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Research Article

Pre-extension Demonstration of Soil Test Crop Response Based Phosphorous Calibration Study for Maize Production (*Zea mays L.)* at Abay Choman District, Western Oromia, Ethiopia

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Abstract

Pre Extension demonstration was held in the Abay Choman district to show how using soil tests can help decide the right amount of phosphorus fertilizer for growing maize. The goal was to create awareness about why soil tests are important for maize production and to gather feedback from farmers and others stakeholders for future improvements in technology. The test was done on the fields of seven farmers, which were used to repeat the experiment. There are two treatments: (T1) blanket recommendation and (T2) a recommendation based on a soil test that indicates how much phosphorus fertilizer to use, along with a recommended nitrogen fertilizer amount of 92 kg per hectare. Plot size for each treatments was 10 m x 10 m = 100 m^2. Maize variety "BH-661" was used with the spacing of 50 cm and 80 cm between seeds and rows respectively. A total of 4 FRGs units which are having 43 male and 17 female members were established. For gender issue 22.1% of the participants were women and 77.9% were men. A grain yield of 6275 kg per hectare was recorded as the most favorable when fertilizers were utilized based on soil analysis. The application of a standard fertilizer led to a yield of 5,136 kilograms per hectare. The average grain yield obtained with soil test crop response based suggested phosphorus fertilizer was 6275 kg/ha with yield advantage of 22.17% over blanket recommendation. Moreover, financial investigation result appeared that net of return 119162.00 and 98850.00 ETB per hectare were picked up from soil test crop response based p-fertilizer suggestion and blanket recommendation respectively. Based on these actualities, the scaling up/out of soil test crop response based suggested P-fertilizers should be carried out for encourage maize generation at the study area.

Keywords

Pre-extension, Soil Test, Fertilizer Recommendation, Maize, Blanket Recommendation, FRG

1. Introduction

Maize (Zea mays L.) is one of the most vital cereals broadly adjusted around the world [3]. Universally, maize is known as queen of cereals since it has the most elevated hereditary abdicate potential among the cereals. It is one of the foremost

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imperative cereal crops utilized within the human count calories in expansive parts of the world and it is a vital bolster component for animals. It is also used as industrial raw material for oil & glucose production [5]. Maize grain has more prominent wholesome esteem because it contains 72% starch, 10% protein, 4.8% oil, 8.5% fiber, 3.0% sugar and 1.7% cinder. Maize is the single most imperative crop in terms of both number of farmers engaged in development and crop yield [7].

Low soil fertility is one among the major components constraining maize generation and efficiency in western Oromia, Ethiopia [15]. In most of maize producing zones within the world, inorganic fertilizers are depended upon to move forward crop yields and keep up soil fertility. Over abundance and inadequately uses of fertilizers result in serious supplement consumption of soils and reduce the production and productivity of maize. [9]

Soil test based fertilizer recommendation plays a crucial part in guaranteeing adjusted nutrition to crops [8]. It is broadly accepted that financial ideal fertilizer application can as it were be accomplished by creating suitable fertilizer recommendation that takes into thought the nutrient status of individual field [11]. Right now there are no site-specific fertilizer recommendations for the diverse soil-crop climatic conditions [4]. Soil test based phosphorus calibration study was conducted at Abay Choman District on Maize by Nekemte Soil Research Center for three years. Under research circumstances once modern technologies are released and confirmed, the next step is conducting pilot test/demonstration on a little number of farmers field.

Abay Choman district was chosen for pre-extension demonstration of soil test based phosphorus suggestion. The research activity will be conducted with the aim of demonstrate the technology by using both method and result type of demonstration and fill the gap between released technology and end users through FRGs and also create awareness for farming communities in order to break traditional fertilization. As a result reported by [14] the yield (76.22 Qt/ha) was obtained from soil test based fertilizer recommendation rates. Accordingly, the result of pre extension demonstration of soil test crop response based fertilizer recommendation will be conducted some time recently advance popularization in order to assess and make mindfulness within the community.

Objective

1) To create awareness on the significance of soil test based crop response fertilizer suggestion rate for maize production within the consider range.
2) To assess farmers and other partners input for encourage technology advancement

2. Materials and Methods

2.1. Description of Study Area

The study was carried out on farmer's fields in Abay choman District. The district found at 9° 31' 42'' to 9° 59' 48'' N latitude and 37° 10' 03'' to 37° 28' 44'' E longitude and capital of the district Fincha town is 289 kms northwest of Addis Ababa. The range gets tall precipitation in one season of the year [2]. The height of the ponder region ranges from 1061 to 2492 meters over ocean level (masl) with two agro biological zones mid-highland and low land [2]. The least and most extreme temperatures of the area are 13.4 and 27.2℃, individually, and the cruel yearly precipitation is 1399 mm. The region has uni-modal precipitation design.

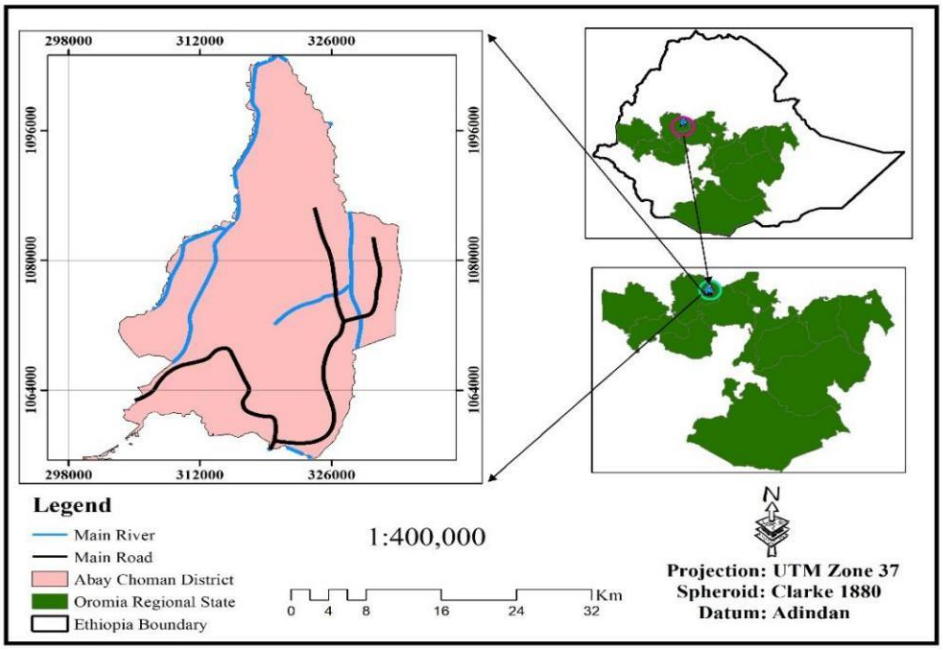

Figure 1. *Outline of the study area.*

2.2. Experimental Strategies and Treatments

The experiment was conducted on farmer's fields and consisted of two treatments where, (T1) blanket recommendation and (T2) soil test crop response based phosphorus fertilizer recommendation. Maize assortment "BH-661" was planted utilizing seed rate of 25 kg ha-1. Suggested optimum N-fertilizer rate of 92 kg ha-1 was applied with part application of 1/3 amid sowing and 2/3 will be applied at 30-35 days after planting [1]. The land size that was demonstrated plots applied is 10 m x 10 m=100 m^2. The spacing between plots, blocks, plants and rows were 50 cm, 1 m, 50 cm and 80 cm respectively. The experiments were done on 7 farmer's fields across the district.

2.3. Soil Sampling and Analysis

Soil samples were taken from farmers' fields using standard methods to check for available phosphorus. The samples were obtained from the fields at a depth between 0 and 20 cm. The samples which having initial available phosphorus below critical concentration determined for the district was selected to conduct the experiment. Then Phosphorus fertilizer rate was calculated by using the formula given below. Amount of phosphorus (kg/ha) = (Pc-Pi) *Pf; Where; Pc - Critical phosphorus concentration 12 ppm, Pi - Initial available Phosphorus P_{rf} - Phosphorus requirement factor which was derived from the calibration study 10.55.

2.4. Data Collected and Types

Data was gathered by observing in the field, interviewing people one-on-one, and having group discussions. We used checklists and data sheets to help with this process. Quantitative data included things like how much grain was produced, the costs involved, the benefits received, the total number of farmers who took part in extension events like farmer groups, training sessions, field visits, and mini field days, as well as the participation and role of stakeholders in showing and assessing new technology. Farmers' thoughts and opinions about how well the technologies worked were gathered.

2.5. Technology Demonstration, Evaluation Techniques and FRGs Establishment

One FRGs comprising 10 to 15 members of mixed genders was established in every site. We looked at gender balance in each FRG. Members of FRGs and other farmers were encouraged to join various events and activities held at each demonstration site. Training was provided on why it's important to use soil tests for fertilizer recommendations and the best farming practices to follow when growing maize. These were ways to help farmers learn from each other and share information, like training sessions, field visits, sharing experiences, and field days to show their work.

2.6. Data Management and Analysis

Data which was collected from the fields were properly managed and analyzed through different methods. We analyzed the gathered numbers using basic statistics like the highest and lowest values, average, and a specific budget analysis from CIMMYT [4]. We gathered farmers' perspectives by sharing their narratives.

3. Results and Discussion

3.1. Soil Physical Properties of the Test Field

3.1.1. Soil Ph

The soil pH in the study area was very acidic to strongly acidic, with values between 4.48 and 5.05 based on the ratings provided [13]. So, the pH of the test soil was good for farming.

3.1.2. Available Phosphorus

The phosphorus levels in the soil were low to medium, measuring between 3.43 and 10.43 parts per million (ppm), based on the ratings shown in [10]. Table 1. So, the soil in the study areas needs fertilizers that have phosphorus to help grow crops.

Table 1. *Selected experimental soil properties before planting in Abay Choman District.*

Experiment Sites	PH (H_2O)	Av. P(ppm)
1	5.05	9.91
2	4.99	3.43
3	4.86	6.48
4	4.63	10.43
5	4.60	5.46
6	4.48	4.47
7	4.86	7.45

3.2. Establishment of Farmers Research Group (FRGs)

During usage of the activity farmers were organized beneath farmers research group (FRGs). A total of 4 FRGs units which are having 43 male and 17 female individuals were built up. For gender issue 22.1% of the members were women agriculturists and 77.9% were men. They were capacitated

with diverse trainings, involvement sharing and on working together to construct their capacity to illuminates their issues by themselves.

Table 2. Number of established farmers research group and members.

District	Kebele	FRG established	Members of FRG		
			Male	Female	Total
Abay Choman	Achane	1	10	5	15
"	Jare	1	11	4	15
"	Ganji haro	2	22	8	30
Total	3	4	43	17	60

3.3. Provision of Training

Training was given on soil test crop response based phosphorus fertilizer application technology, for farmers, DAs and SMS. A total of 31 farmers and 2 agricultural experts were taken training. (Table 3)

Table 3. Number of members took training.

Topic of the training	Location	Farmers		DAs		SMS		Total
		M	F	M	F	M	F	
Soil test crop response based fertilizer suggestion and soil acidity management	Abay Choman	20	11	1	-	1	-	33

3.4. Yield Performance of the Field

3.4.1. Average Grain Yield

The highest mean grain yield (6275 kg/ha) was obtained from the soil test crop response based fertilizer recommendation and (5136 kg/ha) was gained from blanket fertilizer application. As reported by [12] the result of the trial conducted at Chora district showed that maize grain yield was higher (68 qt ha-1) with application of optimum 92 kg ha-1N and site-specific Phosphorus fertilizer recommended.

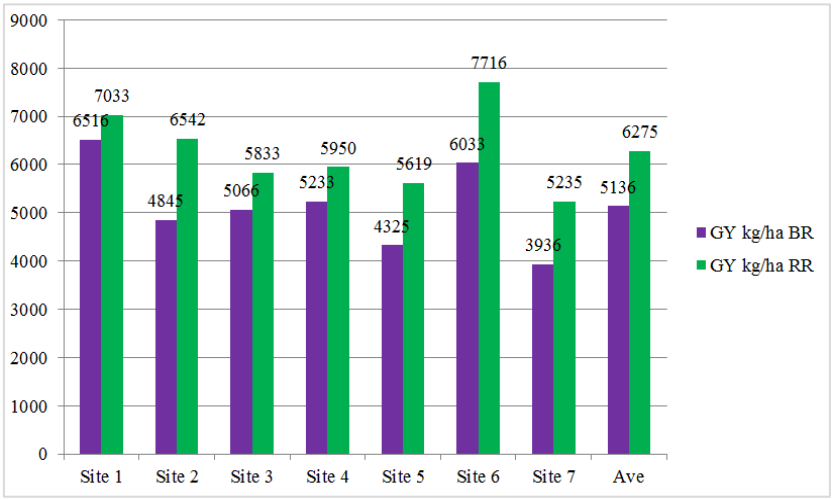

Figure 2. Average maize grain yields over the demonstration sites.

3.4.2. Grain Yield Advantage

Dagnachew Lule reported that, soil test crop response based fertilizer recommendation shows the higher yield as compared to blanket fertilizer recommendation [6]. The research finding appears soil test crop response based fertilizer suggestion was gives 22.1% yield advantage over the blanket type of fertilizer application. Yield advantage of the demonstrated technology was calculated utilizing the following equation.

$$Yield\ advantage\% = \frac{Yield\ of\ STCRBFR - Yield\ of\ blanket\ recommendation}{Yield\ of\ blanket\ recommendation} * 100$$

Table 4. *Average grain yield and Yield advantage obtained in Abay Choman District.*

Treatments	Average yield kg/ha	Yield difference kg/ha	Yield advantage over blanket recommendation (%)
Blanket Recommendation	5136	1139	22.17
STCRBFR	6275		

Where; STCRBFR = Soil test crop response based fertilizer suggestion

3.5. Farmers' Perception

The opinion of farmers was collected from participants during training. Farmers in the study area selected the best performing technology by using their own criteria. The major criteria used: Grain yield, leaf color, plant height, number of cob per plant, cob size, disease resistance and its biomass. Therefore, most of the farmers were selected soil test based fertilizer application to use on their farm fields for the future. (See Table 5)

Table 5. *Rank of demonstrated technology.*

Technology	Farmers rank	Reasons
STCRBFR	1st	High grain yield, double cob per plant, large cob size, disease resistance and good biomass
BR	2nd	Medium grain yield, single cob per plant, medium cob size, disease resistance and medium biomass

Where; STCRBFR = soil test crop response fertilizer recommendation, BR= blanket recommendation.

4. Conclusion and Recommendation

The test was conducted in Abay choman district on 7 farmer's field for two continuous trimming seasons. Four FRG were established in purposively chosen kebeles and training was given on the subject of soil test based crop response fertilizer proposal for agriculturists, development agent, experts and partners in the district. From the test, the highest mean grain yield (6275 kg/ha) was gotten from the soil test crop response based fertilizer suggestion with 22.17% of yield advantage over the cover fertilizer proposal. Based on these realities, the scaling up/out of soil test crop response based prescribed P-fertilizers ought to be carried out for encourage maize production at the consider area.

Abbreviations

BH-661	Bako Hybrid 661
BR	Blanket Recommendation
ETB	Ethiopian Birr
FRG	Farmers Research Group
NSRC	Nekemte Soil Research Center
OARI	Oromia Agricultural Research Institute
Ppm	Parts Per Million
STCRBFR	Soil Test Crop Response Based Fertilizer Recommendation

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Conflict of Interests

The authors declare no conflicts of interest.

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