SUITABLE POLY4-BASED BLENDS FOR MAJOR CORN-GROWING AGROECOLOGICAL ZONES OF TANZANIA

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Abstract

Multiple nutrient deficiencies are a major cause of limited corn productivity in Tanzania. This is primarily driven by the low and improper use of fertilizers causing poor soil fertility management in corn-based farming systems.

To address this, trials were conducted at ten locations to develop a better understanding of corn growth and yield response characteristics to POLY4-based NPK blends in comparison with existing N + P and NPK fertilizers in different agroecological zones of Tanzania.

Of the ten sites, six were responsive to K and/or S fertilizers. Across these six sites, POLY4 blends had an average yield advantage of 12% over MOP NPK blends and 28% compared to N + P (control). POLY4-treated crops also had the heaviest cobs and fewest cobless plants. Lodging occurred at three of the six sites. POLY4-treated corn had a lower lodging incidence than N + P or MOP.

Introduction

- Corn is the main cereal crop grown in Tanzania for food and income. About 4.5 million hectares are planted in corn, and small-scale farmers contribute over 80% of Tanzania's total production.[1] Around 4 million Tanzanian farmers produce 4.5 million tonnes of corn. Most smallholder farmers produce corn for home consumption and sell a portion as a significant source of household income.
- One of the limiting factors to productivity is soil fertility degradation due to nutrient deficiencies. Many soils in the Southern Highlands were reported to have low to very low nitrogen (N), phosphorous (P), calcium (Ca) and sulphur (S).[2] In Eastern and Northern Tanzania 40% of corn grown under subsistence farming systems had potassium (K) levels below the critical minimum.
- Fertilizer use in Tanzania is estimated at 9 kg of nutrients per ha, which is the lowest in the world.[3] About 12% of farmers use inorganic fertilizers and many apply only N and P from urea and diammonium phosphate (DAP). Corn typically receives minimal fertilizer and no K or S. However, trials in Tanzania and nearby countries have shown yield responses with K and S supply.
- There is potential to improve soil fertility and replace nutrient removals by using multi-nutrient POLY4 which contains 14% K_2O, 19% S, 6% MgO and 17% CaO.

Trial location

Methodology

- Trials were conducted at ten local farms across Tanzania. Six of the sites were responsive ($P < 0.1$) to fertilizer in addition to N + P. Only these data are presented.
- N includes 45 kg ha^{-1} in N + P or NPK blend from urea and DAP, and 75 kg ha^{-1} top dressed as urea.
- K in standard NPK blends from MOP.
- K in POLY4 15:20:5 blend is from POLY4. K in POLY4 15:20:10 and 15:20:15 blends is from MOP and POLY4.
- Data analysed by Genstat ANOVA blocked by site. Mean separation by Fisher's LSD test (5%).

Application rate treatments

Treatments	Nutrient application rate (kg ha^{-1})					
	N	P_2O_5	K_2O	S	CaO	MgO
No fertilizer	0	0	0	0	0	0
N + P (control)	120	60	0	0	0	0
POLY4 blend (15:20:5 + 7S)	120	60	15	20	18	6.4
POLY4 blend (15:20:10 + 6S)	120	60	30	18	16	5.7
POLY4 blend (15:20:15 + 4 S)	120	60	45	12	11	3.9
MOP blend (22:30:7)	120	60	15	0	0	0
MOP blend (20:26:13)	120	60	30	0	0	0
MOP blend (18:24:17)	120	60	45	0	0	0

Pre-trial soil status*

Treatments	Region	pH (mg kg^{-1})	P (mg kg^{-1})	K (mg kg^{-1})	S (mg kg^{-1})	Ca (mg kg^{-1})	Mg (mg kg^{-1})
Responsive sites							
Karatu	NR	6.2	15	1014	0	3940	816
Lushoto	NR	6.3	7	20	18	2520	576
Uyole	SH	6.1	7	1443	16	1020	576
Mbozi	SH	5.5	7	741	11	580	204
Babati	NR	6.4	17	234	0	5580	516
Inyala	SH	6.3	4	230	0	5160	240
Non-responsive sites							
Mbinga	SH	5.5	6	195	5	160	96
Moshi	NR	6.7	17	858	5	3780	888
Mbulu	NR	6.2	9	234	3	6100	432
Mtwango	SH	5.1	9	148	21	3180	72

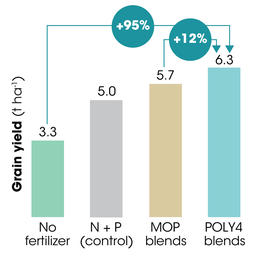
*Responsive and non-responsive sites in the Southern Highlands (SH) and Northern Region (NR).

- There was no relationship between the initial soil analysis and whether a trial site responded to fertilizer in addition to N + P.
- Tanzanian soil K was generally very high. However, this did not preclude a K response.
- Agroecosystem did not affect the responsiveness of each trial.

Results

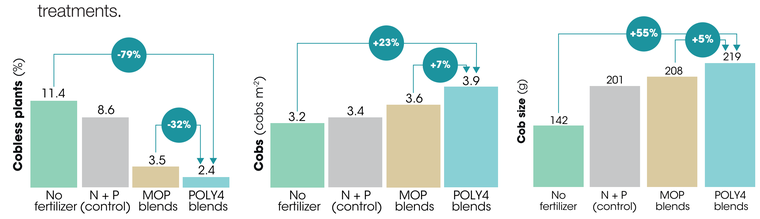
Yield performance

- The best performing blend at each site, and the complementary blend at the same K_2O rate, were averaged.
- In five of the six sites, the best performing blend was one of the POLY4 blends.
- Across the six sites, yield was significantly ($P < 0.05$) increased through application of POLY4 relative to MOP, N + P (control) or not applying fertilizer.



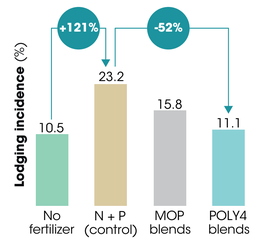
Yield components

- POLY4 significantly ($P < 0.05$) decreased the number of plants without cobs[4], increased cob size and the total number of cobs[5] per m^2 compared to the N + P (control) and no fertilizer treatments.



Lodging incidence

- Three of the sites were affected by lodging.[6] Two trials from 2016 and one trial from 2017.
- Application of nitrogen and phosphorus without K at these sites caused lodging incidence.
- POLY4 treated crops had significantly ($P < 0.005$) fewer plants lodge at the three affected sites, than the N + P (control) treatment.



Conclusions

- Yield was greater with POLY4 blends than standard NPK and N + P blends.
- So far, there is no evidence that the response of corn to POLY4 differs between the Southern Highlands agro-ecosystem and Northern region of Tanzania.
- POLY4-fertilized crop was more likely to have more and larger cobs.
- Application of N + P alone increased lodging. POLY4-treated corn had the lowest degree of lodging.
- Tanzanian soil available K did not relate to crop responsiveness to applied potassium.

Notes

1) USDA FAS, 2019. Grain and Feed Annual 2019 Tanzania Corn, Wheat and Rice Report; 2) Malley, Z.J.U; Mmari, W. and Ngailo J. 2010. Soil fertility survey and evaluation in 100 smallholders Maize and Rice farms in Mbinga District, A consultancy work commissioned and prepared for Mbinga District Council; Mnguu, Y.O. and Msolla, M. (2007). Interpretation of Analytical Results for Soils from Iringa Region.DADs project, Iringa; Msaky J. J. T.; Msanya, B. M, and Kilasara, M., (1998).Soil Survey and Soil Fertility Assessment in Utengule and Ng'onde Villages, Markete District, Tanzania;
3) Wickama et al. 2015; 4) Cobless plants measured at: Karatu, Lushoto, Uyole, Babati, Inyal); 5) Cobs/m^2 measured at: Karatu, Lushoto, Uyole, Mbozi (15 kg K_2O); 6) Lodging measured at: Lushoto, Uyole, Babati.

Sources: 25000-SOH-25011-16, 25000-SOH-25012-17, Selian Agricultural Research Institute (2017-2018).

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