

Evaluation of Different Blended Fertilizers Types and Rates for Better Production of Wheat in Lemu Woreda

Yehuala Alemneh^{1,*}, Zerihun Achiso², Tsadiku Bamud²

Southern Agricultural Research Institution, Areka Agricultural Research Center, Wolyita, Ethiopia

Email address:

*Corresponding author

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Abstract: Ethiopia is likely to rely on the agricultural sector as a source of income and employment for the foreseeable future requiring optimal and up to date fertilizer recommendation packages for all crops given the fact that increasing small holder farmers' productivity. The field experiment was conducted during 2017/18 cropping season at Hadiya zone lemu woreda testing site of Areka Agricultural Research center, southern Ethiopia to evaluate the effect of blended fertilizer on yield of wheat with the treatments of six replicated three times in RCBD design. The treatments were: control (no fertilizer), NPS (92 N, 54 P₂O₅, 10 S), and four rates of NPSB (46 N, 54 P₂O₅, 10 S, 1.07 B; 69 N, 72 P₂O₅, 13 S, 1.4 B, and 92 N, 90 P₂O₅, 17 S, 1.7 B). The plot size was 4 m by 4 m (16 m²) and the spacing between plots and blocks was 50 cm and 100 cm, respectively. The result of this experiment has substantiated the importance of application of NPSB (combination of B with macronutrients NPS) fertilizers in improving yield of wheat in the study area. Despite the need of verification in multi-locations and soil types for wider use, application of NPSB can be recommended for wheat production in the study area.

Keywords: Blended, Wheat, Fertilizer, Cereal Productivity

1. Introduction

About one third of the world population consume wheat as staple food [1] and as compared with other cereal crops, it is reach protein and providing more [2].

Wheat (*Triticumaestivum*L.) is an important food crop in Ethiopia, which accounts for 15.65% of the total cereal output [3]. However, the national average of wheat is (2.54 t ha⁻¹) in 2015 [4], this very low compare with world average. Crop productivity minimal is due to depletion of nutrients, and poor management practices [5].

Ethiopia is likely to rely on the agricultural sector as a source of income and employment for the foreseeable future requiring optimal and up to date fertilizer recommendation packages for all crops given the fact that increasing small holder farmers' productivity entails the integration of improved technology and adoption. Nutrient mining due to sub optimal fertilizer use coupled with imbalanced fertilizer uses have favored the

emergence of multi nutrient deficiency in Ethiopian soils [6], which in part explain fertilizer factor productivity decline and stagnant crop productivity conditions encountered despite continued use the blanket recommendation. The research result from eastern Uganda also showed that the use of low levels of N and P fertilizers on maize and beans was the leading factor for nutrient depletion [7, 8]. Balanced fertilizers containing N, P, K, S, B and Zn in blend form have been recommended to ameliorate site specific nutrient deficiencies and there by increase land, water and labor productivity. The work of Wassie and Shiferaw [8] in southern Ethiopia provides a striking example of how fertilizer use efficiency of potato can be raised when NP fertilizers are combined with K on a location-specific basis. In this study supplementation of K increased potato tuber yields by 197% over the standard N-P recommendation alone. The recent national soil inventory data also revealed S, B and Zn deficiencies are

widespread in Ethiopian soils, while some soils are also deficient in K, Cu, Mn and Fe [9], which all potentially hold back crop productivity. However, fertilizer trials involving multi-nutrient blends that include micronutrients are rare. Very recently, a soil test based fertilizer recommendation and calibration efforts have been made by EIAR and RARIs but only limited to certain location and crop types.

According to EthioSIS fertilizer type recommendation map/atlas, eight types of fertilizer blends are identified for SNNPRS. Similarly four types of fertilizers for Lemuwareda and one types of fertilizer /blends were identified for Bobichokebele. But this needs validation for the fertilizer rates for the identified fertilizer types for specific crops. Therefore, this study was initiated with the objectives of (1) Evaluate the relative influences of NPSB on wheat production and (2) Determine optimum rate NPSB for production of wheat in Lemuwareda.

2. Materials and Methods

2.1. Experimental Details and Treatment Set-ups

On station experiment was carried out for two years (2016 & 2017) at sub-station, Lemuwareda, Hadiya zone to evaluate the yield response of wheat to application of different soil fertility map based blended fertilizer types and rates. The treatments were laid out in RCBD replicated three times across farmers. Six treatments: control (no fertilizer), NPS (92 N, 54 P₂O₅, 10 S), and four rates of NPSB (46 N, 54 P₂O₅, 10 S, 1.07 B; 69 N, 72 P₂O₅, 13 S, 1.4 B, and 92 N, 90 P₂O₅, 17 S, 1.7 B). The plot size was 4 m by 4 m (16 m²) and the spacing between plots and blocks was 50 cm and 100 cm, respectively. Rate of NPSB blend was determined for production of wheat at Lemu and NPS was included for comparison purpose. NPS and NPSB fertilizers were applied at planting whereas urea fertilizer is top dressed after 45 days of planting the test crop. The improved wheat variety Hidase was drilled in rows of 20 cm after fertilizers drilled and thinly cover by soil. All field managements were carried as per the recommendation of the area and all field observations were recorded.

Table 2. Mean (combined over years) wheat yield and yield components as influenced by different blended fertilizer types and rates in Lemu woreda.

| Trt No. | Treatments | Plant height (cm) | Spike length (cm) | Tiller no | Biomass (tone/ha) | Grain yield (kg/ha) |
|---------|-------------------------|-------------------|-------------------|-----------|-------------------|---------------------|
| T1 | Control | 79.4b | 7.6b | 2.7b | 5.75b | 3093.7b |
| T2 | NPS = 92, 54, 10 | 87.6a | 8.1ab | 3.6ab | 7.60a | 3687.4a |
| T3 | NPSB = 46, 54, 10, 1.07 | 89.6a | 8.2ab | 3.7a | 7.79a | 3635.3a |
| T4 | NPSB = 69, 72, 13, 1.4 | 86.03ab | 8.4a | 4.14a | 8.06a | 3676a |
| T5 | NPSB = 92, 90, 17, 1.7 | 85.9ab | 8.5a | 3.3ab | 7.58a | 3614.4ab |
| T6 | NPSB = 92, 36, 10, 1.07 | 86.9a | 8.1ab | 3.5ab | 7.24a | 3343.6ab |
| | Mean | 85.9 | 8.18 | 3.5 | 7.34 | 3508 |
| | CV | 6.47 | 7.35 | 22.5 | 15.31 | 12.84 |
| | LSD | 6.59 | 0.71 | 0.94 | 1.33 | 534.04 |

Two years mean yield and yield components results of wheat are presented in table 2. Significant differences were observed among treatments over control (P<0.05), however,

2.2. Soil Sampling and Analysis

Composite surface (0-20 cm depth) soil samples were collected from each experimental site before planting and from each treatment at harvesting using auger for selected physic-chemical analysis. The collected samples were properly labeled, packed and transported to the Soil laboratory and were prepared and analyzed according to the standard procedures. [10].

2.3. Agronomic Data Collection

Data were collected from the experiment on growth, yield and yield component related parameters on plot and plant basis. Plant height (cm), spike length (cm), tiller number/plant biomass and grain yields were recorded and subjected to analysis of variance (ANOVA).

2.4. Data Analysis

ANOVA was carried out using SAS version 9.2 statistical software programs. Significant difference between and among treatment means were assessed using the least significant difference (LSD) at 0.05 level of probability [11].

3. Results and Discussion

Soil Chemical Properties of Experimental Sites

Composite surface (0-20 cm depth) soil samples were collected from each experimental site before planting. Some selected soil chemical properties of experimental sites and their summary are presented below table.

Table 1. Initial soil sample result.

| pH | %OC | %TN | P.ppm | kav.ppm |
|------|-----|------|-------|---------|
| 6.05 | 1.3 | 0.11 | 41.1 | 84.5 |

The pH of the soil is 6.05 slightly acidic and satisfactory for most crops [12].

Total nitrogen of the study areas was 0.11% that qualify for adequate as suggested [13].

Available Phosphorus is 41.1 very high according to classification of Olsen 1954 [14].

there were no significant difference between fertilizer types (NPS single rate and NPSB –four rates) and among different rates of NPSB for all tested parameters.

Application of NPS @ 92 N, 54 P₂O₅, and 10 S equally affected grain yield of wheat at Lemu with application of NPSB @ 46, 54, 10, and 1.07 and other rates of NPSB which needs further investigation. From view point of soil fertility map fertilizers type rate determination of NPSB, NPSB @ 46, 54, 10, 1.07 gave comparable yield with its higher rates.

Partial budget analysis results indicated that application of

NPSB @ the rate of 46N, 54 P₂O₅, 10 S and 1.07 B gave highest net benefit and %MRR (Table 3). From our current field experiment and partial budget analysis result it could be concluded that application NPSB @ the rate of 46N, 54 P₂O₅, 10 S and 1.07 B could be recommended for wheat production and economically feasible in Lemu woreda and similar agro ecology and soil types.

Table 3. Partial budget analysis of fertilizers on wheat at Lemu.

| No. | Treatment | grain yield | 10% Adjusted yield | gross benefit (ETB) | fertilizer cost | fert. Appln Cost | TVC | Net benefit birr/ha | MRR ratio | %MRR |
|-----|-------------------------|-------------|--------------------|---------------------|-----------------|------------------|--------|---------------------|-----------|---------|
| T1 | Control | 3093.7 | 2784.3 | 27843.3 | 0 | 0 | 0 | 27843.3 | | D |
| T6 | NPSB = 92, 36, 10, 1.07 | 3343.6 | 3009.2 | 30092.4 | 2127 | 500 | 2626.5 | 25578.7 | -0.862 | D |
| T3 | NPSB = 46, 54, 10, 1.07 | 3635.3 | 3271.8 | 32717.7 | 2550 | 400 | 2950 | 29767.7 | 12.95 | 1294.8% |
| T2 | NPS = 92, 54, 10 | 3687.4 | 3318.7 | 33186.6 | 3150 | 600 | 3750 | 29436.6 | -0.414 | D |
| T4 | NPSB = 69, 72, 13, 1.4 | 3676 | 3308.4 | 33084 | 3475 | 500 | 3975 | 29109 | -1.456 | D |
| T5 | NPSB = 92, 90, 17, 1.7 | 3614.4 | 3253.0 | 32529.6 | 3914 | 600 | 4513.7 | 28015.9 | -2.03 | D |

4. Conclusion and Recommendation

Low and/or unbalanced inorganic fertilizers use was major cause for low production of crops and nutrient mining of the soils. Replenishment of deficient fertilizer nutrients based on soil test is a good strategy to improve crop production productivity in sustainable way. From the near past (last five to eight years) identification of deficient nutrient elements of soil of the country by ATA (agricultural transformation agency) and formulation of different fertilizer types for the country helped the farmers to shift from urea and DAP use to more balanced/blended fertilizers (macro and micro nutrients) use. Some recent reports indicated that nutrients like K, S, Ca, Mg and micronutrients particularly Cu, Mn, B, Mo and Zn are becoming depleted and deficiency symptoms are being observed on major crops in different areas of the country. The result of this experiment also has substantiated the importance of application of NPSB (combination of B with macronutrients NPS) fertilizers in improving yield of wheat in the study area. Therefore, despite the need of verification in multi-locations and soil types for wider use, application of NPSB at rate of 46, 54, 10, 1.07 respectively can be recommended for wheat production at the study area.

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