

Bread Wheat (Triticum aestivum) Response for Blended (Micro-nutrient Containing) Fertilizer Application in Debub Ari Woreda of South Omo, Southern Ethiopia

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Abstract
The soils of the study area are deficient with sulphur and boron in addition to nitrogen and phosphorous. So, the experiment aimed at evaluating the effect of sole and combined application of blended fertilizer, and recommended nitrogen and phosphorous rate on wheat yield and yield components. The experiment conducted into two consecutive years (2014 1nd 2015) of main season in Debub-Ari woreda, South Ethiopia. Nine treatments (two blended fertilizers, and recommended rate of nitrogen and phosphorous) were used and treatments were replicated three times and arranged in randomized complete block design. The significant effect of fertilizers were observed on wheat yield and yield components. The application of 200 kg (14_N-21 P_2O_5-6.5S-1.2Zn-0.5B) per ha and the remaining nitrogen (41 kg urea /ha^{-1}) top dressed, resulted 36.8 and 57% grain yield and harvest index improvement. Farmers in the area will be benefited, if applied blended fertilizer depending on soil test result.
Keywords: Blended fertilizer; Micro-nutrient; Bread wheat; Grain yield; Harvest index

INTRODUCTION

About one third of the world's population consume wheat as a staple food (Hussain and Shah, 2002) and as compared with other cereal crops, it is reach protein and providing more protein (Iqtidar, et al., 2006). In Ethiopia, wheat accounts the fourth level from the total cultivated area and also in production (Bekele, etal., 2000). From Sub-Saharan Africa countries, Ethiopia is the largest wheat producer, having more than 1.1 million hectares of cultivated land. Ethiopia is the largest wheat producer in Sub-Saharan Africa with the cultivated land of 1.1 million hectares (CSA, 1995). However, as reported by Hailu and Yirga (1992), nationally, on average less than 1.5 t ha^{-1} yield of wheat produced. In supporting this, Bekele, et al., (2000) reported that the national 1.3 ton per hectare mean yield of wheat in Ethiopia, is 24% and 48% below as compared with the mean yield production potential of African and global. The low average national yield of wheat may be partially attributed to the low level of using inputs for in improving wheat production in the country.

The population of Ethiopia is currently growing at a faster rate and demands an increased proportion of agricultural products. In contrary, the improvements in maximizing food production has a problem and cannot hold the needs of food by the ever increasing population in the country. So, to solve the problem of food shortage and to feed the peoples, it needs strengthening food production capability of the country.

One of the first challenge in maximizing food production is soil nutrient depletion, restrains agricultural crop production and economic growth of Ethiopian. Annually, the net loss of nutrients from cultivated land, and is estimated to be at least 40 kg N, 6.6 kg P and 33.2 kg K per-hectare (Scoones and Toulmin, 1995)

According to Alloway, (2003), plant require essential elements with balanced way to better production. However, in Ethiopia, only di-ammonium phosphate (DAP) and Urea for the past 14 years has been used for crop production. In addition to nitrogen and phosphorous, other nutrients like, sulfur, potassium, boron and zinc and copper are identified low in Ethiopian soil and are needed to address the key nutrient deficiencies in the tested soils according to (ATA, 2016).

Therefore, in south Omo, at Debub Ari woreda, the study of soil inventory data also revealed sulphur, and boron were deficient in the soil in addition to nitrogen and phosphorous. For that reason, this study conducted with the objective to evaluate and verify the effect new blended fertilizers (including micro nutrients) for wheat production at Debub Ari.

MATERIALS AND METHODS

Area description

Field experiments were conducted for two consecutive years of wheat growing seasons, 2014 and 2015 E.C, in Debub Ari Woreda Senma-mer kebele of South Omo zone, Southern Ethiopia ,which is 740 km south west of Addis Abeba. The particular experimental spot is geographically located 37^0 02' N and 06^0 40' E. The area is received 1000 mm mean rainfall, and maximum and minimum temperatures were 35 ^{0}c 15^0c respectively.

The experimental area was silty clay (sand=22%, silt=32% and clay=46%) and moderately acidic in nature (pH: 5.9). Soil of the study area was deficient in NPSB (Nitrogen, phosphorous, sulfur and boron) nutrients and copper (ATA, 2016).

Treatments and experimental design

The experiment consists nine treatments in three replications were arranged with randomized complete block design. The treatments are:

1. Recommended N and P R/NP= fertilizer $N_{69}P_2O_{5(69)}$
2. BF1, = (14N-21P_2O_5-6.5S-1.2Zn-0.5B) 200kg/ha
3. BF2,=(23N-23P_2O_5-0K_2O_5-8S-1.3Zn) =200 kg/ha
4. BF1+N,=(14N-21P_2O_5-6.5S-1.2Zn-0.5B)+N= 200 kg BF1+ 41 kg N
5. BF1+P,=(14N-21P_2O_5-6.5S-1.2Zn-0.5B)+P=200kgBF1+27 kg P_2O_5
6. BF1+NP=(14N-21P_2O_5-6.5S-1.2Zn-0.5B)+NP
7. BF2 +N,= 23N-23$_P$2O_5-0K_2O_5-8S-1.3Zn)+ 23 kg N
8. BF2+P,=23N-23P_2O_5-0K_2O_5-8S-1.3Zn)$_+$ 27kg P2o5
9. BF2+NP,=23N-23P_2O_5-0K_2O_5-8S-1.3Zn)$_+$ 23 kg N and 23 kg p2o5

(Where, N, P and BF stand for Nitrogen, Phosphorous and blended fertilizer respectively.)

Bread wheat (*Triticum aestivum)* variety 'Danda'a was used as a test crop. The seeds were drilled at the rate of 150 kg ha^{-1} with 20cm row spacing. All blended fertilizers and recommended phosphorous fertilizer doses were applied during planting. But, nitrogen fertilizer was applied in two split rates, i.e. at the time of sowing and after 2^{1st} days. All the other agronomic management techniques were applied accordingly.

Data collection procedure

Number of tillers was recorded and calculated per matter square. Plant height was collected at 50% flowering, by measuring from the base of the plants to the apex. Thousand (1000-seed) seed weight, was calculating after threshing, the grain was cleaned; dried 1000 seeds were counted by cereal crops seed counter machine. Above ground biomass was harvested and weighed then calculated in hectare basis. Finally for grain yield, the dried yield which was harvested from the plot was weighed and calculated per hectare basis. Harvest index (HI) calculated by dividing the grain yields to total above ground bio mass.

Data Analysis

Data analyzed with GLM procedure and the means values the studded parameters were compared using the least significant difference (LSD) at 5% level of significance using SAS statistical software version 9.0. Student's paired t test was applied to evaluate differences on wheat parameters between two seasons (SAS, 2007).

RESULT AND DISCUSSION

From the application of different fertilizer management option (with type and rate), in 2014 experimental period, significant variation was observed on some parameters of wheat yield and yield components, while, in the second (2015) experimental time did not show any significant difference on the observed parameters.

The tallest plant height and the heftiest 1000-seed weight attributed by, due to the applied recommended NP and BF1 with NP adjusted, respectively. On plant height and 1000-seed weight, 11 and 27% advantages were observed as compared to BF2 adjusted with NP and recommended NP, respectively (Table 1), in 2014 trial period. Wheat, tiller number and above ground biomass did not show any significant variation at ($p>0.05$) the difference on fertilizer type and rate (Table 1). Significant differences ($p\leq0.05$) on grain yield and HI were observed due to the variation on the applied fertilizers type and rate in 2014. The higher grain yield and highest HI were obtained from the application of BF1 with N adjusted and resulted 36.8 and 57% grain yield and HI improvement as related to the application of BF2 plus N adjusted and BF1 in 2014 trial period, respectively. The grain yield advantages might be attributed by, the constituent of boron in blended BF and its N adjustment. The finding on groan yield is in argument with (Melesse, 2017). Boron role in increasing wheat grain yield is also witnessed by the combined application of boron with micro nutrients, with the benefits 4 to 11% wheat yield (Malakouti, 2000). Several other reports indicated that micronutrients application either through soil or foliar had positive correlation with wheat yield (Habib, 2009; Uddin, et al., 2008).

In 2015, trial period, there was no observed any significant effect at ($p>0.05$) on yield and yield components of wheat (Table 1). This might be due to the inherent soil fertility of the experimental plot was in good status to support wheat growth and yield production. Soil is reach with the required nutrients or fertile in its status could not be respond for the applied fertilizer difference on type and are. According to Dumroese, et al., (2009) for proper growth and basic physiological processes, plants require sufficient amounts of mineral nutrients in the appropriate balance. With a good supply and proper fertilization of mineral nutrients can promote growth and plant vigor increased this idea also supported by Reddy (2004). Season effect was observed on plant height, above ground bio mass, grain yield and HI, while, not affect tiller number and 1000 sees weight (Table 2). This might be due to good fertility status of the soils of the second trial plots.

CONCLUSSION

Producing crops with balanced fertilization using blended fertilizer of macro and micro nutrients more advantageous is based on soil test results. Grain yield of wheat is improved with the application of 200 kg (14_N-21 P_2O_5-6.5S-1.2Zn-0.5B) per hectare with the remaining nitrogen adjusted (41 urea kg/ha^{-1}). Season and soil fertility differences affect consistence in production. Therefore, this research indicated that, taking a consideration on time of application and soil test is crucial in future fertilizer trial in the aria. Also the economic importance of new blended fertilizer should be consider in future work.

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Appendix

Figure 1. A photo show wheat performance from emergence to maturity of fertilizer trial

Table. 1. Effect of fertilizer type and rate on wheat yield and yield components at Debub Omo Ethiopia

Season	Treatment code	Tiller (No)	Plant height (cm)	Thousand Seed Weight	Above ground Bio Mass (t/ha)	Yield (qt/ha)	Harvest index (HI)
Year 2014	R/NP	2.3	95.7^{a}	39.0^{e}	9.8	33.2^{bc}	34.1^{cd}
	BF1	2.0	93.5^{ab}	39.7^{de}	9.7	29.5^{cd}	30.0^{d}
	BF2	2.0	91.3^{abc}	41.7^{cd}	8.6	35.3^{ab}	41.3^{abc}
	BF1+N	2.3	90.3^{abc}	$41.o^{cde}$	8.2	38.3^{a}	47.1^{a}
	BF1+P	2.3	89.9^{bc}	42.3^{c}	8.1	34.2^{b}	43.0^{abc}
	BF1+NP	2.0	87.2^{c}	49.7^{a}	6.7	30.2^{cd}	45.5^{ab}
	BF2+N	1.7	89.0^{bc}	45.7^{b}	8.0	28.9^{d}	36.0^{bcd}
	BF2+P	1.7	87.6^{c}	41^{cde}	8.1	31.6^{bcd}	39.4^{abcd}
	BF2+NP	1.3	86.2^{c}	41.7^{cd}	7.9	32.5^{bcd}	42.2^{abc}
	Mean±SE	**1.9**±0.3	**90.1**±1.9	**42.4**±0.9	**8.4**±0.6	**32.6**±1.3	**37.9**±3.3
	Pr > F	**0.3**	**0.04**	**<0.0001**	**0.2**	**0.002**	**0.04**
	LSD (p≤0.05)	**NS**	**6**	**2.9**	**NS**	**3.9**	**9.5**
	CV	**29.4**	**3.9**	**3.9**	**11.9**	**6.9**	**8.7**
Year 2015	R/NP	2.7	93.6	40.6	10.3	45.3	30.7
	BF1	2.4	81.6	40.8	10.3	42.2	29.4
	BF2	3.5	91.0	43.8	11.9	39.3	26.3
	BF1+N	3.3	93.1	44.9	12.8	52.0	29.0
	BF1+P	3.0	90.7	40.6	9.1	44.7	32.4
	BF1+NP	2.9	94.0	42.6	11.7	36.0	23.5
	BF2+N	2.9	91.5	40.9	11.7	40.5	25.8
	BF2+P	2.5	92.7	42.1	11.6	43.0	27.1
	BF2+NP	3.2	92.2	38.3	12.8	46.6	27.2
	Mean±SE	**2.9**±0.3	**91.1**±3.9	**41.6**±1.3	**11.3**±1.3	**43.2**±4.1	**27.9**±3.1
	Pr > F	**0.2**	**0.5**	**0.7**	**0.6**	**0.4**	**0.7**
	LSD (p≤0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
	CV	**22.3**	**7.2**	**5.7**	**19.2**	**18.4**	**21**

Values with the same letters within a column are not significantly different at α=0.05 level of significance and NS=non-significant at (p≤0.05)

Table. 2. Effect of fertilizer type and rate on wheat yield and yield components on season variation at Debub Omo Ethiopia

	Variable	Season	Tiller (No)	Plant height (cm)	Thousand Seed Weight	Above ground Bio Mass (t/ha)	Yield (qt/ha)	Harvest index (HI)
	Mean ± SE	2014	90.1±0.8	1.9±0.1	42.4±0.7	8.4±0.2	32.6±0.7	39.8±1.4
		2015	91.1±1.3	2.9±0.1	41.6±0.5	11.3±0.4	44±1.4	27.9±1
t test	Method Variances		Satterthwaite Unequal	Pooled Equal	Pooled Equal	Satterthwaite Unequal	Satterthwaite Unequal	Pooled Equal
	Pr > |t|		0.4821	<.0001	0.3701	<.0001	<.0001	<.0001
Equality of Variances	Pr > F		0. 0251	0.5741	0.2468	0.0073	0.0005	0.1558