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Evaluation of Different Blended Fertilizers Types and Rates for Better Production of Wheat at Angecha Woreda

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Abstract: The field experiment was conducting during 2016/17 cropping season at angecha testing site of Areka Agricultural Research center, southern Ethiopia to evaluate the effect of blended fertilizer on yield of wheat with the treatments of seven replicated three times across farmers in RCBD design. An approximate geographical coordinates of the testing site is 7o 0' N latitude and 38o 29'E longitude having an altitude of 2381meteres above sea level. The treatments were control (no fertilizer), three rates of NPS (46N, 54 P_2O_5, 10 S; 69N, 72 P_2O_5, 13 S and 92N, 90 P_2O_5, 17 S,) and three rates of NPSCu (T2 + Cu; T3 + Cu and T4 + Cu). The plot size was 4 m by 4 m (16m^2) and the spacing between plots and blocks was 50 cm and 100 cm, respectively. The result of this experiment also has substantiated the importance application of on yield of wheat NPSCu (combination of Cu with macronutrients NPS) fertilizers in improving yield of wheat in Angecha woreda. Despite the need of verification in multi-locations and soil types for wider use, application of NPSCu can be recommended for wheat production in the study area.

Keywords: Blended, Wheat, Fertilizer, Cereal

1. Introduction

About one third of the world population consume wheat as staple food and as compared with other cereal crops, it is reach protein and providing more [6, 7]. Ethiopia is likely to rely on agricultural sector as 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 farmer's 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 which in part explain fertilizer factor productivity decline and stagnant crop productivity conditions encountered despite continued use the blanket recommendation [9, 2]. The research result from Uganda also showed that use of low level of N and P fertilizer on maize and beans was the leading factor for nutrient depletion [10]. Balanced fertilizers containing NPKSB and Zn in blend form have been recommended to ameliorate site specific nutrient deficiency and thereby increase land, water and labor productivity. 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 location specific basis [9]. In this study supplementation of K increased potato tuber yields 197% over the standard NP recommendation alone. The recent national soil inventory data also revealed SB and Zn deficiencies are widespread in Ethiopia soils, while some soils are also deficient in K, Cu, Mn and Fe [3], which all potentially hold back crop productivity. However fertilizer trials involving multi nutrient blends that include micronutrients are rare. 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 fertilizer for Angecha werda and two types of fertilizer blends were identified for

kebele, but this needs validation for fertilizer type's determination rates for the identified fertilizer types for specific crops. Therefore this study was initiated with the objectives of (1) Evaluate the relative influences of NPS and NPSCu on wheat production and (2) Determine optimum rate of the selected fertilizer type for production of wheat in Angecha woreda.

2. Materials and Methods

2.1. Description of Study Area

The Field experiment was conducted during 2016/17 cropping season at Angacha testing site of Areka Agricultural Research Center, Southern Ethiopia. An approximate geographical coordinates of the site is 7o 0' N latitude and 38o 29' E longitude having an altitude of 2381 meters above sea level. The experimental area is characterized with a bimodal pattern of rainfall that extends from February to September. Its mean annual rainfall is 1656 mm. The peak rainy months are April, July, August and September. The mean annual maximum and minimum temperatures are 24 and 14^{o}c, respectively. [4]

2.2. Experimental Details and Treatment Set-ups

On farm experiment was carried out for two years (2016 & 2017) in Angecha woreda, Kembata Timbaro 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. Seven treatments: control (no fertilizer), three rates of NPS (46N, 54 P_2O_5, 10 S; 69N, 72 P_2O_5, 13 S and 92N, 90 P_2O_5, 17 S,) and three rates of NPSCu (T2 + Cu; T3 + Cu and T4 + Cu). The plot size was 4 m by 4 m (16 m^2) and the spacing between plots and blocks was 50 cm and 100 cm, respectively. The improved wheat Hidase was drilled in rows. NPS and NPSCu blends were used as fertilizer sources and in addition urea was used as N source. NPS and NPSCu fertilizers were applied at planting whereas urea fertilizer is top dressed after 45 days of planting the test crop. 60 gm CuSO4 ha^{-1} was mixed in 400 liters 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.

2.3. Soil Sampling and Analysis

Composite surface (0-20cm 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 labeled, packed and transported to the Soil laboratory and were prepared and analyzed according to the standard procedures of [8].

2.4. 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 (ANOVA).

2.5. Data Analysis

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 [5].

3. Results and Discussion

The mean yield and yield component of wheat results are depicted in table 1. Results of ANOVA indicated that statistically significant differences among treatments were observed in all tested parameters. The effects of blended fertilizers were similar on all parameter, suggesting the production of wheat at Angecha was influenced by the types and rate of fertilizers.

Table 1. *Mean (combined over years) wheat yield and yield components as influenced by different blended fertilizer types and rates in Angecha woreda.*

Trt no	Treatments	Plant height (cm)	Spike length (cm)	Tiller no	Biomass (tone/ha)	Grain yield (kg/ha)
T1	control	70.7c	6.8b	2.2c	7.56c	3197.9c
T2	NPS = 46, 54, 10	76.3b	7.31ba	2.4bc	8.74bc	3656.3bc
T3	NPS = 69, 72, 13	80ba	7.1ba	2.6abc	9.85bac	4208.3ab
T4	NPS = 92, 90, 17	81.7a	7.38a	2.9a	10.36ba	4458.3a
T5	NPSCu = 46, 54, 10 + Cu	83.1a	7.52a	2.83ba	10.47ba	4125.0ab
T6	NPSCu = 69, 72, 13 + Cu	81.1ba	7.4a	2.86a	12.17a	4500.0a
T7	NPSCu = 92, 90, 17 + Cu	80.7ba	7.50a	3.03a	11.32a	4302.1ba
	Mean	79.1	7.30	2.7	10.07	4063
	CV	5.3	5.9	14	20	13
	LSD	4.9	0.51	0.44	2.41	650.67

The highest grain yield (4500 kg ha^{-1}) and biomass (12.17 t ha^{-1}) was obtained by application of NPSCu @ a rate of 69 N, 72 P2O5, 13 S kg ha^{-1}) + 600 gm although not significantly differ from other rates of NPS and NPSCu except NPS @ lowest (46/54/10) rate. Inclusion of Cu on the NPS blend improved wheat production at Angecha and increased grain yield by only 12.8%. Application of 69,72,13 kg ha^{-1}+ 600 gm Cu ha^{-1} (NPSCu) increase wheat yield by 7% over 69,72,13 kg ha^{-1} NPS.

Table 2. *Partial budget analyses of blended fertilizer types and rates on wheat at Angecha.*

No.	Treatment	Grain yield	10% Adjusted yield	gross benefit (ETB)	fertilizer cost	Fertilizer Application. Cost	TVC	Net benefit birr/ha	MRR ratio	%MRR
T1	control	3197.9	2878.11	28781.1	0	0	0	28781.1		
T2	NPS = 46, 54, 10	3656.3	3290.67	32906.7	2213.69	300	2513.69	30393.01	0.641	64.1%
T3	NPS = 69, 72, 13	4208.3	3787.47	37874.7	3126.48	544	3670.48	34204.22	3.295	329.5%
T5	NPSCu = 46, 54, 10 + Cu	4125	3712.5	37125	3188.69	500	3688.69	33436.31	-42.17	D
T4	NPS = 92, 90, 17	4458.3	4012.47	40124.7	4029.18	700	4729.18	35395.52	1.883	188.3%
T6	NPSCu = 69, 72, 13 + Cu	4500	4050	40500	4101.48	744	4845.48	35654.52	2.227	222.7%
T7	NPSCu = 92, 90, 17 + Cu	4302.1	3871.89	38718.9	5004.1	900	5904.1	32814.8	-2.68	D

	No fertilizer	150NPS+ 41kg urea	200kgNPS+ 72kg urea	250NPS+ 102kg urea	Tr2+Cu	Tr3+Cu	Tr4+Cu
Average yield kgha^{-1}	3197.9	3656.3	4208.3	4458.3	4125	4500	4302.1
Adj- yield kgha^{-1}	2878.11	3290.67	3787.47	4012.47	3712.5	4050	3871.89
gross benefit (ETB)	28781.1	32906.7	37874.7	40124.7	37125	40500	38718.9
NPSB	0	2100	2800	3500	2100	2800	3500
Urea	0	413.69	726.48	1029.18	413.69	726.48	1029.1
Cu	0	0	0	0	975	975	975
Labor (fertilizer application)	0	300	544	700	500	744	900
TVC	0	2813.69	4070.48	5229.18	3988.69	5245.48	6404.1
Net benefit birr/ha	28781.1	30093.01	33804.22	34895.52	33136.3	35254.5	32314.8
MRR		46.63	295.3	94.2		168.5	

Results of partial budget analysis also indicated that higher net benefit and highest %MRR were obtained from application of 69, 72, 13 kg ha^{-1} NPS. But highest net benefit and acceptable %MRR were obtained from application of NPSCu @ a rate of 69 N, 72 P2O5, 13 S kg ha^{-1}) + 600 gm. Therefore, we could recommend application of NPSCu @ a rate of 69 N, 72 P2O5, and 13 S kg ha^{-1}) + 600 gm for optimum wheat production in Angecha woreda and similar soil type. However, farther research is needed to verify and demonstrate the effect for wider use.

4. Conclusion and Recommendation

Low 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 the country by ATA and formulation of different fertilizer types for the country, helped the farmers to shift from mare 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 application of NPSCu (combination of Cu with macronutrients NPS) fertilizers in improving yield of wheat in Angecha woreda. Despite the need of verification in multi-locations and soil types for wider use, application of NPSCu can be recommended for wheat production in the study area.

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