



NPK fertilizer type and time of application effect on growth, yield and profitability of maize production

Nurudeen Abdul Rahman^{1*}, Fred Kizito¹, Irmgard Hoeschle-Zeledon², Francis Marthy Tetteh³, George Yakubu Mahama⁴ and Godwin Opoku⁴
¹International Institute of Tropical Agriculture (IITA)-Ghana, ²IITA-Nigeria, ³CSIR-Soil Research Institute, ⁴CSIR-Savannah Agricultural Research Institute.
 Contact: n.abdulrahman@cgiar.org

Introduction

- Maize is mostly produced by smallholder farmers under rain-fed conditions in Ghana.
- Average yield maize is < 2 t/ha on farmers' fields compared with a potential of 6 t/ha (MoFA, 2017).
- Poor soil fertility is key factor for the yield gap.
- Fertilizer application on farmers fields is still low due to high cost and inadequate accessibility.
- The need for short term management practices that can enhance productivity and efficiency of the little fertilizers that smallholder farmers apply to maize.
- We examined the effect of basal fertilizer type and time of its application on growth, yield and profitability in smallholder maize production.



Photo 1. Growth performance of maize plant with NPK fertilizer at planting (left) vs maize with NPK fertilizer at 2 weeks after planting (right) in northern Ghana.

Materials and Methods

Experimental design and treatment

- A 2 × 3 factorial treatment combination laid in RCBD with 4 communities as replicates was used.
- The treatments were basal fertilizer types (blend and compound fertilizer) and time of fertilizer application (full rate at planting, full rate at 2 weeks after planting (2WAP) and half rate at planting and 2WAP (Both)).
- Agronomic data: leaf area index (LAI), plant height, plant biomass, grain yield, stover NH₃ gas emission, nitrogen (N) uptake in grain and apparent N recovery efficiency (ANRE) were measured.
- Economic data: net profit, benefit cost ratio (BCR) and return on investment (ROI) were also calculated for the treatments.

Conclusion

- Applying basal NPK fertilizer at planting of maize significantly increased plant height, plant biomass, LAI, N uptake, ANRE, grain yield, net profit, BCR and ROI relative to the conventional practice of 2WAP.
- It also reduced the ammonia gas emissions compared with the conventional practice.
- We recommend that applying basal NPK fertilizer to maize at planting will enhance sustainability of smallholder maize production in northern Ghana and similar agro-ecologies in West Africa through its effect on productivity, environmental pollution, food security, profitability and livelihoods.

Results

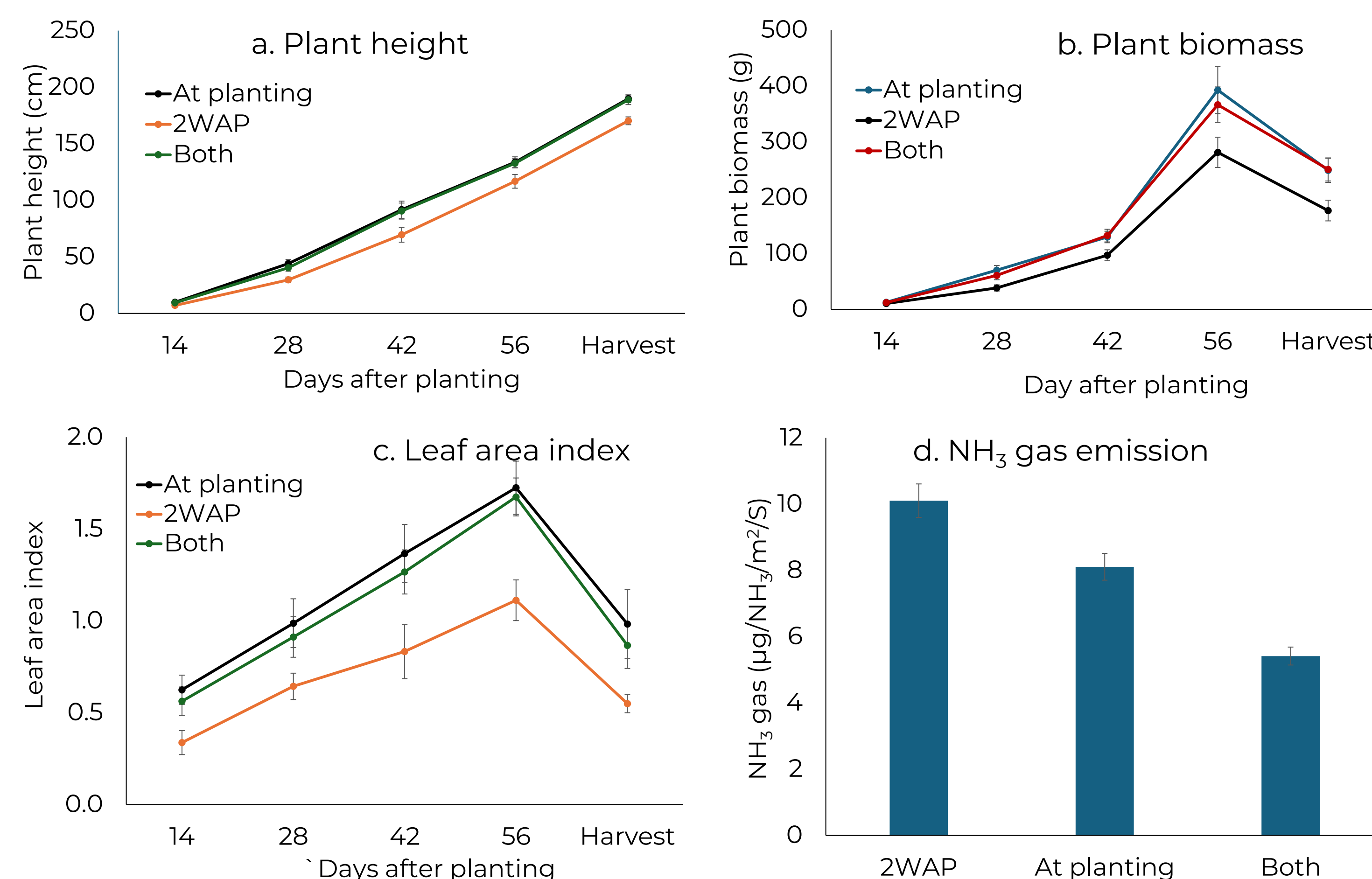


Fig. 1. Effect of time of basal NPK fertilizer application on plant height, plant biomass, leaf area index and NH₃ gas emission in northern Ghana. Bars represent standard error.

Table 1. Effect of basal NPK fertilizer type and time of application on agronomic and economic indicators in northern Ghana

	Agronomic				Economic		
	GYD ¹ (kg/ha)	ST ² (kg/ha)	GNU ³ (%)	ANRE ⁴	Net Profit (GHS ⁵)	BCR ⁶	ROI ⁷ (%)
Basal fertilizer type							
Blend	2.4a	3.7a	1.5a	32.5a	493.9a	1.2a	21.8
Compound	2.1a	3.4a	1.5a	27.0a	348.7a	1.2a	17.4a
Standard error	0.14	0.33	0.03	2.39	166.83	0.08	8.40
P-Value	ns	ns	ns	ns	ns	ns	ns
Time of basal fertilizer application							
At planting	2.5a	4.0a	1.5a	34.1a	657.9a	1.3a	33.6a
2WAP ⁸	1.7b	2.7b	1.4b	19.3b	-0.2b	1.0b	-2.8b
Both ⁹	2.5a	3.9a	1.5a	35.8a	606.2a	1.3a	27.9a
Standard error	0.18	0.40	0.04	2.92	204.33	0.10	10.28
P-Value	**	*	**	**	*	*	*

¹Grain yield, ²Stover, ³Grain N uptake, ⁴Apparent N recovery efficiency, ⁵Ghana cedis (11.3GHS=\$1, [BoG, 2025](https://www.bog.gov.gh/)), ⁶Benefit cost ratio, ⁷Return on investment, ⁸2 weeks after planting, ⁹At planting and 2WAP, ns p > 0.05, *p ≤ 0.05 and **p ≤ 0.01.

Reference

Ministry of Food and Agriculture (MoFA). 2017. Agriculture in Ghana: Facts and figures (2016). Accra: Statistics, Research and Information Directorate (SIRD).