Original Research Article

Optimum Yaramila ($N_{23}P_{10}S_5$) blend formulation and its fertilization for growth and yield of wheat in Enderta district, South Eastern Tigray.

ABSTRACT

Fertilizer use in Ethiopia has focused mainly on the application of nitrogen and phosphorous fertilizers in the form of di-ammonium phosphate and urea for almost all cultivated crops for the last several years. Such unbalanced application of plant nutrients may aggravate the depletion of other important nutrient elements in soils such as S and micro-nutrients. So this trial was conducted in Tigray region Enderta district with the objective of evaluating Yaramila (23-10-5, N: P_2O_5: S) and its rate on yield of wheat crop. In this trial five treatments was included and it was laid out in Randomized Complete Block Design (RCBD) with three replications. Data collected on biomass and grain yield was analyzed by SAS verion9 statistical software.

The results indicated that biomass, grain, and straw yields of wheat responded to the additional yaramila levels. But, these levels did not beat recommended NP and the maximum grain yield was obtained at the recommended NP. The yaramila@200kg/ha level has almost equal level N and P with the recommended NP and additional sulfur levels but the yield and yield components of wheat were not significantly higher than recommended NP even with additional NP adjusted. This implies that either the sulfur or the formulation of blending decreased nitrogen and phosphorus efficiency. Hence, nitrogen and phosphorus are the yield limiting nutrients rather than sulfur for wheat in the study area. Moreover, Yaramila blended based on this formulation as source of sulfur is not suitable fertilizer for wheat growth in the study. So, other alternative sources of sulfur rather than yaramila should be used for wheat production in the study sites.

Keywords: Yaramila, Blend, Wheat, Fertilization, Enderta

1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is an important food crop in Ethiopia,next to Maize. According to Central Statistical Authority [1]of Ethiopia the crop accounts for 15.65% of the total cereal output. However, its productivity is low due to depletion of nutrients and is insufficient to meet the domestic needs of the people in the country [2]. As a result, for the past several years, farmers in the country had used blanket recommendation of only Urea and DAP (Di Ammonium Phosphate) as an input to improve soil fertility and increase crop production including wheat. On the other hand, reports by [3] depicted that application of N& P fertilizers alone leads depletion of such as sulfur in soils.

In various parts of the world sulfur deficiency has reported in declining of yield and yield quality of the crops. Researches pointed out that S deficiency can adversely affect plant growth and grain quality of durum wheat through its effect on protein composition [4]. Besides, in Ethiopia, application of S with N significantly affects the yield and yield components and grain protein content of rice [5].

Sulfur deficiency was not reported in Ethiopia for many years. In contrast, in recent years the soil map reports which were developed by Ethiopian Soil Information System (EthioSIS) indicated a sulfur deficiency in various areas of the country including Tigray region [6]. Inline to this, various efforts were made to include S fertilizer through the introduction of S containing blended fertilizers produced in the country. However, the application rate for various districts in a region is the same and does not consider soil type variability. Moreover, there was no adequate evidence which justifies whether the recommended rates of S containing blend (yaramila [23 N: 10P205: 5S]) in the blend formula meets the crops nutrient demand or not in. Thus, this study was designed to investigate the optimum level of Yaramila fertilizer for yield increment of wheat in Vertisols of Enderta districts of Tigray region.

2. MATERIALS AND METHODS

2.1. Study area

The experiment was conducted on Cambisols of Enderta district, south eastern Tigray. Geographically, the district is located between 13˚12'55" and 13˚38'38" N latitude and 39˚16'43" and 39˚48'08" E longitudes. The average elevation of the district is about 2200 m above sea level [7]. The growing season of 2012 had received a relatively lower rainfall compared to the long term average, since the area was among those affected by El-Nino. The mean annual temperature ranges between 11.5 and 24.4 ˚C.

2.2. Experimental design and procedures

The experiment comprised 5 treatments (T1=control, T2= Rec NP, T3=Yaramila @150Kg/ha

T4= Yaramila @200Kg/ha and T5= Yaramila @200Kg/ha + N P adjusted to recommended rate.
These treatments were laid out in Randomized Complete Block Design (RCBD) with three replications. The plot size was 3m by 3m with spacing of 1m between blocks and 0.5m between plots based on recommendations set by Mekelle soil research center. The yaramila and phosphorus fertilizers were applied at planting, while the nitrogen fertilizers was applied twice during the crop growth stage that is 1/3 of the full dose at planting and the other 2/3 at the full tillering stage. In the trial, picaflour (Kakaba) bread wheat variety was used as a test crop.

The initial soils of the experimental field were analyzed for texture, pH, organic matter, cation exchange capacity (CEC), total nitrogen, and available phosphorus. The methods used for soil physical and chemical analysis were Soil pH [8], Organic carbon % [9], soil texture by hydrometer [10], available Phosphorus [11], total nitrogen by Kjeldhal method [12] and Neutral Ammonium acetate method [13] for cation exchange capacity. Data on biomass and grain yield were collected.

2.3. Data analysis

Analysis of variance (ANOVA) was carried out using Statistical Analysis Software (SAS) version 9. Whenever treatment effects were significant, mean separations were made using the least significant difference (LSD) test at the 5% level of probability.

3. RESULTS AND DISCUSSION

3.1. Soil properties before planting

The soil of the study sites are clay and clay loam in texture [10]), neutral in pH, low in carbon and total nitrogen [14], low in available P [11], and high in CEC [13].

Table 1: Soil physio- chemical properties of the site before sowing

Parameters	Site1	Site2	Site3
pH_{water}(1:2.5)	7.23	6.95	6.9
Organic Carbon (%)	0.54	0.64	0.72
Total N (%)	0.12	0.06	0.05
PvailableP-Olsen(mg/kg)	3.64	2.88	4.6
CEC (Cmol+/Kg)	32	33	35
% Sand	27	25	19
% Silt	29	35	26
% Clay	44	40	55
Textural class	ClayLoam	Clay Loam	Clay

3.2. Biological yield (total above ground biomass) and grain yield

Results depicted that yield and yield components of wheat was increased with increased application level of yaramila (23:10:5 N: P2O5: S) as shown in the figure1 below. Moreover, adjusting the level of NP with yaramila increased biomass, grain, and straw yields of wheat in the study area. However, the highest biomass, grain, and straw yields of wheat were recorded at the recommended NP as compared with all of the treatments. The lowest yield and yield components of wheat were recorded at control treatments.

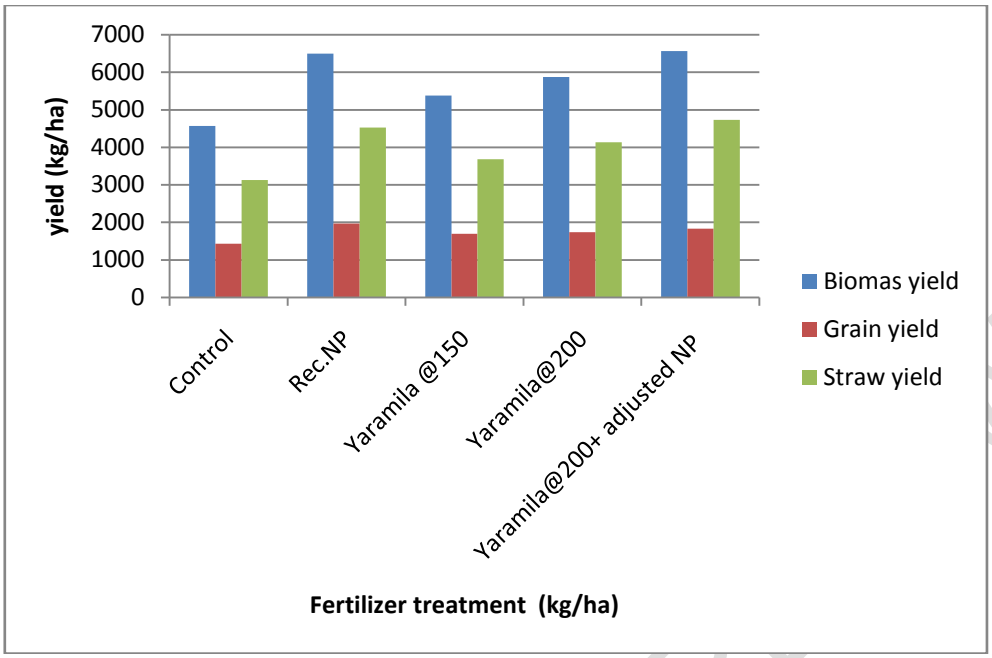

Figure1. Biomass, grain and straw yield of wheat as influenced by fertilizer application

Application of yaramila @ a rate of 200kg/ha with adjusted NP significantly (*P= 0.05)* increased biomass, grain and straw yield of wheat in the study area even though it is not significantly different with recommended NP (Table2). On the other hand, the highest grain yield of wheat was recorded at the recommended NP. These results indicated that even if yaramila increased yield and yield components of wheat it could not beat the recommended NP in all yield parameters of wheat in the study area. Yaramila@200kg/ha level has almost equal level N and P with the recommended NP and additional sulfur levels but the yield and yield components of wheat were higher in the Recommended NP. This showed that either the formulation of this blending or the level of sulfur decreased the nitrogen and phosphorus efficiency.

Table 2. Effect of yaramila level on biomass and grain yields of wheat

Treatment) ***(kgha-1)***	***Biomas yield*** ***(kgha^{-1})***	***Grain yield*** ***(kgha^{-1})***	***Straw yield*** ***(kgha^{-1})***
Control	*4567.9c*	*1436.4b*	*3131.5c*
Rec.NP	*6493.8a*	*1969.8a*	*4524.1a*
Yaramila @150	*5382.7bc*	*1700ba*	*3682.7bc*
Yaramila@200	*5876.5ba*	*1737.7ba*	*4138.9ba*
Yaramila@200+ adjusted NP	*6567.9a*	*1832.7a*	*4735.2a*
Mean	***5777.78***	***1735.31***	***4042.469***
CV	***18.15***	***22.52***	***18.89***
Pvalue	***0.00***	***0.005***	***0.003***

Means followed by the same letter along columns are not significantly different. RecNP: Recommended nitrogen and phosphorus fertilizer CV: coefficient of variance.

4. CONCLUSIONS

The study was aimed at optimum rates of yaramila fertilization for wheat yield in Cambisols of Enderta district. The results indicated that biomass, grain, and straw yields of wheat responded to the additional yaramila levels. But, these levels did not beat recommended NP and the maximum grain yield was obtained at the recommended NP. The yaramila@200kg/ha level has almost equal level N and P with the recommended NP and additional sulfur levels but the yield and yield components of wheat were not significantly higher than recommended NP even with additional NP adjusted. This implies that either the sulfur or the formulation of blending decreased nitrogen and phosphorus efficiency in the study area. Hence, further detail researches should be done on the nitrogen and phosphorus levels with their interaction and method of application. These NP are the wheat yield limiting nutrients rather than sulfur in the study area.

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