Ethiopian Journal of Science and Sustainable Development

e-ISSN 2663-3205 Volume 9 (2), 2022

Journal Home Page: www.ejssd.astu.edu.et

EJSSD
ETHIOPIAN JOURNAL OF SCIENCE AND SUSTAINABLE DEVELOPMENT
An Official International Journal of Adama Science and Technology University

Research Paper

Evaluation of Different Blended Fertilizers Types and Rates for Improving the Productivity of Wheat (Triticum aestivum L.) in Debub Ari District, South-western Ethiopia

Abebe Hegano*, Atinafu Tunebo, Shemelis Tesema

Southern Agricultural Research Institute, Jinka agricultural Research Center, P.O.Box 96, Jinka, Ethiopia

Article Info

Article History:
Received 06 March 2022
Received in revised form 19 June 2022
Accepted 30 June 2022

Keywords:
Blended Fertilizer
Wheat
Grain Yield
Biomass

Abstract

Crop specific fertilizer recommendation is necessary for sustainable crop production. Accordingly, a field experiment was conducted in Debub Ari district, Southern Ethiopia, to evaluate blended fertilizer types and rates effect on improving the production of wheat during the main rainy season of 2018 and 2019. The experiment was laid out in Randomized Complete Block Design with three replications. The 9 treatments used for the field experiment were 1) control, 2) (142 NPS + 42 urea) kgha^{-1}, 3) (189 NPS + 72 urea) kgha^{-1}, 4) (237 NPS +102 urea) kgha-1, 5) (142NPS + 159 urea) kgha^{-1}, 6) (150NPSB+ 41urea) kgha^{-1}, 7) (200 NPSB + 72 urea) kgha^{-1}, 8) (250NPSB + 102Urea) kgha-1 and 9) (150 NPSB + 161Urea) kgha^{-1} treatments. Application of blended fertilizer significantly ($p < 0.05$) increased the plant height, number of tillers per plant, spike length, number of seeds per spike, grain yield, aboveground biomass, and thousand seed weight at harvest as compared to the control. The maximum and significant grain yield (3796.7kg ha^{-1}) and minimum (1466.5 kg ha^{-1}) were obtained from the application of 237 kg ha^{-1} NPS + 102 kgha^{-1} urea and unfertilized treatment, respectively. The application of 237 kg ha^{-1} NPS + 102kgha^{-1} urea had a 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.

1. Introduction

Wheat (Triticum spp.) is the major cereal crop grown in the highlands of Ethiopia (Efrem et al., 2000). It is well-produced across a wide range of soil conditions, although it is best adapted to fertile, well-drained silt and clay loam soils (Bekele et al., 2000). In Ethiopia, it ranks fourth in a total area of cereal grains coverage of 13.38% (1.69 million ha) and third in cereal grain production (15.17% (4,642.96 million t)) next to maize and tef, and in SNNPR wheat ranks third in area coverage (0.13 million ha) and also it ranks third in grain production (339.19 million t) next to maize and tef (CSA, 2018).

Despite the long history of wheat cultivation, its high cover of production area, its productivity, and its importance to the Ethiopian agriculture, its average yield is still very low, not exceeding 2.74 t ha-1 nationally and 2.67 t ha-1 regionally (CSA, 2018) as compared to the world average 3.0 t ha-1 (FAOSTAT, 2013). The low yield and reduction in productivity of wheat could be due to low soil fertility, in addition to other biotic and abiotic factors (Tesfaye, 1988).

E-mail: *abehegeno@gmail.com*

https://doi.org/10.20372/ejssdastu:v9.i2.2022.414

Inadequate agronomic and soil management, insufficient level of technology generation and dissemination are the most significant problems to enhancing bread wheat production in Ethiopia. On the other hand, low soil fertility followed by slow progress in developing wheat with durable resistance to disease, pests and weeds is considered the most important constraint limiting bread wheat production in Ethiopia (Demeke and DiMarcantonio, 2013). Soil fertility improvement requires a balanced application of inorganic and organic nutrient sources (Teklu and Hailemariam, 2009). Inorganic fertilizers have been the important tools to overcome soil fertility problems and they are also responsible for a large part of the food production enhancement worldwide (Sanchez et al., 1997). It has been estimated that at least 30 to 50% of crop yield increment is attributable to the application of commercial fertilizers (Stewart et al., 2005).

Plants require essential nutrients with adequate amounts for better production (Alloway, 2003). However, in Ethiopia, only di-ammonium phosphate (DAP) and Urea for the past many years has been used for crop production. According to (ATA, 2016), in addition to nitrogen and phosphorous, other nutrients like sulfur, potassium, boron, zinc, and copper are identified as low in Ethiopian soil and are needed to address the key nutrient deficiencies. The soil of the study area lacks some major macronutrients like nitrogen and phosphorus, secondary macronutrients like sulphur, and some - micronutrients especially boron; not only in the study area most of the soil of Debub Ari District lacked the above nutrients (ATA, 2016). Therefore, this study was done with the general objective of evaluating the effect of blended fertilizer types and rates on growth, yield, and yield components of wheat production.

2. Materials and Methods

2.1. Description of the Study Area

The experiment was conducted at Debub Ari district South Omo Zone, Southwestern Ethiopia for two consecutive years (2018 and 2019) during main cropping season. Geographically, the site is located at 05°50’ N and 36°41’ E with an altitude of 1930 m.a.s.l. It is found in the northeastern direction at a distance of 18 km from Jinka town. The experimental site has a bi-modal rainfall pattern with a shorter rainy season from March-May and the longest rainy season from August to November. The long-term mean annual is 1342.03 mm and the maximum and minimum monthly average temperatures of the study area are 27.61 and 16.3°C, respectively.

2.2. Treatments and Experimental Design

The experiment having nine treatments was laid out in a Randomized Completely Block Design (RCBD) with three replications with a plot size of 4m*4m. Net plot size 3m*4m was used for the data collection. The treatments consists of four rates of NPS and four rates of NPSB blend viz. control (no fertilizer), 142 kg NPS + 42 kg urea, 189 kg NPS + 72 kg urea, 237 kg NPS + 102 kg urea, 142 kg NPS + 159 kg urea, 150 kg NPSB + 41 kg urea, 200 kg NPSB + 72 kg urea, 250 kg NPSB + 102 kg urea, and 150 kg NPSB + 161 kg urea. The amount of nutrients present in applied blended fertilizers is explained in Table 1. A blended fertilizer NPS and NPSB were used based on soil fertility and fertilizer type recommendation Atlas Map for SNNPRS (ATA, 2016).

A full dose of NPS and NPSB was applied in the rows mixed with soil just at the time of planting. Whereas nitrogen was split twice, half was applied at planting, and a half was applied 35 days after planting. Improved wheat variety was used for the experiment, and all management practices were applied as per research recommendations for wheat. All necessary agronomic and soil data collection were done at appropriate crop growth stages following recommended procedures.

2.3. Data Collection

2.3.1. Agronomic characters

Data for yield and yield components were collected as per the procedures mentioned as follows. For plant height, five plants from the central rows of each plot were randomly selected. Then the average values of these plants were recorded. Grain yield and biomass were determined by harvesting the entire net plot area and converted into kilograms per hectare. Thousand seed weight was counted at random from total grain yield and weighed by using sensitive balance and expressed

Table 1: Treatments description, fertilizer rates and their composition

No.	Treatments	Nutrient contents (%) in fertilizers types			
		N	P_2O_5	S	B
1	No fertilizer	-	-	-	-
2	142 NPS+42 kg urea	46	54	10	-
3	189 NPS +72 kg urea	69	72	13	-
4	237 NPS+102 kg urea	92	90	17	-
5	142 NPS+159 kg urea	92	54	10	-
6	150 NPSB+41 kg urea	46	54	10	1.07
7	200 NPSB+72 kg urea	69	72	13	1.4
8	250 NPSB+102 kg urea	92	90	17	1.7
9	150 NPSB + 161kg urea	92	54	10	1.07

in grams. Number of tillers per plant, spike length, and number of seeds per spike were also recorded.

2.3.2. Soil Sampling

Soil samples were randomly taken from the experimental field at a depth of 0 to 20 cm using an auger in a zigzag pattern, and composited into one sample before sowing the crop. Before analysis, the samples were air-dried and ground to pass through a 2 mm sieve for analysis of selected soil physicochemical properties other than organic carbon (OC) and total nitrogen (TN), which were ground to pass through a 0.5 mm sieve to remove course materials. The soil samples were analyzed using standard soil laboratory procedures at Jinka Agricultural Research Center Soil Laboratory.

2.4. Data Analysis

The collected data was subjected to analysis of variance (ANOVA) as per the design used in the experiment SAS version 9.1 Statistical Software. Least Significant Difference (LSD) was used to separate means at ($p<0.05$) probability levels of significance (SAS Institute, 2007). Pearson correlations were done to determine linear associations between agronomic parameters.

2.5. Partial Budget Analysis

For the economic evaluation, partial budget and marginal analyses were performed to investigate the economic feasibility of inputs at planting and for outputs at the crop harvest. Current prices of wheat, urea and blended fertilizer were used for the analysis. The potential response of crop towards the added fertilizer and price of fertilizers during planting ultimately determine the economic feasibility of fertilizer application (CIMMYT, 1988). The gross benefit ha-1 is the product of field price and the mean yield for each treatment. The total variable cost (TVC) is the sum of the cost of fertilizer and the cost of fertilizer application. The net benefit per hectare for each treatment is the difference between the gross benefit and the total variable costs. For each pair of treatments, a percent marginal rate of return (MRR) was calculated. To obtain an estimate of these returns, MRR was calculated using the following formula:

$$\text{MRR}\ (\%) = \frac{\text{Change in Net benefit (NB2} - \text{NB1)} \ * 100}{\text{Change in TVC (TVC2} - \text{TVC1)}}$$

where, NB1- Net benefit at level one; NB2- Net benefit at level two; TVC1-Total variable cost at level one and TVC2-Total variable cost at level two.

3. Results and Discussion

3.1. Soil Fertility Status before Planting

The analyzed soil data before planting indicated that the textural class of the surface soil was clay and the soil was moderately acidic (pH 5.61) with high organic carbon (°C) and total nitrogen (TN) contents (Tekalign, 1991) (Table 2). Available phosphorus (P) content (3.59 ppm) was very low (Jones, 2003) and it is indicative of soil has probable yield responses to P application. Available B content of the soil in the experimental field was low (Jones, 2003). According to Hariram and Dwivedi (1994), the available sulfur content of the soil in the experimental field is 18.46 ppm which is high.

Table 2: Some soil physical and chemical properties of the experimental site before planting in Debub Ari during the 2018 and 2019 cropping seasons

Soil properties	Values	Rates	References
Clay	69		
Silt	20		
Sand	11		
Textural class		Clay	
pH(H_2O)	5.61	Moderately acidic	Jones, 2003
Organic carbon (%)	3.54	High	Tekalign, 1991
Total N (%)	0.25	High	Tekalign, 1991
Available P (ppm)	3.59	Very low	Jones, 2003
Available S(ppm)	18.46	Medium	Hariram and Dwivedi, 1994
Available B (ppm)	0.12	Low	Jones, 2003

Generally, the soils of the experimental field had characterized to be low available P, B, and S which indicated that potentially reduced the yield of wheat production. However, the soils of the study site had high OC and TN. Thus, an additional application of P, B, and S have enhanced the grain yield of wheat in the study area.

3.2. Growth Parameters

3.2.1. Plant Height

The result analysis of variance indicated that the applied blended fertilizer types and rates - significantly ($P<0.05$) affected the plant height of wheat. The highest plant height (85.57 cm) was recorded from the application of 237 kg NPS + 102 kg urea (92N, 90 P_2O_5, 17S) ha^{-1}. However, the lowest plant height (67.17 cm) was recorded from the control plot, but the other treatments were statistically non-significant from each other (Table 3). The increment in plant height might be due to the greater role of N applied for elongation and vegetative growth of wheat. On the other hand, the minimum plant height in control plots might have been due to low soil fertility status in the experimental field. A similar result was also reported by Sofonyas et al. (2021) who reported that the application of 300 kg of NPSZn ha^{-1} blended fertilizer significantly increased the plant height of bread wheat compared to unfertilized treatments. Haji et al. (2020) also reported that the maximum plant height (118.06 cm) was obtained from the application of 200 kg NPS ha^{-1} blended fertilizer while the minimum (86.2 cm) was obtained from control treatments.

3.2.2. Spike Length

Spike length of wheat was significantly ($P<0.05$) affected by the applied blended fertilizer types and rates as compared to the unfertilized plot. The maximum spike length (8.85cm) was recorded from the application of 237 kg NPS + 102 kg urea ha^{-1} while the minimum spike length (7.77 cm) was recorded from the control plot (Table 3). However, there was a non-significant difference was observed within applied blended fertilizer. Similar to this result, Haji et al., (2020) reported that the maximum (9.37 cm) spike length was obtained from 200 kg NPSB ha^{-1} blended fertilizer whereas the minimum (6.14 cm) was from the control (unfertilized) treatment. The spike length increment with the blended fertilizer application might be supplying better photo assimilation (Berhan, 2012). The author also observed that the higher the spike length produced the higher grain per spike leading to a higher yield.

3.3. Yield and Yield Components

3.3.1. Number of Tillers per Plant

Number of tillers per plant significantly ($P<0.05$) influenced by the application of blended fertilizer types and rates as compared to unfertilized treatments. The maximum number of tillers per plant (6.1) was obtained with the application of blended fertilizer 237 kg NPS + 102 kg urea (92N, 90 P2O5, 17S) ha^{-1}, while the minimum number of tillers per plant (3.45) was obtained from the unfertilized plots (Table 3). This result is in line with that of Seyoum (2017), who reported that the highest number of tillers per plant of bread wheat due to the combined application of 200 kg NPS + 92 kg N ha^{-1} indicates the positive role of the optimum rate of nitrogen for tillering.

3.3.2. Number of Seeds per Spike

The analysis of variance showed that there was a significant difference among the applied blended fertilizer types and rates (P≤0.05) on the number of seeds per spike. The highest number of seeds per spike (38.6) was obtained from the plot treated with 237 kg NPS + 102 kg urea (92N, $90P_2O_5$, 17S) ha^{-1}, while the lowest (23.8) was recorded from the control treatment (Table 3). The maximum rate of NPS blended fertilizer enhanced the number of seeds per plant by 62% over the control treatments. In agreement with this result, Abebual et al. (2019) reported that a maximum (50.47) number of seeds per spike of wheat were obtained from the application of the NPSZnB ($175N+125P_2O_5$+11.1S+3.3Zn+0.15B) kg ha^{-1} fertilizer rate while the minimum (32.73) was obtained from the control plot.

3.3.3. Thousand Seed weight

The analysis of variance showed that thousand kernel weight was significantly affected (P ≤ 0.05) by the different blended fertilizer types and rates. The maximum thousand kernel weight was obtained from the rate of 237 kg NPS + 102 kg urea (92N, $90P_2O_5$, 17S) ha^{-1} (Table 3), which is higher by about 27% as compared to thousand kernel weight obtained from the unfertilized plot. This result is in line with Dinkinesh et al. (2020), who reported that a maximum (44.8 g) 1000 kernels weight with the application of 183 kg NPSB ha^{-1} rate while the minimum (37.2 g) was recorded from an unfertilized plot.

3.3.4. Above Ground Biomass

The aboveground biomass was significantly (P < 0.05) influenced by the application of blended fertilizer types and rates as compared to the unfertilized plot. The maximum aboveground biomass (7652.8 kg ha^{-1}) was obtained from the application of 237 kg NPS + 102 kg urea (92N, 90P2O5, 17S) ha^{-1} whereas the minimum aboveground biomass (4086.8 kg ha^{-1}) was recorded from the control (Table 3). Application of 237 kg NPS + 102 kg urea (92N, $90P_2O_5$, 17S) ha^{-1} increases aboveground biomass by 87.3% as compared with the unfertilized treatment. The increment of aboveground biomass might be due to improvement of root growth and increased uptake of nutrients favoring better growth and tillering (Dinkinesh et al., 2020). Similarly, Abebual et al. (2019) reported that the highest total biomass (14290 kg ha-1) from the treatment with the application of NPSZnB ($175N+125P_2O_5$+11.1S+3.3Zn+0.15B) $kgha^{-1}$, while the minimum (3390 kg ha^{-1}) was recorded from the control treatment.

3.3.5. Grain yield

The analysis of variance revealed that the different level of blended fertilizer types had a significant ($P<0.05$) influence on the grain yield production (Table 3). The study showed that the maximum grain yield of 3796.7 kg ha^{-1} was obtained from the plots maintained by 237 kg NPS + 102 kg urea (92N, $90P_2O_5$, 17S) ha^{-1} application whereas the minimum 1466.5 $kgha^{-1}$ was obtained from unfertilized plots (Table 3). Application of 237 kg NPS + 102 kg urea (92N, 90P2O5, 17S) ha^{-1} improves grain yield production by 58.9% as compared to the unfertilized plot. The maximum grain yield from the highest NPS rates with optimum N amounts might have due to resulting in improved root growth and enhanced uptake of nutrients which increased yield and yield components. Similar result was obtained by Abebual et al. (2019) who reported that the highest grain yield (5770 $kgha^{-1}$) obtained from the application of NPSZnB ($175N+125P_2O_5$+11.1S+3.3Zn+0.15B) kg ha^{-1} whereas, the lowest was recorded from unfertilized plots. Similarly, Dinkinesh et al. (2020) reported that the treatments that received blended fertilizers of 183 kg ha^{-1} NPSB increased grain yield of wheat as compared to the control. Sofonyas et al., (2021), also reported the maximum grain yield of wheat (3580.2 kg ha^{-1}) was obtained from 200 kg NPSZn ha^{-1} fertilizer application over the unfertilized plot.

Table 3: Growth, yield and yield components of wheat as influenced by blended fertilizer type and rate in Debub Ari during the 2018 and 2019 cropping seasons

Treatments (kg/ha)	**No. of tiller per plant**	**PH (cm)**	**Spike length (cm)**	**seed/spike**	**TSW (Gram)**	**Biomass ($Kgha^{-1}$)**	**Yield ($Kgha^{-1}$)**
No fertilizer	3.45^{c}	67.17^{d}	7.77^{c}	23.8^{c}	32.49^{e}	4086.80^{d}	1466.50^{d}
142 NPS + 42 kg urea	4.42^{bc}	77.73^{b}	8.16^{bc}	31.27^{b}	39.47^{ab}	5692.70^{bc}	2768.20^{b}
189 NPS + 72 kg urea	4.33^{bc}	78.67^{b}	8.55^{ab}	30.57^{b}	37.83^{bc}	6062.50^{bc}	2618.90^{bc}
237 NPS + 102 kg urea	6.10^{a}	85.57^{a}	8.85^{a}	38.60^{a}	41.17^{a}	7652.80^{a}	3796.70^{a}
142 NPS + 159 kg urea	3.97^{bc}	74.07^{c}	8.08^{bc}	32.67^{b}	34.78^{de}	5274.30^{cd}	2166.50^{c}
150 NPSB + 41 kg urea	4.47^{bc}	79.37^{b}	8.08^{bc}	29.97^{b}	38.63^{abc}	5921.90^{bc}	2567.60^{bc}
200 NPSB + 72 kg urea	4.00^{bc}	79.30^{b}	8.35^{abc}	29.80^{b}	38.06^{bc}	6597.20^{ab}	2806.10^{bc}
250 NPSB + 102 kg urea	4.53^{b}	77.33^{b}	7.77^{c}	32.67^{b}	39.04^{abc}	6489.60^{ab}	2608.00^{bc}
150 NPSB + 161kg urea	4.53^{b}	78.43^{b}	8.35^{abc}	32.80^{b}	36.35^{cd}	6.39.90^{bc}	2750.40^{b}
LSD (5%)	1.06	2.87	0.61	5.53	3.03	1210.6	554.43
CV	13.85	2.14	4.29	10.2	4.67	11.69	12.24

***NB.** Means with the same letter are statistically not significant at 5% level of significance, CV=Coefficient of variation, LSD= Least significance difference, PH= Plant height, TSW= Thousand Seed weight*

3.4. Correlation analysis

Correlation between growth and yield components of common bean as influenced by the application of blended fertilizers was computed and its results are presented in Table 4. Significant and positive correlation of grain yield with the other yield components was observed. This indicates that, grain yield of wheat could be invariably enhanced by increasing those characteristics. Grain yield was significantly and positively associated with number of tillers per plant (r= 0.65***), plant height (r= 0.83***), spike length (r= 0.49*), number of seeds per spike (r= 0.58**), above ground biomass (r= 0.79***) and thousand seed weight (r= 0.84***) (Table 4). The result indicated that the applied fertilizers have significant and positive contribution to the economic yield. This result was supported by the recent findings of Abebual et al. (2019) who reported that significant and positive association of grain yield with number of tillers per plant, plant height, spike length, number of seeds per spike, above ground biomass and thousand seed weight was observed on bread wheat.

Table 4: Correlation coefficients between mean agronomic parameters of wheat grown under blended fertilizers

	NTP	PH	SL	NSS	BM	GY	TSW
NTP	1						
PH	0.61***	1					
SL	0.46*	0.53**	1				
NSS	0.62***	0.64**	0.47*	1			
BM	0.66***	0.79***	0.36NS	0.63***	1		
GY	0.65***	0.83***	0.49*	0.58**	0.79***	1	
TSW	0.53**	0.73***	0.27NS	0.49*	0.77***	0.84***	1

***Note**: NTP- Number of tillers plant^{-1}, PH- Plant height, SL-Spike length, NSS- Number of seed spike^{-1}, BM- Aboveground biomass, GY-Grain yield, TSW- Thousand seed weight, NS- non-significant and *, ** *** stands for significantly different at 5%, 1%, and 0.1%, respectively.*

3.5. Partial Budget Analysis

The partial budget analysis was significantly affected by the application of different blended fertilizer types and rates (Table 5). According to the economic analysis, a maximum net benefit of 56550.08 ETB ha^{-1} was obtained from the plot received from 237 kg NPS + 102 kg urea ha^{-1} which was economically superior treatment, followed by 142kg NPS + 42 kg urea ha^{-1} blended fertilizers, which had a total net benefit of 40200.92 ETB ha^{-1}. While the minimum net benefit (27716.85 ETBha^{-1}) was obtained from unfertilized plots (Table 5). The highest net benefits from the application of blended fertilizers for the production of the wheat might not be enough for the farmers to accept as good practices but also farmers prefer the highest profit *i.e.* with low cost and high income. For this purpose, it is necessary to conduct a marginal rate of return and dominated treatment analysis (CIMMITY, 1988). To determine treatments with the maximum return to the farmer investment, marginal rate of return and dominant analysis was performed over the control treatment. The maximum marginal rate of return (16151.8%) was obtained from the application of 237 kg NPS + 102 kg urea ha^{-1} blended fertilizer (Table 6). Therefore, the result revealed that the application of 237 kg NPS + 102 kg urea ha^{-1} blended fertilizer gives 16151.8%, which is well above the 100% minimum rate of return, which was considered as the optimum for the recommendation. This treatment shows the maximum net benefit, relatively low variable cost, and acceptable marginal rate of return when compared with the other treatments.

Table 5: Partial budget analysis of blended fertilizer type and rates on wheat production in Debub Ari during the 2018 and 2019 cropping seasons

No.	Treatments (kg/ha)	Variables				
		Average Yield kgha^{-1}	10%Adjusted Yield kgha^{-1}	Gross benefit (ETB ha^{-1})	Total variable cost (TVC) (ETB ha^{-1})	Net benefit (ETB ha^{-1})
1	Control (No Fertilizer)	1466.5	1319.85	27716.85	0	27716.85
2	142 kg NPS + 42 kg Urea	2768.2	2491.38	46259.95	6059.03	40200.92
3	189 kg NPS + 72 kg Urea	2618.9	2357.01	42340.65	7156.56	35184.09
4	237 kg NPS + 102 kg Urea	3796.7	3417.03	64818.16	8268.08	56550.08
5	142 kg NPS + 159 kg Urea	2166.5	1949.85	32678.77	6939.47	25739.3
6	150 kg NPSB + 41 kg Urea	2567.6	2310.84	42149.49	6378.15	35771.34
7	200 kg NPSB + 72 kg Urea	2806.1	2525.49	45429.01	7606.28	37822.73
8	250 kg NPSB + 102 kg Urea	2608	2347.2	40471.46	8819.74	31651.72
9	150 kg NPSB + 161 kg Urea	2750.4	2475.36	43843.54	8139.02	35704.52

10% Adj. Yield= Marketable Yield Adjusted to 10% downward; ETB= Ethiopian Birr

Table 1: Dominance and marginal analysis, wheat yield production by blended fertilizer type and rate in Debub Ari during the 2018 and 2019 cropping seasons

Treatments (kg/ha)	Variables				
	10% Adjusted Yield kgha^{-1}	TVC (ETBha^{-1})	Net Benefit (ETBha^{-1})	Dominance Analysis	MRR (%)
No fertilizer	1319.85	0	27716.85	-	-
142 kg NPS + 42 kg urea	2491.38	6059.03	40200.92	ND	206.04
150 kg NPSB + 41 kg urea	2310.84	6378.15	35771.34	D	-
142 kg NPS + 159 kg urea	1949.85	6939.47	25739.3	D	-
189 kg NPS + 72 kg urea	2357.01	7156.56	35184.09	D	-
200 kg NPSB + 72 kg urea	2525.49	7606.28	37822.73	D	-
150 kg NPSB + 161kg urea	2475.36	8139.02	35704.52	D	-
237 kg NPS + 102 kg urea	3417.03	8268.08	56550.08	ND	16151.8
250 kg NPSB + 102 kg urea	2347.2	8819.74	31651.72	D	-

Treatments which carries D = Dominated and ND= Non-dominant

4. Conclusion and Recommendation

The application of blended fertilizer types and rates showed significant differences for yield and yield components of wheat. The application of blended fertilizer at the rate of 237 kg NPS + 102 kg urea (92N, $90P_2O_5$, 17S) ha^{-1} resulted in the maximum grain yield, total biomass, plant height, number of tillers per plant, spike length, number of seeds per spike, and thousand kernels weight. The current study revealed that the maximum grain yield of 3796.7kg ha^{-1} was obtained from the plots received 237 kg NPS + 102 kg urea (92N, $90P_2O_5$, 17S) ha^{-1} of blended fertilizer application. The partial budget analysis also indicated that the maximum net benefit (56550.08 ETB ha^{-1}) with acceptable marginal rate of return (MRR %) 16151.8% was obtained with application of 237 kg NPS + 102 kg urea (92N, $90P_2O_5$, 17S) ha^{-1} blended fertilizer. Thus, based on the grain yield and economic analysis, the application of 237 kg NPS + 102 kg urea (92N, $90P_2O_5$, 17S) ha^{-1} blended fertilizer can be recommended for Debub Ari district and other areas with similar agro-ecology and soil conditions. However, to reach at a further recommendation, further investigations are needed each nutrients omission and commission and blended fertilizer formulation types.

Acknowledgements

The authors thank Southern Agricultural Research Institute (SARI) for financially supporting the field experiment. And also very grateful to Jinka Agricultural Research Center for the analysis of the soil parameters and for the facilitation of the vehicle and other accommodations to conduct the research.

Reference

Abebual Woldetsadik, Wondwosen Tena & Asmare Melese (2019). Effect of Different Blended Fertilizer Formulation on Yield and Yield Components of Bread Wheat (Triticum aestivum L.) in Siyadebrenawayu District, North Shewa, Ethiopia. Journal of Biology, Agriculture & Healthcare, 9 (15), 13-23.

Alloway, B.J. (2003). Zinc in soils and crop nutrition. International Zinc Assocation. pp114. http:// www.zinccrops.org

ATA (Agricultural Transformation Agency) (2016). Soil Fertility Status and Fertilizer Recommendation Atlas of the Southern Nations Nationalities and Peoples' Regional State, Ethiopia, by Ministry of Agriculture and Natural Resources and Agricultural Transformation Agency, Ethiopian, Addis Ababa, Ethiopia.

Bekele Hundie, Mawangi, W. & Tanner DG. (2000). Adaptation of improved wheat technologies in Addaba and Dodola woredas of the Bale high lands of Ethiopia CIMMYT/EARO, Addis Ababa, Ethiopia. Bread wheat cultivars released in Ethiopia from 1949 to 1987.

Berhan Abayu (2012). Agronomic and Economic Effects of Blended Fertilizers under Planting Method on Yield and Yield Components of Tef: MSc Thesis, Mekelle University, Mekelle, Ethiopia.

CIMMYT. (1988). From agronomic data to farmer recommendations: An Economics Training Manual. Completely revised edition. Mexico. D.F.

CSA (Central Statistics Agency) (2018). The Federal Democratic Republic of Ethiopia Central Statistical Agency agricultural sample survey report on area and production of major crops (private peasant holdings, meher season), Volume I, Statistical Bulletin 586, Addis Ababa Ethiopia, 2017/18 (2010 E.C.)

Demeke Mekonnen & Di Marcantonio F. (2013). Analysis of incentives and disincentives for wheat in Ethiopia. Technical notes series, MAFAP, FAO, Rome.

Dinkinesh Abera, Tamado Tana & Tadesse Dessalegn (2020). Effects of blended NPSB fertilizer rates on yield and grain quality of durum wheat (Triticum turgidum L.) varieties in Minijar Shenkora District, Central Ethiopia. Ethiopian Journal of Agricultural Sciences, 30(3), 57–76. https://www.ajol.info/index.php/ejas/article/view/198452

Efrem Bechere, Hirut Kebede & Getachew Belay (2000). Durum wheat in Ethiopia: An old crop in an ancient land. Institute of Biodiversity Conservation and Research. Addis Ababa, Ethiopia.

FAOSTAT (The Food and Agriculture Organization Corporate Statistical Database) (2013). Agricultural production Statistics. (http://www.fao.org/faostat.)

Haji Jewaro Beketa, Demelash Kefale & Tarekegn Yoseph (2020). Effect of Blended Fertilizer Types and Rates on Growth, Yield and Yield Components of Bread Wheat (Triticum aestivum L.) in Wondo District, Southern Ethiopia. International Journal of Agriculture Innovations and Research, 8(4), 326-342.

Hariram & Dwivedi, K.N. (1994). Delineation of sulfur deficient soil group in the central alluvial tract of Uttar Pradesh. Journal of the Indian SSS, 42, 284-286.

Jones, J.B. (2003). Agronomic Handbook: Management of Crops, Soils, and Their Fertility. CRC Press LLC, Boca Raton, FL, USA.

Sanchez, A. P. & Leakey, R. B. (1997). Land use transformation in Africa: three determinants for balancing food security with natural resource utilization. Agron J., 7, 15-23.

SAS (Statistical Analysis Systems) (2007). SAS/STAT user's guide Version 9.1 Cary NC: SAS Institute Inc. USA

Seyoum Alemu (2017). Effect of blended NPS and N fertilizer rates on yield components, yield and grain protein content ofbread wheat (Triticum aestivum L.) in Bore district, Guji Zone, Southern Ethiopia. MSc Thesis. School of Plant Sciences, Haramaya University, Ethiopia.

Sofonyas Dargie, Fisseha Hadgu, Hagos Brhane, Tsigabu Mehari , Molla Hadis, Girmay Hailu & Daniel Berhe (2021). Evaluation of NPSZn Blended Fertilizer on Yield and Yield Traits of Bread Wheat (Tritcum aestivum L .) on Cambisols and Vertisols. Ethiop. J. Agric. Sci. 31(2), 33-43.

Stewart, W. M., Dibb, D. W., Johnston A. E. & Smyth, T. J. (2005). The contribution of commercial fertilizer nutrients to food production. Agron J. 97, 1-6.

Tekalign Tadesse (1991). Soil, plant, water, fertilizer, animal manure and compost analysis. Working Document No. 13. International Livestock Research Center for Africa, Addis Ababa, Ethiopia.

Teklu Erkossa & Hailemariam Teklewold (2009). Agronomic and Economic Efficiency of Manure and Urea Fertilizers Use on Vertisols in Ethiopian Highlands. Agricultural Sciences in China. 8(3), 352–360.

Tesfaye Tesemma (1988). Durum wheat breeding in Ethiopia. In:Van Ginkel, M. and D.G. 18-22.:616.