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# Influence of balanced nutrients on growth performance and yield of Teff (*Eragrostis tef* (Zucc.)) in the midland of Bensa, Southern Ethiopia

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## Abstract

In Ethiopia aapplication of suboptimal levels of mineral fertilizers aggravates the decline in soil fertility. The aim of this study was to evaluate different blended fertilizer formulation and provide site and crop specific recommendations for teff production at Bensa in southern nation nationality and people regional state of Ethiopia. The experiment consists of five blended fertilizers (1) recommended NP (64 kg N + 30 kg P $ha^{-1}$) (2) 150 kg NPS (63N, 25P, 10.5 S) + 34.5 kg N $ha^{-1}$ (3) 150 kg NPSB (64N, 23P,10.1 S, 1.06 B) + 36.8 kg N $ha^{-1}$(4) 150 kg NPKSB (64N, 18P, 18K, 7.1S, 0.75B) + 43.24 kg N $ha^{-1}$(5) 150 kg NPSZnB(63N, 15P,7.6S, 2.23Zn, 0.37B) + 36.8 kg N $ha^{-1}$and (6) 150 kg NPKSZnB(63N, 17P, 18K, 7.6S, 2.23Zn, 0.37B) + 36.8 kg N $ha^{-1}$.The experiment was arranged in a randomized complete block design using 4 m by 4 m plot size and replicated across five farms. Agronomic data, including plant height, tiller number, straw yield, total biomass and grain yield were measured and using the SAS statistical package program version 9.0. The least significant difference (LSD) at 5% probability level was used to establish the difference among the means. To investigate the economic feasibility of the blended fertilizers, partial budget and benefit cost ratio were used. The current experiment revealed that balanced nutrient alone without appropriate proportion could not increase teff yield in the study area to the required level. On the other hand, blended fertilizer contain apposite P rate gave highest grain yield. Application of 150 kg NPS (63:25:10.5) + 34.5 kg N $ha^{-1}$ gave highest biological yield and the result was economically feasible. Therefore, application of 150 kg NPS + 34.5 kg N $ha^{-1}$ is recommended to use by farmers as an alternative soil management option for teff production around Bensa.

**Keywords:**blended fertilizers, teff, productivity, balanced nutrient, soil.

## INTRODUCTION

Ethiopia is among the most populous in Sub-Saharan Africa (SSA). Agriculture sector is of great economic importance to Ethiopia; however, it is characterized by low productivity and the prevalence of a fragmented smallholder/subsistence farmer population that is relegated to highly degraded/marginal lands [1]. The annual per-hectare net loss of nutrients is estimated to be at least 40 kg N, 6.6 kg P and 33.2 kg K [2]. Continuous cropping, high proportions of cereals in the cropping system, and the application of suboptimal levels of mineral fertilizers aggravate the decline in soil fertility [3-5]. Low productivity can be attributed to limited access by small farmers to agricultural inputs, financial services, improved productiontechnologies, irrigation and agricultural output markets and, more importantly, to poor land management practices that have led to severe land degradation [6].

In addition, locally available organic matter inputs have also become more limiting due to increasing demand for fuel and fodder, as well as lower biomass production driven by declining soil fertility and competing uses [7, 8]. Nutrient loss due to biomass energy consumption of dung and crop residues which otherwise added to the soil is equivalent to the total amount commercial fertilizer use in the country [6]. Livestock through grazing and crop residue consumption remove over 3 million tons nutrients [9, 10]. In turn livestock produces dung equivalent to 1.4 million tons of N, P2O5 and K2O [11], though very small fraction goes back to the soil due to its other competitive uses.Moreover, although many parts of East Africa have inherently rich soils, nutrient depletion through erosion and removal by crops over many years have resulted in very low productivity [12, 13].

To counteract the production and productivity problems, efforts have been made by the farmers in increasing use of inorganic and organic inputs. However, despite significant rise in total fertilizer import from 250,000 tons in 1995 to 500,000 tons in 2012 [14], the intensity of the fertilizer use has increased only marginally over the past decade from 31 kilograms per ha in 1995 to 36 kilograms per ha in 2008 which is still less than the blanket recommendation [15, 16].

Therefore, different fertilizer materials would be required to ensure balanced fertilizer use involving all or most of the nutrients required by crops. Experience in Malawi provides how N fertilizer efficiency for maize can be raised by providing S, Zn, B, and K which increased maize yields by 40% over the standard N-P recommendation alone[17]. In line with this [18] also reported how fertilizer use efficiency of potato can be raised when NP fertilizers are combined with K on a location-specific basis in southern Ethiopia. Supplementation of K increased potato tuber yields by 197% over the standard N-P recommendation alone. Therefore, it is crucial to investigate the effects of different blended fertilizers on teff yield and this study was initiated to determine the amount and types of fertilizers in order to improve teff production at Bensa area.

## MATERIALS AND METHODS

On farm study was conducted at Bensa district of South Nations Nationalities and People Regional State (SNNPRS) in 2015 and 2016 main cropping season. The experimental sites were located between 06.48611N latitude and 038.77166E longitude at an altitude of about 1992 meter above sea level at Bensa. Between 1996 and 2015, Bensa (the experimental area) received an average annual rainfall of 109.6 mm. The mean maximum and minimum annual air temperature was 12.3 and 25.4 °C at Bensa. Five blended fertilizers types namely NPS (63N, 25P, 10.5 S); NPSB(64N, 23P,10.1 S, 1.06 B); NPKSB(64N, 18P, 18K, 7.1S, 0.75B);NPSZnB(63N, 15P,7.6S, 2.23Zn, 0.37B); and NPKSZnB(63N, 17P, 18K, 7.6S, 2.23Zn, 0.37B)were used based on soil nutrient deficiency of the area.

The experiment consists of six treatments including recommended NP (64 kg N + 30 kg Pha$^{-1}$), 150 Kg NPS+ 75 Kg urea top dressed ha$^{-1}$, 150 Kg NPSB+ 80 Kg urea top dressed ha$^{-1}$, 150 Kg NPKSB + 94 Kg urea top dressed ha$^{-1}$, 150 Kg NPSZnB+ 80 Kg urea top dressed ha$^{-1}$ and 150 KgNPKSZnB+ 80 Kg urea top dressed ha$^{-1}$. The experiment was laid out in RCB design using 4 m by 4 m plot size and replicated across five farms. The blended fertilizers and DAP were applied at planting and Urea was top dressed 45 days after planting. The test crop was planted in row and other crop management practices were applied as per the recommendation developed for the crop.

Agronomic data for teff, including plant height, tiller number, straw yield, total biomass and grain yield were collected. To estimate biological and grain yield, the whole plot size (16m$^2$) was harvested and threshed manually. Analysis of variance for all data were performed using the SAS statistical package program version 9.0 [19]. The least significant difference (LSD) at 5% probability level was used to establish the difference among the means.

Economic analysis was performed to investigate the economic feasibility of the blended fertilizers for teff production. Partial budgetand benefit cost ratio analyses were used. The average yield was adjusted downwards by 10%, assuming that farmers would get 10% less yield than is achieved on an experimental site. The average open market price for teff (18 ETB kg$^{-1}$) and the official prices for N (urea: 11.9 ETB kg$^{-1}$), P (DAP: 14.8 ETB kg$^{-1}$), Zn ($ZnSO_4$: 19.84 ETB kg$^{-1}$), K (KCl: 14.7 ETB kg$^{-1}$). And the official prices of the blended fertilizers (NPS: 10.94 ETB kg$^{-1}$ and NPSB: 15.41 ETB kg$^{-1}$) were used for analysis.

## RESULT AND DISCUSSION

Two years experiment result showed significant difference among the different nutrient combinations considered in this trial. Based on the result presented in table 1, significant difference was observed among treatments on grain yield and number of tillers. Significantly higher yield (1946.3 kg ha$^{-1}$) was obtained from plots treated by 150 kg NPS (63:25:10.5)+ 34.5 kg N ha$^{-1}$ compared to plots received treatment 3and 5 (Table 1).

**Table 1:** Yield and yield components of teff influenced by different fertilizer types

| Treatments | Plant height | No of tiller | Straw yield t ha$^{-1}$ | Biomass t ha$^{-1}$ | Grain yield kg ha$^{-1}$ |
|---|---|---|---|---|---|
| 1. 64 kg N + 30 Kg P ha$^{-1}$ (the recommended NP) | 79.84 | 3.6ab | 4.58 | 6.0250 | 1446.4ab |
| 2.150 kg NPS (63:25:10.5) + 34.5 kg N ha$^{-1}$ | 79.08 | 3.6ab | 4.52 | 6.4625 | 1946.3a |
| 3.150 kg NPSB (64:23:10.1:1.06) + 36.8kg N ha$^{-1}$ | 79.36 | 3.2b | 5.04 | 6.3625 | 1326.2b |
| 4.150 kg NPKSB (64:18:18:7.1:0.75) + 43.24kg N ha$^{-1}$ | 79.60 | 3.9ab | 4.48 | 6.0250 | 1542.5ab |
| 5.150 kg NPSZnB (63:15:7.6:2.23:0.37)+ 36.8 kg N ha$^{-1}$ | 82.12 | 3.7ab | 4.60 | 6.0250 | 1425.3b |
| 6.150 kg NPKSZnB (63:17:18:7.6:2.23:0.37) + 36.8 kg N ha$^{-1}$ | 82.84 | 4.3a | 4.74 | 6.2500 | 1513.9ab |
| LSD | NS | 0.79 | NS | NS | 421.61 |
| CV | 6.40 | 16.34 | 27.52 | 22.58 | 21.06 |

Even though in the soil fertility map of the district clearly indicated that N, P, S, B and K are deficient in the soils of the area, the amount of P in the nutrient combination is critical. Reducing recommended P to 50% in treatment 5 resulted significant yield reduction compared to treatment 2. This finding is consistent with yield reduction observed by [20], although balanced nutrients were applied, yield was significantly lower where N and P applied were below the recommended amount. Yield reduction due to low level of P applied can also aggravated due to acidic nature of the area. Application of P fertilizer to an acidic soil resulted in precipitation reaction between exchangeable $Al^{3+}$ and added P resulting in the formation of a highly insoluble Al-phosphate [21]. In such soil types the proportion of P fertilizer that could be available to a crop becomes inadequate [22]. However, plots received K containing blended fertilizers gave comparable teff yield with treatment 2, while P was reduced by 40 and 43%, respectively. This result indicating that the study site required application of K for teff production. Based on the current experiment, applying balanced nutrients without maintaining P at the recommended rate and avoiding K from the nutrient formulation could not improve teff production around Bensa area.

## Economic analysis

The economic analysis result also supported the biological yield; plots received 150 kg NPS (63:25:10.5) + 34.5 kg N $ha^{-1}$gave highest net benefit indicating economic feasibility of the treatment. Based on the result presented in Table 2, the highest benefit cost ratio with highest net benefit (28996 ETB $ha^{-1}$) was obtained from the application of 150 kg NPS + 34.5 kg N $ha^{-1}$compared to all treatments considered in this experiment.

**Table 2:** Economic (Partial budget and Benefit cost ratio) analysis of blended, nitrogen and phosphorus fertilizers on teff

| Treatments | BF Kg $ha^{-1}$ | N Kg $ha^{-1}$ | P Kg $ha^{-1}$ | Av.yield | Adj. yield | TCTV (ETB $ha^{-1}$) | Revenues (ETB $ha^{-1}$) | NB | Benefit cost ratio |
|---|---|---|---|---|---|---|---|---|---|
| 2. NPS | 150 | 34.5 | 0 | 1946.3 | 1751.67 | 2534 | 31530.1 | 28996 | 12.4 |
| 1. Reco.NP | 0 | 64 | 30 | 1446.4 | 1120.05 | 3177 | 20160.9 | 16984 | 6.3 |
| 3. NPSB | 150 | 36.8 | 0 | 1326.2 | 1097.91 | 3264 | 19762.4 | 16498 | 6.1 |
| 5. NPSZnB | 150 | 36.8 | 0 | 1425.3 | 1074.2 | 3308 | 19335.6 | 16028 | 5.8 |
| 6. NPKSZnB | 150 | 36.8 | 0 | 1513.9 | 1161.68 | 3837 | 20910.2 | 17073 | 5.4 |
| 4. NPKSB | 150 | 43.24 | 0 | 1542.5 | 1166.81 | 3960 | 21002.6 | 17043 | 5.3 |

Yield adjustment=10%,price of teff = 18 ETB/kg, BF: blended fertilizer, Av.yield: average yield, Adj.yield: adjusted yield, TCTV: total cost that vary, Reco: recommended, ETB: Ethiopia birr.

## CONCLUSION AND RECOMMENDATION

The current experiment revealed that balanced nutrient alone could not increase teff yield in the study area to the required level. Blended fertilizer contain apposite P rate gave highest grain yield. Application of 150 kg NPS (63:25:10.5)+ 34.5 kg N $ha^{-1}$ gave highest biological yield and the result was economically feasible compared to all treatments. Therefore, 150 kg NPS +34.5 kg N $ha^{-1}$is recommended to use by farmers as an alternative soil management option for teff production around Bensa.

Currently, Ethiopian soil information system (Ethiosis) has completed soil fertility map of the southern nation nationalities and people regional state (SNNPRS) and reported with fertilizer recommendation for each woreda. Therefore, to enrich soil productivity and to made farmers benefited from their smallholding, further investigation, considering P and K at recommended amount should be conducted by developing new treatment combinations including the new fertilizer formula reported for Bensa district.

## REFERENCE


1. World Bank. Ethiopia – Agricultural Growth Program (AGP) Appraisal Stage, Project Information Document (PID),2010; Report No: AB5416.
2. Scoones I, Toulmin C. Soil nutrient budgets and balances: What use for policy? Managing Africa's Soils 1999; No. 6.
3. Tanner DG, Amanuel Gorfu, Kassahun Zewdie. Wheat Agronomy Research in Ethiopia, 1991.
4. Hailu GH, Tunner DG, MengistuH. Wheat research in Ethiopia: a historicalperspective.Addis Ababa:IAR/CIMMYT, 1991.
5. Negatu W, Mwangi W. An Economic Analysis of the Response of drumwheat to fertilizer: Implications for sustainable wheat production in the Central Highlandsof Ethiopia. In: D.G. Tanner (ed.). The Eighth Regional Wheat Workshop for Eastern, Central and Southern Africa 1992; CIMMYT.
6. PIF (Ethiopia's Agriculture sector Policy and Investment Framework). Planning andprogramming Directorate of MOA, 2010.
7. Kidanu S, Mamo T, Stroosnijder L. Biomass production of Eucalyptus boundary plantations and their effect on crop productivity on Ethiopian highland Vertisols. Agroforestry Systems 2005;63(3):281.
8. Nigussie H, Poesen J, Paridaens K, Nyssen Jan, Deckers S, Mitiku H *et al*. Nutrient export and associated costs from micro-dam catchments in Tigray. In: Teklu Erkossa and Michael Menker, 2007. Soils for Sustainable Development Ethiopian Society of Soil Science. Proceeding of the Eighth Conference. Addis Ababa, Ethiopia,April 27-28, 2006.
9. NCS. Ethiopia national conservation strategy. National Conservation Secretariat, Environment Protection Agency. MONRD, Addis Ababa, 1992.
10. FAO (Food and Agriculture Organization of the United Nations).Ethiopian highlands reclamation study (EHRS). Final Report,Rome, 1984;Vols. 1–2.
11. Hawando T. The survey of the soil and water resources of Ethiopia.UNU/Toko,1995.
12. Ngome AF, Becker M, Mtei, Mussgnug MKF. Maize productivity andnutrient use efficiency in Western Kenya as affected by soil type and crop management.International Journal of Plant Production. 2013; 7:517-536.
13. Thorne PJ, Thornton PK, Kruska RL, Reynolds L, Waddington SR, RutherfordAS, *et al*. Maize as food, feed and fertiliser in intensifying crop-livestocksystems in East and southern Africa: An ex ante impact assessment of technology interventionsto improve smallholder welfare. ILRI Impact Assessment Series 11. ILRI (InternationalLivestock Research Institute), Nairobi, Kenya.2002; 123 pp.
14. CSA (Ethiopian Central statistical agency). Structural transformation in Ethiopia: Evidence from cereal markets, International Food Policy Research Institute (IFPRI), 2012.
15. Alem L, Joseph M, Kethers S, Steele C, Wilkin son R.Information environments for supporting consistent registrar medical handover. HIM J. 2008; 37(1):9-25.
16. Fufa B, Hassan RM. Stochastic Technology and Crop Production Risk: The Case of Small-Scale Farmers in East Hararghe Zone of Oromia Regional State in Ethiopia, Strategies and Analysis for Growth and Access.Ethiopia, 2005.
17. John IH, Mayorga E,Tsamakis E, McClain ME, Aufdenkampe A, Quay P *et al*. Organic matter in Bolivian tributaries of the Amazon River: A comparison to the lower mainstream, Limnol. American Society of Limnology and Oceanography, Inc.,Washington, 1995, 2000; 45(7):1449-1466.
18. Haile W, Boke S. Response of Irish Potato (*Solanum tuberosum*) to the Application of Potassium at Acidic Soils of Chencha, Southern Ethiopia. International Journal of Agricultural Biology. 2011; 13:595-598.
19. SAS Institute Inc. JMP-5 statistical software, version 9.0 carry, USA, 2002.
20. Ayalew A, Habte M. Use of Balanced Nutrients for Better Production of Teff (*Eragrostis tef* (Zucc.) at Bensa in Southern Ethiopia. Journal of Resources Development and Management. 2017;32:46-50.
21. Pearson RW. Soil acidity and liming in the humid tropics. Cornell International Agricultural Bulletin,New York 1975; 30.
22. Somani LL. Crop production in acid soils. 1st edition, Agrotech Publishing Academy, New Delhi 1996; 224 pp.