International Journal of Research Studies in Agricultural Sciences (IJRSAS)
Volume 8, Issue 1, 2022, PP 28-37
ISSN No. (Online) 2454–6224
DOI: http://dx.doi.org/10.20431/2454-6224.0801004
www.arcjournals.org

Effect of NPS-B Blended Fertilizer and Nitrogen Application on Bread Wheat Yield and Economic Profitability on Nitisols of Southern, Ethiopia

Melkamu Hordofa Sigaye*, Ribika Mekuria and Kidist Kebede

Ethiopian Institute of Agricultural Research Institute, Wondo Genet Agri. Research Center Shashemane Ethiopia.

Corresponding Authors:** ***Melkamu Hordofa Sigaye, *Ethiopian Institute of Agricultural Research Institute, Wondo Genet Agri. Research Center Shashemane Ethiopia.*

Abstract: *The drive for higher agricultural production without balanced use of fertilizers created problems of soil fertility exhaustion. Inorganic fertilizers have been an important tool to overcome soil fertility problems and are also responsible for a large part of the food production increases. The study was conducted at Bule southern, Ethiopia, and aimed to determine the optimum level of NPS-B blended fertilizers by supplementing N from urea rates for maximum yield of bread wheat production and to determine the economically optimum level of NPS-B and by supplementing N from urea fertilizer. The treatments were: (100 kg ha^{-1} NPSB + 150 kg ha^{-1} Urea), (150 kg ha^{-1} NPSB + 150 kg ha^{-1} Urea), (200 kg ha^{-1} NPS + 150 kg ha^{-1} Urea), (250 kg ha^{-1} NPSB + 150 kg ha^{-1} Urea), (100 kg ha^{-1} NPSB + 250 kg ha^{-1} Urea), (150 kg ha^{-1} NPS + 250 kg ha^{-1} Urea), (200 kg ha^{-1} NPSB + 250 kg ha^{-1} Urea), (250 kg ha^{-1} NPBS + 250 kg ha^{-1} Urea), (100 kg ha^{-1} NPSB + 350 kg ha^{-1} Urea), (150 kg ha^{-1} NPSB + 350 kg ha^{-1} Urea), (200 kg ha^{-1} NPSB + 350 kg ha^{-1} Urea), (250 kg ha^{-1} NPSB + 350 kg ha^{-1} Urea), control and R-NP (69N and 20P). The treatments were arranged in a randomized complete block design and replicated three times. The maximum on biomass yield (13994.0 kg ha^{-1}), grain yield (6990.6 kg ha^{-1}), and straw yield (76201 kg ha^{-1}) were obtained from the application of 200 kg ha^{-1} of NPSB and 250 kg ha^{-1} of Urea and followed by recommended NP fertilizers and of 250 kg ha^{-1} of NPSB and 250 kg, ha^{-1} of Urea were superior to all of the other treatments. However, the lowest above-ground biomass, grain, and straw yields were obtained from control or unfertilized plot. The economic analysis revealed that the highest net benefit of 178860.4 ETB ha^{-1} with a marginal rate of return (MRR%) of 309.0 % was obtained in response to the application of 200 kg ha^{-1} of blended NPS-B with 250 kg ha^{-1} of Urea. However, the lowest net benefit was obtained from an unfertilized or control plot. Therefore, applications of 200 kg ha^{-1} NPSB of blended plus 250 kg ha^{-1} of urea is economically advisable for farmers in the Bule districts southern, Ethiopia and areas with similar agro-ecological and soil conditions for better bread wheat production;*

Keywords: *Grain yield, Wheat, Nitrogen, and NPS-B blended fertilizers*

1. Introduction

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops worldwide and is a common component of the diet for more than one-third of the world population (Desta *et al.* 2017). In Ethiopia, wheat provides about 15% of the daily caloric intake of the population (FAO 2015). Wheat in Ethiopia is widely cultivated in the middle to high-altitude zones (1 800–2 400 m) on about 1.7 million ha, with a current annual total grain production of 4.6 million tons generated by 4 million smallholder farmers (CSA 2018a). In the southern highlands, wheat is the third-largest cereal after maize and teff, providing a means of livelihood for more than half a million smallholder farmers (CSA 2018a). However, the wheat yield remains low at 2.6 t/ha, about half of that obtained at the station trials (5.0 t/ha) in Ethiopia (Samuel *et al.* 2017) and slightly lower than the national average (2.7 t/ha).

As a result of low productivity, the country has been forced to import about one million tons of wheat grain annually, at the cost of over 500 million USD, to fill the domestic grain demand (Elias et al. 2019). Such low levels of wheat yield are widely believed to be due to low soil fertility caused by low and unbalanced fertilizer application (Abdulkadir *et al*. 2017; Elias 2019). Previous studies suggested that N and P are the most limiting nutrients on Nitisols (Abebe *et al.* 2018). On the other hand, continuous application of DAP (Di-Ammonium Phosphate: 18–46% N-P_2O_5) containing only nitrogen (N) and phosphorus (P) without due consideration of other nutrients is known to cause depletion of secondary and micronutrients (Elias *et al.* 2019). Until recently, the agricultural extension program has promoted a blanket recommendation of 100 kg DAP and 100 kg urea/ha for all cereal crops and soil types but the actual application rate is 65 kg DAP and 45 kg urea/ha (Elias 2017).

The low and unbalanced fertilizers application together with poor soil fertility management is presented as the major cause for low agricultural productivity in Ethiopia (Hailu *et al.* 2015). Under such conditions, the application of multi-nutrient blended fertilizers is acknowledged for being able to enhance the productivity and nutrient use efficiency of crops (Elias *et al.* 2019). Recently, according to the soil fertility map Ethiopia soil analysis data revealed that the deficiencies of most of the nutrients such as nitrogen (86%), phosphorus (99%), sulfur (92%), born (65%), zinc (53%), potassium (7%), copper, manganese, and iron were widespread in Ethiopian soils (Ethio-SIS, 2016). Similarly, Asgelil *et al.* (2007) found that the soil analyses and site-specific studies also indicated that elements such as K, S, Ca, Mg, and micronutrients (Cu, Mn, B, Mo, and Zn) were becoming depleted and deficiency symptoms were observed in major crops in different parts of the country. Inorganic fertilizers have been an important tool to overcome soil fertility problems and are also responsible for a large part of the food production increases.

The drive for higher agricultural production without balanced use of fertilizers created problems of soil fertility exhaustion and plant nutrient imbalances not only of major but also of secondary macronutrient and micronutrients. Similarly (Fageria and Baligar, 2001 and Singh, 2011) stated that the deficiencies of secondary macronutrients and micronutrients will arise if they are not replenished timely under intensive agriculture. Consequently, to overcome this problem, multi-nutrient balanced fertilizers containing N, P, K, S, B, and Zn in blended form have been issued to ameliorate site-specific nutrient deficiencies and thereby increase crop production and productivity.

Having considered the problems outlined above, the Ethiopian government has been promoting the use of multi-nutrient blend fertilizers since 2015 (Simtowe 2015). The promotion of blend fertilizer follows from the results of the soil fertility survey and preparation of the regional nutrient deficiency atlas of the country under the Ethiopian Soil Information System project (Ethio-SIS 2016). To supply sulfur and Boron commercial fertilizer, DAP is replaced by NPSB. Since the composition of newly introduced fertilizer differs from that of familiar fertilizer (DAP), the appropriate rate is not determined, and insufficient information for bread wheat production in the study area. Therefore, this research aimed to determine the optimum level of NPSB by supplementing N from urea for maximum yield of bread wheat production and to determine the economically optimum level of NPSB by supplementing N from urea fertilizer at Bule district southern, Ethiopia.

2. MATERIALS AND METHODS

2.1. Description of Experimental Area

The experiment was conducted during 2019-2020 the main cropping season at Bule woreda, Dasura kebele Ethiopia. Geographically the site is located at N 06^0 20’ 19” E 38^0 26’38” with an altitude of 2410 *m. a. s l.* The mean annual rainfall of the site is 1401-1800 mm, with the mean average temperature ranging between 12.6^o–20^{o}C. The rainfall is bimodal with long growing periods from mid-March to the end of October, about 87 % of the total rainfall of the area occurs from mid-June to mid-September, with its peak in June and August, which caused soil loss and nutrient leaching. According to FAO, (1998) the dominant soil type of experimental site was nitisols This soil originated from kaolinitic minerals which are inherently low in nitrogen phosphorus cations exchange capacity, pH, and high exchangeable acidity.

2.2. Experimental set-up and procedure

The experimental sites were prepared for sowing using standard cultivation practices and were plowed using oxen-drawn implements. The experiment was laid out in randomized complete block design with three replicates for each treatment and detail of the treatments (Table 1). The nutrients level of in 100 kg of NPS-B were (19 N – 36.1 P_2O_5 – 0.0 K_2O + 6.7 S + 0.0 Zn + 0.71 B). The blended and DAP fertilizers were basal applied once at planting. To minimize losses and increase efficiency, all the N fertilizer (urea) was applied in the row in two applications: half at planting and the other half 40 days after planting, during the maximum growth period of the crop at full tillering stage, after first weeding and during light rainfall to minimize N loss. Lime ($CaCO_3$) was evenly broad casted manually and mixed thoroughly in upper soils at 15 cm plow depth applied uniformly for all experimental units one month before seed sowing based on exchangeable acidity and lime requirement was calculated by formula.

$$LR, CaCO_3\ (kg/ha) = \frac{cmolEA/kg\ of\ soil * 0.15\ m * 10^4\ m^2 * B.D.(Mg/m^3) * 1000}{2000}$$

Table 1. Detail of treatment set up and nutrient levels

Treat	Urea (kg ha^{-1})	NPS-B (kg ha^{-1})	Nutrient level (kg ha^{-1})			
			N	P_2O_5	S	B
1	Control	0	0	0	0	0
2	*Rec-N and P*		69	46	0	0
3	150	100	87.10	36.10	6.70	0.71
4	150	150	96.15	54.15	10.05	1.07
5	150	200	105.20	72.20	13.40	1.42
6	150	250	114.25	90.25	16.75	1.78
7	250	100	133.10	36.10	6.70	0.71
8	250	150	142.15	54.15	10.05	1.07
9	250	200	151.20	72.20	13.40	1.42
10	250	250	160.25	90.25	16.75	1.78
11	350	100	179.10	36.10	6.70	0.71
12	350	150	188.15	54.15	10.05	1.07
13	350	200	197.20	72.20	13.40	1.42
14	350	250	206.25	90.25	16.75	1.78

2.3. Soil Sampling and Analysis

Representative composite surface soil samples were collected from 0-20cm depth at each experimental unit just before sowing. After manual homogenization, the samples were ground to pass a 2 mm sieve. Soil particle size distribution was determined by the Boycouos hydrometric method (Van Reeuwijk, 2002); pH of the soils was measured in water suspension in a 1:2.5 (soil: water ratio) (Van Reeuwijk, 2002); organic carbon was determined using the wet oxidation method (Walkley and Black, 1934); total nitrogen was determined using Kjeldahl digestion with concentrated H_2SO_4 and $K_2SO_4^-$ catalyst mixture (Black, 1965); available P was determined using the Olsen method (Olsen *et al.*, 1982); total sulfur in soil extracts was done using Turbidimetric method. The cation exchange capacity was determined after extracting the soil samples by ammonium acetate method (1N NH_4OAc) at pH 7.0 (Sahlemedhin and Taye, 2000). Exchangeable acidity (EA) Al^{+3} and H^+ was determined from a neutral 1N KCl extracted solution through titration with a standard NaOH solution (McLean, 1965).

2.4. Crop Sampling, Harvesting and Data Collection

Randomly five plants were collected for growth and yield component data. Plant height, spike length, number of tillers m^{-2}, number of grains per spike, above ground biomass, grain yield, straw yield, and other parameters were recorded. Seeds were weighed and adjusted to constant moisture levels of 12%.

2.5. Economic Analysis

Economic analysis was performed to investigate the economic feasibility of the treatments. Partial budget and marginal analyses were used. Current prices of wheat, urea, DAP and NPS 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 market cost of wheat grain was 31.00 Eth-birr kg^{-1}. The prices for blended fertilizers NPSB, TSP, and Urea were 21.54, 21.54, and 19.12 Eth-birr kg^{-1}, respectively. The cost of other production practices like, seed and weeding were assumed to remain the same or insignificant among the treatments. Analysis of marginal rate of return (MRR) was carried out for non-dominated treatments, and the MRRs were compared to a minimum acceptable rate of return (MARR) of 100% in order to select the optimum treatment (CIMMYT, 1988). The net benefit per hectare for each treatment is the difference between the gross benefit and the total variable costs. The average yield was adjusted downward by10% to reflect the difference between the experimental field and the expected yield at farmers' fields and with farmer's practices from the same treatments (CIMMYT, 1988).

2.6. Statistical Analysis

Data from the field and laboratory were tested for normality, before being subjected to analysis of variance (ANOVA) using SAS software program version 9.4, (SAS, 2014). The significant difference among treatment means was evaluated using the least significant difference at ($p \leq 0.05$).

3. Result and Discussion

3.1. Soil physicochemical properties of soil

Soil laboratory analysis result shows that soil particle size distributions experimental site soil was 40.2%, 21.3% and 35.5 % sand, silt and clay, respectively. Thus, the soil textural class of the soils of the site was clay loam (FAO, 1998). The pH value of the soil was 5.23 (*1:2.5 soil: water*) which is strong acidic soil (Tekalign,1991). The soil pH has a vital role in determining several chemical reactions in influencing plant growth by affecting the activity of soil microorganisms and altering the solubility and availability of most of the essential plant nutrients particularly the micronutrients such as Fe, Zn, B, Cu and Mn (Sumner, 2000). The organic carbon% and total nitrogen content% of the soil were 2.10% and 0.51% respectively. According to (Tekalign,1991) organic carbon% and total nitrogen content % of the soil was medium/moderate. The soil available P content was 12.50 mg kg^{-1} which is medium (Cottenie 1980) table 2. Whereas, the cation exchange capacity of 25.35 Cmolc kg^{-1} and rated as moderate according to (Hazelton and Murphy, 2007).

Table 2. Some physico-chemical properties of soil

Properties	Values
pH-H2O (1:2.5)	5.23
Sandy (%)	40.2
Silt (%)	21.3
Clay (%)	38.5
Textural class	Clay loam
Total Nitrogen%	0.51
Organic Carbon (%)	2.10
Available Phosphorous	12.50
Available S (%)	1.52
CEC Cmolc kg-1	25.35

3.2. Effects of NPS-B Blended Fertilizer and Nitrogen on Yield and Yield Components Bread Wheat

The analysis of result revealed that application of different rates of NPSB blended and Urea fertilizer brought significant (p<0.001) effect on all of yield components of bead wheat. The plant height was increased by increasing from the rate of urea 150-350 kg ha^{-1} and 150-250 kg ha^{-1} of NPSB blended fertilizer. The pooled mean result show that the longest plant height (94.3cm) and spike length (7.9 cm) and maximum number of tillers per m^2 (237) were obtained from the application of 200 kg ha^{-1} of NPS-B and 250 kg ha^{-1} of Urea fertilizers, superior than all of the other treatments. The improvement in total number of tillers at highest rates of combined application of blended NPS-B and N might be attributed to the synergetic roles of the four nutrients played in enhancing growth and development of the crop. Also, Phosphorus found in NPSB responsible for improved root development at early growth stage and which in turn promotes N uptake and N assimilation by growth points triggering tillers which subsequently resulted to overall plant growth and increase in bread wheat. In addition, nitrogen promotes activities essential for carbohydrate utilization and its most important function in plant promotion of rapid growth through increasing total number of tillers (Saeed *et al.*, 2012). In conformity with this result, Harfe (2017) reported that the nitrogen fertilizer rate increased from nil to 69 kg ha^{-1}, the plant height of bread wheat increased from 82.63 cm to 94.18 cm. Similar to this result, Shahraki *et al.* (2017) reported that the plant height was significantly affected by nitrogen rate in which the tallest plant height (101.94 cm) was produced in response to applying 150 kg N ha^{-1}, whereas the shortest (90 cm) was produced at control (unfertilized) treatment of durum wheat. In agreement with this result, Abayu (2012) reported that application of blended fertilizer (69 kg N ha^{-1} + 46 kg P_2O_5 + 22 kg S ha^{-1}

+ 0.3 kg Zn ha^{-1}) brought significant increase in tillers per plant of unfertilized plot. Botella *et al*. (1993) reported stimulation of tillers with optimal application of N and they attributed this to the positive effect of N on cytokine synthesis which is an important hormone for cell division and shoot growth. In addition, phosphorus encourages the growth of lateral roots and fibrous rootlets that facilitate nutrient uptake (Barker and Pilbeam, 2007), and sulfur facilitates the uptake of other nutrients by the crop (Samuel *et al*., 1993). The decreasing spike length with increasing supply of nitrogen fertilizer might be due to excessive application of N fertilizer causing high tissue N concentration which might have toxic effect on wheat growth resulting in stunted growth and reduced spike length (Smith and Hamel, 1999).

The fact that nitrogen is essential for increased cell division and elongation is attributed for the nutrient's effect in resulting improvement of vegetative growth. Sulfur is also reported to enhance the assimilation of N in crop plants (Abdin, 2000). Similar results were reported by Tilahun Chibsa *et al.* (2017) in which the highest spike length (5.28 cm) for durum wheat was obtained at combined application of 92/46 kg N/P2O5 ha^{-1}. Ali *et al*. (2013) also reported that adequate supply of boron increased spike length of wheat by 29.4% as compared to the control. The result of the current study indicated that balanced and adequate soil nutrient management is one important practice for increasing durum wheat yield component which is an important yield component of bread wheat.

The analysis result show that application of different rates of NPSB blended and Urea fertilizer brought significant (p<0.001) effect on biomass yield, grain yield and straw yield. The maximum on biomass yield (13994.0 kg ha^{-1}), grain yield (6990.6 kg ha^{-1}), and straw yield (76201 kg ha^{-1}) were obtained from the application of 200 kg ha^{-1} of NPSB and 250 kg ha^{-1} of Urea and followed by recommended NP fertilizers and of 250 kg ha^{-1} of NPSB and 250 kg ha^{-1} of Urea were superior than all of the other treatments. However, the inferior bread wheat attributes were obtained from control (unfertilized) treatment. Application of application of 200 kg ha^{-1} of NPSB and 250 kg ha^{-1} Urea fertilizers were superior in grain yield by 28.8% and 98.5% from recommended NP and control or unfertilized plot the grain yield.

Adequate supply of nitrogen leads to high photosynthetic activity, vigorous vegetative growth and dark green color and finally improves the utilization of carbohydrates. Sulfur is also reported to enhance the photosynthetic assimilation of N in crop plants (Abdin, 2000). While adequate supply of phosphorus increases tiller emergence especially secondary tillers and their survival, it helps in increasing the biomass yield through proper regulation of carbohydrates translocation (Prasad, 2017). Ample supply of boron facilitates photosynthetic activities and leaf expansion that leads into improved plant growth (Tahir *et al*., 2009). Consistent with this result, Sisay (2016) reported that aboveground dry biomass yield of tef was significantly influenced by the blended fertilizers (64 kg N + 68 kg P_2O_5 + 14.6 kg S + 4.46 kg Zn +1.34 kg B ha^{-1}).

The results agree with the findings of Hiwot (2012) which showed that application of blended fertilizer, and urea significantly increased tef grain yield. Saeed *et al.* (2012) also reported maximum straw yield (8,458 kg ha^{-1}) at application of 140 kg N ha^{-1} 75 kg P_2O_5 and 25 kg S ha^{-1} at different growth stages. Kebkab *et al*. (2017) also reported increment of straw yield of durum wheat with increase in application of a mineral fertilizers. Application of NPSB blended and Urea fertilizers was significantly (p<0.1) influenced thousand kernels weight of bread wheat. The highest thousand kernels weight (48.3 gm) was recorded at application of application of 200 kg ha^{-1} of NPSB and 250 kg ha^{-1} Urea fertilizers. On the other hand, the lowest thousand kernels weight was observed at application of the highest rate of nitrogen followed by the control. This might be due to the highest rate of nitrogen fertilization leads to higher vegetative growth but decline grain weight due to low translocation of carbohydrates to the reproductive part of the crop. In agreement with this result, Haileselassie *et al.* (2014) reported that increasing nitrogen rate from 92 kg N ha-1 to 138 kg N ha^{-1} decreased thousand kernels weight of bread wheat by about 3.7%. Leta *et al.* (2013) also reported that the thousand kernels weight of durum wheat decreased with increasing nitrogen levels. Similarly, Abebe and Manchore (2016) and Tilahun Chibsa *et al.* (2017) reported that nitrogen applied at 69 kg ha^{-1} gave the highest thousand kernels weight (57.00 g) than the unfertilized plot (46.79 g) for bread wheat.

Table 3. Mean values of yield and yield components of bread wheat as influenced by nitrogen and NPS-B blended fertilizers during 2019 cropping season

Treatments (kg ha^{-1})		PH (cm)	SL(cm)	NT (m^2)	BM (kg ha^{-1})	GY (kg ha^{-1})	SY (kg ha^{-1})	TSW (gm)
Urea	NPSB							
Control		60.4^{c}	3.9^{e}	64^{f}	4965.2^{g}	2375.9^{g}	2729.3^{e}	29.2^{d}
RNP		91.8^{a}	6.2^{abcd}	223^{ab}	10635.8^{b}	5230.5^{b}	5615.3^{bcd}	47.6^{ab}
150	100	68.5^{bc}	5.2^{cdef}	90^{ef}	5843.5^{gf}	3241.2^{f}	2812.5^{ef}	31.8^{cd}
150	150	86.3^{ab}	5.9^{bcde}	116^{de}	6519.6^{ef}	3810.2^{ef}	2919.6^{ef}	41.1^{abc}
150	200	90.6^{a}	7.3^{ab}	142^{cd}	7757.2^{cde}	3612.6^{ef}	4354.6^{de}	38.1^{bcd}
150	250	92.7^{a}	6.2^{abcd}	150^{cd}	9016.9^{c}	3915.6^{def}	4574.7^{d}	37.9^{bcd}
250	100	89.3^{a}	5.8^{bcdef}	147^{cd}	7473.9^{de}	3454.9^{f}	4229^{def}	39.4^{abcd}
250	150	91.1^{a}	5.3^{cdef}	156^{cd}	8539.6^{cd}	4247.7^{cde}	4501.9^{cd}	45.3^{ab}
250	200	94.3^{a}	7.9^{a}	237^{a}	13994.0^{a}	6990.6^{a}	7213.3^{a}	50.9^{a}
250	250	93.2^{a}	7.0^{abc}	264^{a}	11323.9^{b}	6455.6^{a}	5078.3^{bcd}	50.7^{a}
350	100	89.7^{a}	5.1^{cdef}	159^{cd}	8879.7^{cd}	4151.8^{de}	4937.9^{bcd}	41.4^{abc}
350	150	93.9^{a}	4.9^{def}	117^{de}	11020.4^{b}	5028.3^{b}	6202.1^{abc}	40.6^{abc}
350	200	91.7^{a}	5.3^{cdef}	172^{bc}	11036.7^{b}	4910.2^{bc}	6266.7^{ab}	41.0^{abc}
350	250	88.7^{a}	4.1^{ef}	151^{cd}	9017.3^{c}	4552.6^{bc}	4675.3^{cd}	39.6^{abcd}
CV		13.5	20.0	19.7	10.5	9.4	19.5	16.6
LSD@$\leq$0.05		19.8*	2.1**	51.8**	1542.1**	696.9**	1549.1**	11.7*

Means with the same letter along the column are not significantly different at $p \leq 0.05$, where; PH-plant height, SL-Spike length, NT-number of tillers, BM-biomass, GY-grain yield, SY-straw yield

Table 4. Mean values of yield and yield components of bread wheat as influenced by nitrogen and NPS-B blended fertilizers during 2020 cropping season

Treatments (kg ha^{-1})		PH (cm)	SL(cm)	NT (m^2)	BM (kg ha^{-1})	GY (kg ha^{-1})	SY (kg ha^{-1})	TSW (gm)
Urea	NPSB							
Control		65.6^{d}	4.3^{f}	85^{e}	5275.8^{i}	2167.7^{h}	3239.3^{f}	24.0^{f}
RNP		97.0^{ab}	6.6^{abcd}	244^{a}	11279.8^{cb}	5189.2^{bc}	6178.3^{abc}	42.4^{abc}
150	100	77.0^{c}	5.6^{cde}	108^{de}	7487.5^{gh}	3032.8^{gh}	4585.9^{cdef}	26.6^{de}
150	150	91.5^{b}	6.3^{bc}	137^{cd}	7163.6^{h}	3601.8^{defg}	3693^{def}	35.8^{bc}
150	200	95.8^{ab}	7.7^{ab}	163^{bc}	8067.9^{fgh}	3404.4^{efg}	4794.7^{cdef}	32.9^{cd}
150	250	97.9^{bc}	6.6^{bcde}	171^{bc}	8327.6^{fgh}	5040.7^{fgh}	3418.1^{ef}	36.0^{cd}
250	100	94.5^{ab}	6.2^{bcde}	169^{bc}	8451.2^{fg}	3246.7^{fg}	5335.7^{bc}	40.8^{abc}
250	150	96.3^{ab}	5.7^{cde}	177^{bc}	8850.3^{ef}	4039.5^{def}	4942^{cde}	40.1^{abc}
250	200	99.5	8.0^{a}	258^{a}	13971.3^{a}	6482.4^{a}	7620.1^{a}	45.7^{a}
250	250	98.4^{ab}	7.4^{abc}	285^{a}	12301.2^{b}	5580.7^{b}	6851.7^{ab}	45.5^{ab}
350	100	94.9^{ab}	5.5^{cde}	180^{bc}	9857^{de}	3943.6^{defg}	6044.7^{abc}	36.2^{abc}
350	150	99.1^{a}	5.3^{cde}	138^{cd}	11664.4^{b}	4453.4^{b}	7342.2^{a}	35.4^{bc}
350	200	96.9^{ab}	5.7^{cde}	193^{b}	11397.3^{bc}	4368.5^{bc}	7160.1^{a}	35.8^{bc}
350	250	93.9^{ab}	4.5^{ef}	172^{bc}	10327.9^{cd}	4343.8^{cd}	6115.3^{abc}	34.4^{bcd}
CV		10.3	16.9	17.0	7.9	13.0	17.7	13.5
LSD@$\leq$0.05		6.9*	1.7**	50.7**	1266.7**	153.9**	1645.0	8.3*

Means with the same letter along the column are not significantly different at $p \leq 0.05$, where; PH-plant height, SL-Spike length, NT-number of tillers, BM-biomass, GY-grain yield, SY-straw yield

Table 5. Pooled mean values of yield and yield components of bread wheat as influenced by nitrogen and NPS-B blended fertilizer during 2019-2020 cropping season

Treatments (kg ha^{-1})		PH (cm)	SL(cm)	NT (m^2)	BM (kg ha^{-1})	GY (kg ha^{-1})	SY (kg ha^{-1})	TSW (gm)
Urea	NPSB							
Control		63.0^{b}	4.1^{f}	74^{f}	5120.5^{g}	2271.8^{k}	2984.3^{f}	26.6^{f}

RNP		94.4^{a}	6.4^{bcd}	233^{b}	10957.8^{b}	5209.7^{c}	5896.8^{bc}	45.0^{ab}
150	100	71.1^{b}	5.4^{de}	99^{fg}	6665.5^{f}	3136.9^{j}	3699.2^{ef}	29.2^{ef}
150	150	88.9^{a}	6.1^{cd}	126^{ef}	6841.6^{f}	3705.9^{ghi}	3306.3^{f}	38.4^{bcd}
150	200	93.2^{a}	7.5^{ab}	152^{cde}	7912.5^{e}	3508.5^{hij}	4574.7^{de}	35.5^{de}
150	250	95.3^{a}	6.4^{bcd}	161^{cde}	8672.3^{de}	4478.1^{def}	3996.4^{ef}	37.0^{cd}
250	100	91.9^{a}	6.0^{cd}	158^{cde}	7962.6^{e}	3350.8^{ij}	4782.4^{de}	40.1^{bcd}
250	150	93.7^{a}	5.5^{de}	166^{c}	8694.9^{de}	4143.6^{efg}	4722.0^{de}	42.7^{abc}
250	200	96.9^{a}	8.1^{a}	247^{ab}	13982.6^{a}	6736.5^{a}	7416.7^{a}	48.3^{a}
250	250	95.8^{a}	7.2^{abc}	274^{a}	11812.6^{b}	6018.1^{b}	5965.0^{bc}	48.1^{a}
350	100	92.3^{a}	5.3^{def}	170^{c}	9368.4^{cd}	4047.7^{de}	5491.3^{cd}	38.8^{bcd}
350	150	96.5^{a}	5.1^{def}	128^{def}	11342.4^{b}	4740.8^{cd}	6772.2^{ab}	38.0^{cd}
350	200	94.3^{a}	5.5^{de}	182^{c}	11217.0^{b}	4639.2^{de}	6713.4^{ab}	38.4^{bcd}
350	250	91.3^{a}	4.3^{ef}	162^{cd}	9672.6^{c}	4447.9^{def}	5395.3^{cd}	37.0^{cd}
CV		12.7	18.7	17.9	8.9	11.3	18.3	18.5
LSD@≤0.05		13.3*	1.3*	34.7*	963.7**	566.2**	1087*	6.9*

Means with the same letter along the column are not significantly different at $p \leq 0.05$, where; PH-plant height, SL-Spike length, NT-number of tillers, BM-biomass, GY-grain yield, SY-straw yield

Economic Analysis

As indicated in Table 6, the highest net benefit of 178860.4 ETB ha^{-1} with marginal rate of return (MRR) of 309.0 % was obtained in response to application of 200 kg ha^{-1} of blended NPSB with 250 kg ha^{-1} of Urea. However, the lowest net benefit was obtained from unfertilized or control plot. Thus, applications of 200 kg ha^{-1} NPSB of blended plus 250 kg ha^{-1} of urea is economically advisable for farmers in the study area for better bread wheat production; beneficial as compared to the other treatments in the study area because the highest net benefit and the marginal rate of return were above the minimum level (100%).

Table 6. Nitrogen and NPS-B blended fertilizer effects on partial budget and marginal rate of return (MRR) analysis for bread wheat production

Treat	GY	GB	TVC	NB	MRR%
1	2044.6	63383.2	0.0	63383.2	
3	2823.2	87519.5	5022.0	82497.5	3.8
2	4688.7	145350.6	5022.0	140328.6	57831.1
4	3335.3	103394.6	6099.0	97295.6	d
7	3015.7	93487.3	6934.0	86553.3	d
5	3157.7	97887.2	7176.0	90711.2	17.2
8	3729.2	115606.4	8011.0	107595.4	20.2
6	4030.3	124939.0	8253.0	116686.0	37.6
11	3642.9	112930.8	8846.0	104084.8	d
9	6062.9	187948.4	9088.0	178860.4	309.0
12	4266.7	132268.3	9923.0	122345.3	d
10	5416.3	167905.0	10165.0	157740.0	146.3
13	4175.3	129433.7	11000.0	118433.7	d
14	4003.1	124096.4	12077.0	112019.4	d

Where: ETB = Ethiopian Birr (currency); TCV = Total cost that vary; NB = Net benefit; MRR = AGY-adjusted grain yield, GB=Growth benefit, Marginal rate of return; Price for Urea, NPS, TSP and wheat grain; 19.12, 21.75, 21.75, 30 .0 Eth- birr kg^{-1} respectively.

4. Conclusion

The result of the current study indicated that balanced and adequate soil nutrient management is one important practice for increasing bread wheat yield component and yield. The result of economic analysis showed that combined application of 200 kg ha^{-1} of NPSB and 250 kg ha^{-1} of urea gave economic benefit. Therefore, it could be concluded that application of 200 kg ha^{-1} of NPSB with supplement 250 kg ha^{-1} of urea fertilizer combinations were producing economically profitable grin yield of bread wheat. Thus, this rate of fertilizer would be recommended for the study area. However, the amount of nitrogen and phosphorous in this recommendation is more than previous recommended rate of nitrogen and phosphorous.

Acknowledgments

We acknowledge the support of Ethiopian Institute of Agricultural Research and Wondo genet Agricultural Research Center during part of this work.

Conflict of Interest

The authors declare that they have no conflict of interest.

REFERENCES

[1] Abayu, B. (2012). Agronomic and economic effects of blended fertilizers under planting method on yield and yield components of tef [M.Sc. Thesis]. Mekelle University.

[2] Abdin, M. Z. (2000). Effect of sulfur application on lipid, RNA and fatty acid content in developing seeds of rapeseed (*Brassica campestris* L.). *Plant Science*, *150* (1), 71–76. https://doi.org/10.1016/S0168-9452(99) 00167-3

[3] Abdulkadir B, Kassa S, Desalegn T, Tadesse K, Yohalashet M, Fana G, Abera T, Amede T, Degefie DT. 2017. Crop response to fertilizer application in Ethiopia: a review. In: Lulseged T, Tilahun A, Job K, Degefie T, Steffen S (eds), *A review of soil fertility management and crop response to fertilizer application in Ethiopia: Towards development of site- and context-specific fertilizer recommendation*. Addis Ababa, Ethiopia: International Center for Tropical Agriculture (CIAT). p. 86.

[4] Abebe, B., & Manchore, M. (2016). Effect of the rate of N fertilizer application on growth and yield of wheat (*Triticum aestivum* L.) at chencha, southern Ethiopia. International Journal of Plant, Animal and Environmental Science, 6(11), 2224–3186. doi:10.21276/ljpaes.

[5] Ali, R., Khan, M. J., & Khattak, R. A. (2008). Response of rice to different sources of Sulfur (S) at various levels and its residual effect on wheat in rice wheat cropping system. *Soil Environment*, *27*(1), 131–137.

[6] Asgelil D., Taye B., and Yesuf A. 2007. The status of Micro-nutrients in Nitisols, Vertisols, Cambisols, and FLuvisolss in major Maize, Wheat, Teff and Citrus growing areas of Ethiopia. In Proceedings of Agricultural Research Fund. pp 77-96.

[7] Barker, A. V., and Pilbeam, D. J. (2007). Handbook of plant nutrition. Taylor and Francis.

[8] Berhanu D (1985). The Vertisols of Ethiopia Their properties, classification and management. 5th Meeting of the Eastern African Soil Correlation and Land Evaluation Sub Committee, 4-10 December 1983, Wad Medani Sudan. World Soil Resources Report 56.

[9] Botella, M. A., Cerda, A. C., & Lips, S. H. (1993). Dry matter production, yield and allocation of carbon-14 assimilate by wheat as affected by nitrogen source and salinity. *Agronomy Journal*, *35*(5), 1044–1049. https:// doi.org/10.2134/agronj1993. 00021962008500050016x.

[10] CIMMYT. 1988. From agronomic data to farmer's recommendations: economics training manual. Completely revised edition, CIMMYT, Mexico. D.F. 79 pp.

[11] Cottenie, A., 1980. Soil and plant testing as a basis of fertilizer recommendations. FAO Soil Bulletin 38/2. Food and Agriculture Organization of the United Nations, Rome, Italy

[12] CSA (Central Statistical Agency). 2018a. Agricultural Sample Survey for the crop season. Vol. 5. report on Area and production Statistical Bulletin 578. FDRE/CSA, A.A, Ethiopia.

[13] Desta G, Mihratu A, Tolessa D, Hailu M, Tadiyos B. 2017. Enhancing Sustainable Wheat Productivity and Production through Development of Wheat Varieties Best Adapted to Irrigated Lowland Areas of Ethiopia. International Journal of Agriculture Innovations and Research 6: 305–310.

[14] Elias E, Okoth PF, Smaling EMA. 2019. Explaining bread wheat (*Triticum aestivum*) yield differences by soil properties and fertilizer rates in the highlands of Ethiopia. *Geoderma* 339: 126–133.

[15] Elias E. 2017. Characteristics of Nitisol profiles as affected by land use type and slope class in some Ethiopian highlands. *Environmental Systems Research* 6: 20.

[16] EthioSIS (Ethiopian Soil Information System). (2014). Soil analysis report agriculture transformation agency [Unpublished]. Ministry of Agriculture and Agriculture Transformation Agency.

[17] Fageria, N. K. and V. C. Baligar. 2001. Improving nutrient use efficiency of annual crops in Brazilian acid soils for sustainable crop production. Commun. Soil Sci. Plant Anal. 32:1303–1319.

[18] FAOSTAT (Food and Agricultural Organization of the United Nations Statistics). (2015). Food balance sheets.

[19] FAO-WRB (Food and Agriculture Organization of the United Nation) World Reference Base for Soil Resources), 1998. World reference base for soil resources. World soil report. No. 84. Rome. 88p.

[20] Haileselassie, B., Habte, D., Haileselassie, M., and Gebremeskel, G. (2014). Effects of mineral nitrogen and phosphorus fertilizers on yield and nutrient utilization of bread wheat (Tritcum aestivum L.) on the sandy soils of Hawzen District, Northern Ethiopia. Agriculture, Forestry and Fisheries, 3(3), 189–198. doi: 10.11648/j.aff.204030.18.

[21] Hailu H, Mamo T, Keskinen R, Karltun E, Gebrekidan H, Bekele T. 2015. Soil fertility status and wheat nutrient content in Vertisol cropping systems of central highlands of Ethiopia. Agriculture and Food Security 4: 19

[22] Harfe, M. (2017). Response of bread wheat (*Triticum aestivum L.*) varieties to N and P fertilizer rates in Ofla district, Southern Tigray, Ethiopia. African Journal of Agricultural, 12(19), 1646–1660. https://doi.org/10.5897/AJAR2015.10545.

[23] Hazelton, P., and B. Murphy, 2007. Interpreting soil test results: What do all the numbers mean 2nd Edition. CSIRO Publishing. 152p.

[24] Hiwot, L. (2012). Evaluating the effect of low seeding rate, planting method and blended fertilizer application on Eragrostis tef (Kuncho variety) yield, yield component and nutrient uptake by grain grown on Regosols and Vertisols [MSc Thesis]. Mekelle University.

[25] Kebkab, E., Dechassa, N., & Negassa, W. (2017). Effect of compost and phosphorus application on growth, yield and P-Uptake of durum wheat (*Triticum Durum* Desf.) on vertisol, Central Highland of Ethiopia. International Journal of Agriculture Innovations and Research, *5*(4), 1469–1473.

[26] Landon, J.R. 1991. Booker tropical soil manual Hand Book for soil survey and agricultural land evaluation in the tropical and sub tropics. Long man scientific and technical, ESSXEX, New York.474p.

[27] Leta, G., Belay, G., and Worku, W. (2013). Nitrogen fertilization effects on grain quality of durum wheat (*Triticum turgidum L.Var.Durum*) varieties in Central Ethiopia. Journal of Agricultural Sciences, 1(1), 1–7.

[28] McLean, KO. 1965. Methods of Soils Analysis. Part II. Agronomy. No. 9. American Society Agronomy. Madison, Wisconsin, USA.

[29] Olsen S.R., and L.E. Sommers. 1982. Phosphorus. Methods of Soil Analysis, Part 2. 2nd ed., pp. 403-429. Amer. Soc. Agronomy, Madison, Wisconsin.

[30] Prasad, S. 2017. Effect of sowing time and nutrient management on growth and yield of heat tolerant varieties of wheat [PhD. Thesis]. College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya.

[31] Saeed, B., Gul, H., Zaman, K. A., & Parveen, L. (2012). Growth factors and straw yield of wheat cultivars in relation with nitrogen and sulfur fertilization. Asian Research Publishing Network (ARPN). Journal of Agricultural and Biological Science, 7 (1), 1103–1109.

[32] Sahlemedhin, S. 1999. Draft guideline for regional soil testing laboratories. NFIA, Addis Ababa Ethiopia

[33] Samuel, G., Mekbib, G. & Matthias, K., 2017. The Wheat Sector in Ethiopia: Current Status and Key Challenges for Future Value Chain Development. In: C. Borgemeister; J. von Braun; M. Denich; T. Stellmacher; E. Youkhana. s.l.:ZEF Working Paper Series .

[34] Samuel., T., Nelson, W. L., Beaton, J. D., and Havlin, J. L. (1993). *Soil fertility and fertilizers* (5th ed). MacMilln Company.

[35] SAS (Statistical Analysis System Institute). 2014. SAS Version 9.4 © 2002-2012. SAS Institute, Inc., Cary, North Carolina, USA.

[36] Shahraki, H., Mobasser, H. R., & Ganjali, H. R. (2017). Effect of nitrogen fertilizer and mycorrhizal fungi on yield and yield component of wheat. International Journal of Agriculture and Biosciences, 6, 21–24.

[37] Singh J, Bisen S, Bora DK, Kumar R, Bera B (2011). Comparative study of organic, inorganic and integrated plant nutrient supply on the yield of Darjeeling tea and soil health. Field Crop Research 58:58-61.

[38] Sisay, A. (2016). Response of tef [*Eragrostis tef (Zucc*.) Trotter] to different blended fertilizer rates on Vertisols in Jama District, Northeastern Ethiopia [MSc. Thesis]. Haramaya, University Haramaya.

[39] Smith, D. L., & Hamel, C. (1999). Crop yield: Physiological processes. Spring Verlag.

[40] Sumner, M.E. 2000. Handbook of Soil Science, CRC Press, Boca Raton, FL.

[41] Tahir, M., Tanveer, A., Shah, T., HFiaz, N., & Wasaya, A. (2009). Yield response of wheat (*Triticum aestivum* L.) to boron application at different growth stages. *Pakistan Journal Life Social Science*, *7*(1), 39–42.

[42] Tekalign Tadese. 1991. Soil, plant, water, fertilizer, animal manure and compost analysis. Working Document No. 13. International Livestock Research Center for Africa, Addis Ababa, Ethiopia.

[43] Tilahun Chibsa, B., Gebrekidan, H., Kibebew Kibret, T., and Tolessa Debele, D. (2017). Effect of rate and time of nitrogen fertilizer application on durum wheat (*Triticum turgidum Var* L. Durum) grown on Vertisols of Bale highlands, southeastern Ethiopia. *American Journal of Research Communication*, *5* (1), 39–56

[44] Van Reeuwijk, 2002. Procedures for Soil Analysis (6th Ed.). FAO, International Soil Reference and Information Center.6700 AJ Wageningen, The Netherlands.

[45] Wakjira, T., 2018. Teff Yield Response to NPS Fertilizer and Methods of Sowing in East Shewa, Ethiopia. Journal of Agricultural Sciences. 13(2): 162-173.

[46] Walkley, A, Black, I. A, (1934). An examination of different method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Science, 37: 29-37.

Citation: *Melkamu Hordofa Sigaye,et.al, (2022). "Effect of NPS-B Blended Fertilizer and Nitrogen Application on Bread Wheat Yield and Economic Profitability on Nitisols of Southern, Ethiopia." International Journal of Research Studies in Agricultural Sciences (IJRSAS), 8(1), pp. 28-37 DOI: http://dx.doi.org/10.20431/2454-6224.0801004*