Agronomic and economic performance of fertilizer microdosing in the shea-maize agroforestry parklands of Benin

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Introduction

Maize (*Zea mays* L.) is essential for food security in Africa, but yields remain low due to poor soil fertility. In monocropping systems fertilizer microdosing (MD) has been shown to be an efficient, alternative fertilizer application strategy for farmers who cannot afford the recommended fertilizer rates. This study compares yield and profitability of different fertilizer application strategies in *Vitellaria paradoxa* C.F. Gaertn. parklands.

Materials and Methods

Wewe, Northern Benin

- **Yield zone** : A (canopy area), B (3 m), C(10 m), and D (20 m) from the canopy
- **Fertilizer application strategies**: Control (no fertilizer), MD (17.8 kg N ha^{-1}, 3.1 kg P ha^{-1}, and 5.8 kg K ha^{-1}), Recommended Rate (76 kg N ha^{-1}, 13.1 kg P ha^{-1}, and 24.9 kg K ha^{-1})

Results & Discussion

- Average grain yield of MD and RR in 2023 and 2024 were 22% and 50%, respectively, higher ($p < 0.05$) than the average for control (Table 1)
- Average Fertilizer Use Efficiency of MD in 2023 and 2024 was 190% higher than the average of RR (Fig. 1).

Table 1. Comparison of maize grain yield (t ha^{-1}) in *V. paradoxa* parklands

	Grain yield			
	2023		2024	
Zones				
A	1.35		1.94	a
B	1.59		2.87	b
C	1.71		2.96	b
D	1.56		2.79	b
SEM	0.06		0.10	
Fertilizer application strategies				
Control	1.36	a	2.25	a
MD	1.73	b	2.76	b
RR	1.66	b	3.72	c
SEM	0.06		0.09	

Means along the same columns with different alphabets are significantly different at ($p < 0.05$). SEM demotes the overall standard error of the mean.

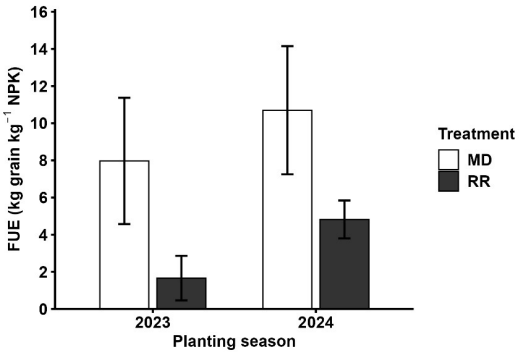

Figure 1. Comparison of fertilizer use efficiency (FUE) of MD and RR.

- Cost for Control was 13% and 35% lower ($p < 0.05$) than MD and RR respectively (Table2). However, profit for MD and RR were 28% and 111% respectively higher ($p<0.05$) than Control (Table 2).

Table 2. Comparison of total cost ($ ha^{-1}), revenue ($ ha^{-1}) and profitability ($ ha^{-1}) of fertilizer application strategies.

	Cost		Revenue		Profit	
Control	299	a	659	a	360	a
MD	343	b	804	b	461	a
RR	463	c	1223	c	760	b
SEM	1.7		59		59	

Means along the same columns with different alphabets are significantly different at ($p < 0.05$). SEM demotes the overall standard error of the mean.

- MD required 45% more ($p < 0.01$) sowing time than the control and RR, yet total labour time of RR was 12% higher ($p < 0.01$) than for MD (Table 3).

Table 3. Comparison of labor time (hr ha^{-1}) of fertilizer application strategies.

	Sowing		Chemical application		Harvest		Total time	
Control	47.8	a	71.4	a	179.9	a	846.9	a
MD	71.4	b	71.4	a	185.3	a	875.8	a
RR	48	a	158.7	b	200.8	b	957.9	b
SEM	1.2		2.8		1.5		3.7	

Means along the same columns with different alphabets are significantly different at ($p < 0.05$). SEM demotes the overall standard error of the mean.

Conclusions

Fertilizer microdosing in shea parklands is less labour-demanding, increases maize yield, fertilizer use efficiency and profit. Therefore, it may thus be a viable entry pathway to intensifying production of agroforestry systems for farmers with low cash availability.

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