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Evaluation of Different Blended Fertilizers Types and Rates for Better Production of Wheat in Esera Woreda, Dauro Zone

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Abstract

Production and productivity of wheat is decreased mainly by soil fertility depletion and inappropriate rate of poor nutrients availability. Crop specific fertilizer recommendation is necessary for sustainable crop production. Accordingly, a field this experiment was conducted during the main rainy season of 2017 and 2018 to evaluate blended fertilizer types and rates effect on improving production of wheat in Esera woreda, Dauro Zone, Southern Ethiopia. The experiment was laid out in Randomized Complete Block Design with three replications. The experiment consisted of ten treatments viz. control, (150NPSB+41urea) kgha^{-1}, (250 NPSB+102) kgha^{-1}, (150 NPSB+41urea+cu) kgha^{-1}, (200 NPSB+71 urea +cu) kgha^{-1}, 250NPSB+102urea+cu) kgha -1, (173.2 NPS + 4.87 $ZnSO_4$) kgha^{-1}, (189.5k NPS + 6.5 $ZnSO_4$) kgha^{-1}, (237NPS +8.125 $ZnSO_4$) kgha^{-1}, treatments. Blended fertilizers were applied at planting time and urea was top dressed after 35 days of planting. Application of blended fertilizer significantly ($p < 0.05$) increased the grain yield, and aboveground biomass, as compared to the control. On the other hand plant height, number of tillers per plant, spike length and number of seeds per spike were not shown significance. The maximum grain yield 2979.2 kg ha^{-1} and minimum (1989.6 kg ha^{-1}) were obtained from the application of 237 NPS +8.125$ZnSO_4$ kg ha^{-1} and 200+71urea +cu, respectively. The application of 173.2NPS + 4.87 $ZnSO_4$ kg ha^{-1} had maximum and acceptable Marginal rate of return (MRR %) and net benefit. Therefore, this type and rate of blended fertilizer can be recommended since it produced a high marginal rate of return, high net benefit, and relatively low total cost of production, for wheat production in the study area and other similar agro-ecologies

Keywords: Blended-fertilizer; Grain-yield; Wheat

Introduction

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 [1,2,3,4,5] 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 [6,7]. Balanced fertilizers containing N, P, K, S, B and Zn in blend form have been recommended to ameliorate site specific nutrient deficiencies and thereby increase land, water and labor productivity. The work of [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 three types of fertilizers for Esra woreda, Dauro zone were identified. But this needs validation for the fertilizer types and determination of 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, NPSBCu and NPSZn on wheat production and (2) Determine optimum rate of the selected fertilizer type for production of wheat in Esra woreda.

Materials and Method

Experimental details and treatment set-ups for Esera

On farm experiment was carried out for two years (2017 & 2018) in Esera woreda, dawuro 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. Ten treatments: control (no fertilizer), three rates of NPSB (69N,54 P2O5,10 S, 1.07B; 92N,72 P2O5,13 S, 1.4B and 115N,90 P2O5,17 S, 1.7B) and three rates of NPSBCu (69N,54 P2O5,10 S, 1.07B + Cu; 92N,72 P2O5,13 S, 1.4B + Cu and 115N,90 P2O5,17 S, 1.7B + Cu) NPSZn (69N,54 P2O5,10 S + Zn; 92N,72 P2O5,13 S + Zn and 115N,90 P2O5,17 S +Zn). The plot size 4*4 =16m2 and the spacing between rows were 20 cm. NPS and NPSB blends, and CuSO4 were used as fertilizer sources and in addition urea was used as N source. NPS, NPSB

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and ZnSO4 fertilizers were applied at planting whereas urea fertilizer is top dressed after 45 days of planting the test crop. 600 gm CuSO4 ha -1 was mixed in 400 liter water and foliar application was made at appropriate stage of the crop. All field managements were carried as per the recommendation of the area and all field observations were recorded.

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 Physico-chemical analysis. The collected samples were properly labelled, packed and transported to the Soil laboratory and were prepared and analyzed according to the standard procedures.

Agronomic data collection

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

Data analysis

The collected data were subjected to statistical analysis. Analysis of variance (ANOVA) was carried out using SAS version 9.2 statistical software programs (SAS, 2009). Significant difference between and among treatment means were assessed using the least significant difference (LSD) at 0.05 level of probability [10].

Results and discussion

Esera Woreda

The mean yield and yield component of wheat results are depicted in (Table 1). Results of ANOV indicated that statistically significant differences among treatments were observed in biomass and grain yield. The effects of application of different types and rates of blended fertilizers on plant height, spike length and tiller number of wheat at Esara were no significant. From the biomass and grain yield data it can be suggested that including Cu on higher rates of NPSB negatively affected the wheat production at study area; which is not justified but there could be given many reasons, so should be critically evaluated in the future to justify. Highest wheat grain yield was recorded by application of 237 kg/ha NPS + 8.125 kg/ha $ZnSO_4$ but not statistically different from that of other types and rates. In total, yield components of wheat were not impacted applied fertilizer types and rates.

Discussions and Conclusion

From our current study result lower rate of NPSB (150 kg) with 41 (50) kg urea top dressing gave comparable yield with other rates of NPSB and other blends. Thus application of NPSB (150 kg) with 41 (50) kg urea top dressing could be recommended for study area and other similar areas for wheat production. Partial budget analysis has shown that all applied fertilizers were not economically feasible. Therefore, further study is needed on management of identified fertilizers (rate, time or method) or on removing other yield limiting soil factors such as acidity, other limiting element, or toxic element.

Table 1: Over years mean wheat yield and yield components as influenced by different blended fertilizer types and rates combined in Esera woreda.

Trt no	Treatments	Plant height (cm)	Spike length (cm)	Tiller no	Biomass (kg/ha)	Grain yield (kg/ha)
T1	C Control (no fertilizer)	73.0	7.31	2.9	6260.4abc	2349bcd
T2	150kg/ha NPSB+41kg/urea	74.8	7.14	3.0	7020.8ab	2625abc
T3	200kg/ha NPSB+71kg urea	73.2	7.42	3.5	7208.3a	2729.2ab
T4	250kg/ha NPSB+102kgurea	71.7	7.47	2.9	7322.9a	2685.4abc
T5	150kg/ha NPSB+41kg urea+cu	73.0	7.58	2.9	7062.5ab	2708.3abc
T6	200kg NPSB+71kg urea +cu	73.1	7.40	3.2	5729.2ab	1989.6d
T7	250kgNPSB+102kgurea+cu	68.8	7.10	2.9	5656.3c	2104.2cd
T8	173.2kg/ha NPS + 4.87 kg/haZnSo4	69.1	7.00	2.9	5812.5bc	2349bcd
T9	189.5kg/ha NPS + 6.5kg/haZnSo4	71.6	10.05	2.9	7052.1a	2632.3abc
T10	237kg/ha NPS +8.125kg/ha ZnSo4	71.4	7.23	3.2	7427.1a	2979.2a
	Significance level	NS	NS	NS	*	*
	CV	5.8	27.8	21.5	17.3	21.25
	LSD	4.92	2.24	NS	1339.4	610.9

Table: Partial budget analysis of fertilizers.

	control	150 NPSB+ 41 UTD	200 NPSB+ 71UTD	250 NPSB+ 102UTD	T2+CU	T3+CU	T4+CU	173.2 NPS+4.87 ZnSO4	189.5 NPS+6.5 ZnSO4	237 NPS+8.125 ZnSO4
Average yield $kgha^{-1}$	2349	2625	2729.2	2685.4	2708.3	1989.6	2104.2	2349	2632.3	2979.2
Adj- yield $kgha^{-1}$	2114.1	2362.5	2456.3	2416.9	2437.5	1790.6	1893.8	2114.1	2369.1	2681.3
gross benefit (ETB)	14799	16537.5	17193.96	16918.02	17062.29	12534.5	13256.5	14799	16583.5	18769
NPSB	0	2100	2800	3500	2100	2800	3500	2078.4	2274	2844
Urea	0	389.5	674.5	969	389.5	674.5	969	0	0	0
Cu	0	0	0	0	600	600	600	0	0	0
ZnSO4	0	0	0	0	0	0	0	134.4	182	227.5
fertilizer application	0	400	500	700	450	550	750	450	450	550
TVC	0	2889.5	3974.5	5169	3539.5	4624.5	5819	2662.8	2906	3621.5
Net benefit birr/ha	14799	13648	13219.46	11749.02	13522.79	7909.98	7437.46	12136	13677.5	15147
MRR%		D	D	D	D	D	D	D	633.9	205.447

Table: %MRR analysis.

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 (no fertilizer)	2349	2114.1	14798.7	0	0	0	14798.7		
T8	173.2NPS + 4.87 kg/ha ZnSO4	2349	2114.1	14798.7	2212.8	450	2662.8	12135.9	-1.000	D
T2	150k NPSB+41kg/ha UTD	2625	2362.5	16537.5	2489.5	400	2889.5	13648	6.670	667.0
T9	189.5 NPS + 6.5 kg/ha ZnSO4	2632.3	2369.1	16583.49	2456	450	2906	13677.49	1.787	178.7
T5	150 NPSB+41kg UTD+cu	2708.3	2437.5	17062.29	3089.5	450	3539.5	13522.79	-0.244	D
T10	237 NPS +8.125 kg/ha ZnSO4	2979.2	2681.3	18768.96	3071.5	550	3621.5	15147.46	19.813	1981.3
T3	200 NPSB+71kg urea	2729.2	2456.3	17193.96	3474.5	500	3974.5	13219.46	-5.462	D
T6	200 NPSB+71kg UTD +cu	1989.6	1790.6	12534.48	4074.5	550	4624.5	7909.98	-8.168	D
T4	250 NPSB+102kg/ha UTD	2685.4	2416.9	16918.02	4469	700	5169	11749.02	7.051	705.1
T7	250 NPSB+102kg UTD+cu	2104.2	1893.8	13256.46	5069	750	5819	7437.46	-6.633	D

Table: Final partial budget analysis after removal of dominant treatments (after two steps but first step is not shown).

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 (no fertilizer)	2349	2114.1	14798.7	0	0	0	14798.7		
T8	173.2NPS + 4.87 kg/ha ZnSO4	2349	2114.1	14798.7	2212.8	450	2662.8	12135.9	0.096	9.6

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