15	0.64	6.26	3.94	0.12	0.57
p value	0.62	0.65	0.66	0.79	0.2	0.56	0.77	0.55

Table 2. Grain yield as affected by zone and fertilizer application

Zone	Busunu (Ghana)		Wewe (Ghana)	
	Grain yield (kg ha ⁻¹)	Harvest index	Grain yield (kg ha ⁻¹)	Harvest index
0	2412.2	0.44	1579.4	0.42
3	2842.1	0.46	2089.1	0.45
10	2990.9	0.47	2089.5	0.45
20	3133.2	0.48	2243.8	0.49
Lsd	277.3	0.04	503	0.1
p-value	0.00	0.16	0.07	0.41
Fertilizer application				
FP	1604.5	0.35	1177.1	0.36
NR	3224.6	0.49	2194.6	0.44
NRZn	3305.2	0.51	2353.5	0.52
NRB	3244.1	0.5	2276.5	0.48
Lsd	114.5	0.04	269.4	0.06
p-value	0.00	0.00	0.00	0.00
Zone X fertilizer				
p-value	0.01	0.94	0.34	0.64

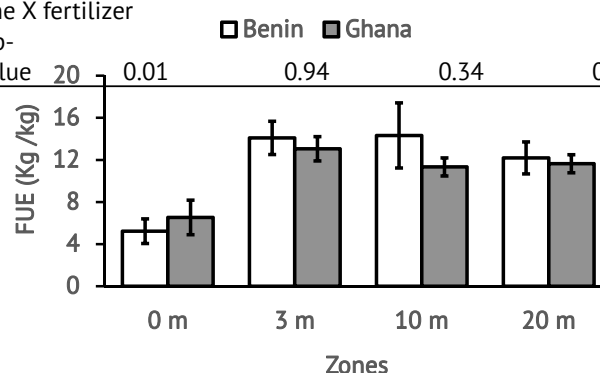


Figure 2. Fertilizer use efficiency as affected by Zones

Conclusions

- Zn and B are not limiting farmers' maize yields in northern Ghana and Benin.
- Sole NPK fertilizer produced comparable yields and FUE with micronutrients fertilizers
- Smallholder farmers could use sole NPK for sustainable maize production in open agroforestry parklands

