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Participatory evaluation and verification of maize on soil test crop response based at Chobi community micro watershed, Caliya District, western Oromia, Ethiopia

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Abstract
Verification trial of soil test crop response based phosphorus recommendation for maize was conducted at Chobi community micro watershed in Caliya District of Western Oromia in 2023 main cropping season. The trial was used to extrapolate verification result formerly conducted at Ilu Galan District on maize as bench mark. P-Critical (14.5) and P-requirement factor (5.5) was used for maize in this district. Three treatments were used, T1 (control), T2 (STBFR), T3 (Farmer Practices) laid out with simple adjacent plots side by side by using improved maize variety (BH-661) and replicated over ten farmers' fields in the district. The plot size was 10m x 10m ($100m^2$) for each treatment. The highest mean grain yield (8195kg/ha) was obtained from soil test crop response based fertilizer recommendation while the lowest mean grain yield (1802kg/ha) was recorded from the control plot. Eventually, partial budget analysis also indicated that phosphorus critical and requirement factor were economically feasible having net benefit of (217,500 Et.Birr) at 836% MRR. Therefore, Pc and Pf were verified and recommended for farmers of Chobi community micro watershed Caliya District to produce and obtain optimum yield from maize while further participatory evaluation and demonstration of this result will be expected to popularize the technology to farmers of the study areas and similar agro-ecologies. The change of pre-sowing and post-harvest soil parameters will be included after analysis completed.

Keywords: Farmer practices, Maize, P-Critical, P-requirement factor, Soil test based

Introduction

Ethiopia is endowed with huge potential for agricultural development and cereal crops like maize are widely cultivated across a range of environmental conditions. However, it has been one of the more food insecure countries of the world. Food insecurity in the country is mainly due to inadequate utilization of improved crop production and protection technologies by the predominantly small-scale farmers (CSA, 2010) [2]. Since 1952 maize research has been ongoing at deferent capacities to generate and recommend improved technologies for maize production. As a result, maize productivity and production has been increasing over the years. The progress made from the 1950's to 1990's has been documented in the proceedings of the First and Second National Maize Workshops of Ethiopia (Kebede *et al*., 1993; Mosisa *et al*., 2002) [4, 6]. In the 2000s, efforts have also been made by deferent stakeholders to enhance maize research, and thus increase maize productivity and production. According to Lynch (1998) [5] there are three approaches of germplasm improvement for grain yield in the farmers' field: Improving yield response to high levels of input, Improving yield under low input availability and Improving yield under both low and high input availability.

Improving crop yield only under high levels of input may result in varieties unsuitable for low input conditions which occur frequently in resource poor farming conditions. In general, to feed these alarmingly increasing of the country's population increasing production and productivity is very critical issue and deserved an intervention. Soil fertility depletion is among the major impediments to sustained crop productivity because of limited application of fertilizers in Ethiopia. Crop yield can be enhanced through balanced application of fertilizers (inorganic and organic soil nutrients).

Intentionally/unintentionally/ most of the farming communities think that maize is considered as lowland or as mid land crop. But now a days it could be due to occurrence of climatic change from time to time a change of crop agro ecology was observed. Last year when the survey was conducted, maize production was observed at the farmers' fields in Chobi Micro watershed even greater in its performance than that of maize belt areas. So, maize calibration and verification study has been done at Ilu Galan district. Eventually, participatory evaluation and verification of this result in Caliya district by extrapolation of the result obtained from Ilu Galan district is very important since they are adjacent districts to each other and assumed to be sharing similar agro-ecology. The main objective of this study was to Evaluate and verify maize production based on soil test crop response results at Chobi Community Micro Watershed.

Materials and Methods

The trial will be conducted at Chobi community micro watershed, western Oromia, Ethiopia. Chobi community watershed is located in Caliya district West Shawa zone, western Oromia. This is agro-climatically characterized as high land. Chobi micro watershed is a community micro watershed and covered an area of 699ha. Farmland 424 (60.6%), Grazing 122 (17%), Homestead 72 (10.37%), Forest/woodlot 53 (7.6%), Hillside 25 (4%), Gully 3 (0.43%). Found within the range of 2600-2800 masl. This indicates that an area is characterized by Baddaa (highland) agro-climatic zone. The annual average RF of the district is 900-1400 mm (Caliya Agricultural Office, 2022) [1].

Location

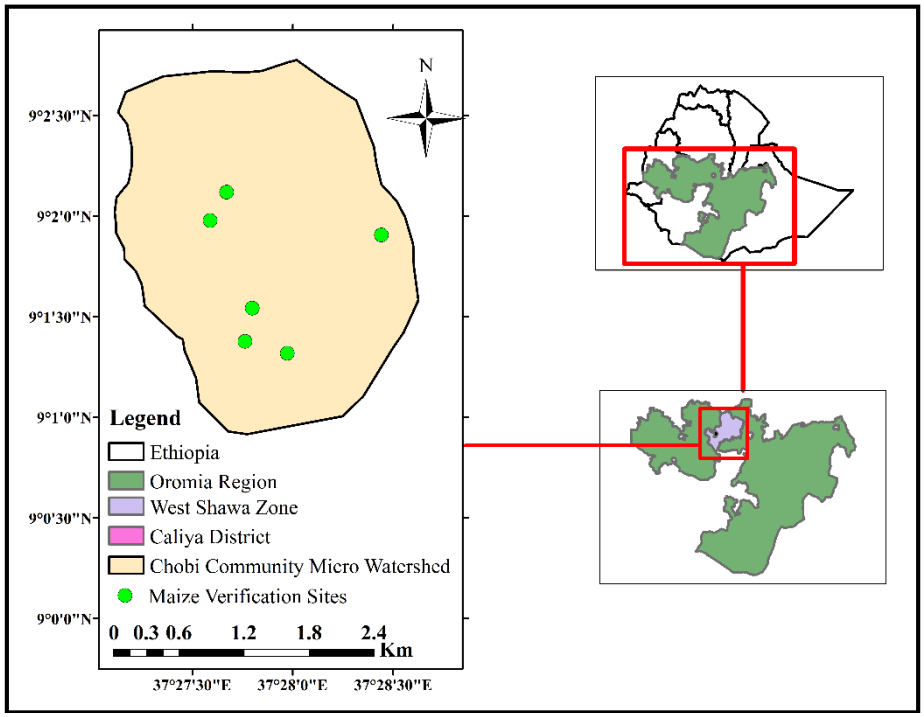

Fig 1: Selected Maize Verification Sites

Pre-sowing composite soil samples were collected from the selected areas to analyze for total nitrogen, available phosphorous and soil pH.

Treatment combinations

Treatment 1: STBCRFR (Pc=14.5 and Pf=5.5) and 200 kgha^{-1} Urea

Treatment 2: Blanket recommendations (100 kgha^{-1} NPS and 100 kgha^{-1}Urea)

Treatment 3: Negative control (no fertilizer application)

Plot Size: Sown on 10mx10m for each treatment and replicated over ten farmers' fields and BH-661 maize hybrid variety released from Bako Agricultural Research Center was used as test crop.

Data to be collected

These treatments will be applied and replicated over 10 farmers' fields existing in the watershed for each treatment. Pre-sowing soil samples, sowing date, 50% flowering date, 90% maturity date, yield and yield components was evaluated. The data was analyzed by using GenStat 18th edition statistical software and LSD is used for mean separation.

Results and Discussion

The trial was conducted on ten (10) sites/farmers' fields during 2023/2024 cropping season. Pre-sowing composite soil sample was collected from the selected areas to analyze for total nitrogen, available Phosphorous and soil pH.

Fig 2: Photo taken during evaluation of the trial

The cumulative mean values of biomass yield of 4250 kg/ha, 20925 kg/ha and 25325 kg/ha result was recorded from negative control, farmer practices and STCPR, respectively. On the other hand, cumulative mean values for grain yield of 1802 kg/ha, 4680 kg/ha and 8195 kg/ha result was recorded from negative control, farmer practices and STCPR, respectively (Table 1).

Table 1: Cumulative Mean Values for Maize Verification trial at Chobi Community Micro Watershed (2024)

S/N	Treatments	Biomass Yield (kg/ha)	Grain Yield (kg/ha)	HI
1.	Control	4250	1802	0.42
2.	Farmer practices	20925	4680	0.22
3.	STCPR	25325	8195	0.32

All FRG members and neighboring farmers, develop agents, district experts and researchers were closely evaluate the performance of soil test crop response based on their own criteria. The farmers' feedback or farmer's perception was collected during demonstration. At the end of the evaluation process, result of the evaluation was displayed to the evaluators, and discussion was made on the way ahead. Number of cob per plant, disease tolerant and other traits were considered as the most selection criteria for each of maize under different practices (Table 2-4; Fig. 2).

Table 2: Pair-wise farmers' preference ranking for maize under different practices in the district

Selection Criteria	1	2	3	4	5	6	7	8	9	10	Frequency	Rank
1		1	1	1	1	1	1	1	9	1	8	2nd
2			2	2	5	2	2	2	9	2	6	4th
3				4	5	6	7	8	9	10	0	7th
4					5	6	4	4	9	4	3	4th
5						5	5	5	9	5	7	3rd
6							6	6	9	6	5	5th
7								7	9	7	3	6th
8									9	8	2	7th
9										9	9	1st
10											1	8th

N. B. 1= Disease tolerant, 2= Lodging tolerant 3= Early maturity, 4=Cob length, 5= Number of cob/plant, 6= Grain color, 7= Crop stand, 8= Stay greenness; 9= high yielder and 10= Grain size;

Table 3: Score ranking of different practices under maize by farmers in the district

Practices	Caliya			Overall Rank
	Total Score	Mean Score	Rank	
Maize under soil test based (critical P)	53	5.3	1st	1st
Maize under farmers' practice	43	4.3	2nd	2nd
Control	36	3.6	3rd	3rd

N. B. 1= Disease tolerant, 2= Crop stand (Lodging tolerant) 3= Early maturity, 4=Cob length, 5= Number of cob/plant, 6= Grain color, 7= Crop stand, 8= Stay greenness; 9= high yielder and 10= Grain size

Table 4: Farmers' reasons for ranking and selection of maize under different practices

No	Practice	Rank	Reasons
1	Maize under soil test based	1st	High yielder, disease tolerant, lodging tolerant, high number of cobs per plant (mostly two cobs per plant), good plant stand, good cob length
2	Maize under farmers' practice	2nd	Medium yielder, medium in disease tolerant, medium in lodging tolerant, medium number of cobs per plant (mostly 1 cob per plant), medium plant stand, medium cob size
3	Control	3rd	Low yielder. Low in cob per plant mainly small in size, small seed size and forced maturity

Marginal rate of returns (MRR) were found to be 836% for soil test based P fertilizer rate and 277% for farmers practices. The economic analysis showed that the highest net income (217500birr) was obtained from soil test based P recommendation with marginal rate of return (836%) which is greater than the minimum rate of return (MRR) 100% (CIMMYT, 1988). Based on this result, partial budget analysis indicated that soil test based P recommendation is economically feasible for maize production in Caliya district at Chobi Community micro watershed (Table 5).

Table 5: Partial Budget Analysis

Treatment	Urea N (kg/ha)	NPSB (kg/ha)	MGY (kg/ha)	TVC (Birr/ha)	FB (Birr/ha)	NB (EB/ha)	MRR (%)
Control	0	0	1802	3500	54060	50,560	-
FP	100	100	4680	6500	140,400	133,900	277
STBFR	200	100	8195	7500	245,850	217500	836

NB: MGY= Mean Grain Yield, TVC=Total Variable Cost, GFB= Gross Field Benefit, NB= Net Benefit, MRR= Marginal Rate of Return

Conclusion and Recommendations

From the result, it was observed that maize production based on soil test crop response based is relatively higher in measured parameters than that of farmers' practices and the control treatments. Accordingly, the farmers existing in the watershed should be advised to produce maize based on calibrated phosphorus than that of farmers practice and the control treatments. So that, to popularize the technology demonstration of this result in Caliya District at Chobi Community micro watershed is paramount important.

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