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Effects of Blended and Urea Fertilizer Rates on Yield and Yield Components of Food Barley (*Hordeum vulgare* L.) at Banja District, North Western Ethiopia

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Abstract: A field experiment was carried out in 2018 and 2019 main cropping seasons in Banja District of Awi Administrative Zone, Amhara Regional State, Ethiopia with the objective to determine optimum blended and urea fertilizer rate for barley production. Twelve treatments combination from three levels of urea and four levels blended (NPSB) were used for the field experiment with one recommended NP and control. The experiment was laid out in randomized complete block design with factorial arrangement in three replications in four farmers' fields. Soil samples were collected before planting and analyzed for selected physicochemical properties. Application of different NPSB blended and Urea fertilizers rates had significantly influenced yield and yield components of barley in all year and combined analysis. The highest plant height, spike length, seed numbers per plant and biomass yields were obtained from plots that received in applications of (250 kg NPSB and 350 kg Urea ha^{-1}). The maximum grain yield (3668.6 kg ha^{-1}) was obtained with application of blended 100 kg NPSB and 350 kg Urea ha^{-1} fertilizers rate. Conversely, the lowest grains yield (958.1 kg ha^{-1}) was perceived in control plot. Moreover, the application of blended 100 kg NPSB and 350 kg Urea ha^{-1} had increased grain yield by about 283% as compared to the negative control and about 63.3% as compared to the positive control plot (100 kg NP and 150 kg Urea ha^{-1}) at all over cropping years combined analysis. The highest net benefit of 85,500.22 ETB ha^{-1} with MRR of 4225.4% were obtained from combined applications of 100 kg ha^{-1} of NPSB blended with 350 kg ha^{-1} of Urea fertilizer. Therefore, based on the yield response and economic indicators, it is recommended to apply 100 kg ha^{-1} of NPSB blended with 350 kg ha^{-1} of Urea fertilizers for barley production of the study area and similar agro ecologies.

Keywords: Blended Fertilizer, Food Barley, Urea

1. Introduction

Barley (*Hordeum vulgare* L.) is one of the most staple foods and economically important widely used cereal crop in Ethiopia next to teff, maize, wheat, and sorghum [1]. However, production of barley in Ethiopia falls under low fertility soils [2]. Similarly, Woldeyesus *et al*. (2002) investigated that low barley productivity was obtained in the highland of Ethiopia due to low soil fertility. Low soil fertility is one of the bottlenecks to sustainable agricultural production and productivity in Ethiopia [3], on the use and application of nitrogen and phosphorous fertilizers in the form of Di-ammonium phosphate (DAP) (18-46-0) and Urea (46-0-0) or blanket recommendation for the major food crops. Continuous application of nitrogen (N) and phosphorus (P) fertilizers without due consideration of other nutrients led to the depletion of other important nutrient elements such as potassium (K), magnesium (Mg), calcium (Ca), sulfur (S) and micronutrients.

In Ethiopia, fertilizer use trend has been focused mainly in soils [4]. Balanced fertilization is the key to sustainable crop production and maintenance of soil health. It has both economic and environmental consideration. An imbalanced fertilizer uses results in low fertilizer use efficiency leading to less economic returns and a greater threat to the environment [4]. Moreover, recently balanced fertilizers containing N, P, K, S, B and Zn in blend form have recommended ameliorating site specific nutrient deficiencies and thereby increasing productivity. The need for site-specific fertilizer prescriptions is increasingly apparent, however, fertilizer trials involving multi-nutrient blends that include micronutrients are rare in Ethiopian context. Although there is general perception that the new fertilizer blends better than the traditional fertilizer recommendation (urea and DAP), their comparative advantages not explicitly examined and understood under various production environment.

As long as the agriculture sector remains as the livelihood means of more than 85 per cent of the population, using all sorts of modern technology is essential to beat top most problem of the nation, i.e., poor agricultural productivity. The fertilizer blending project which is set to be put in place recently is believed to bring tangible results, as the blended fertilizer will be produced and used based on specific crop and soil demands unlike DAP and Urea. Blended fertilizer is customized to specific type of soils and crops as well. This helps to feed crops that Urea and DAP have not managed to nourish. And in the long run, instead of DAP and Urea, blended fertilizer shall be distributed to smallholder farmers which own farm lands with deficiency in some important nutrients. Here, the right rate of recommended blended fertilizer for the specific soil, ecology and crop type is important. Hence, the objective of this study was to determine optimum blended NPSB and urea fertilizer rate for barley in yield and yield component at Banja district.

2. Materials and Methods

2.1. Study Site

A field experiment was carried out in 2018 and 2019 main cropping seasons in Banja District of Awi Administrative Zone, Amhara Regional State, Ethiopia. The district is located at latitude of 10°57′17″ to 11° 03′05″ north and longitude of 36°39′09″ to 36°48′25″ east, an altitude ranges between 1870 and 2570 masl and 122 km far from the regional city Bahir Dar to south and 447 km north to Addis Ababa.

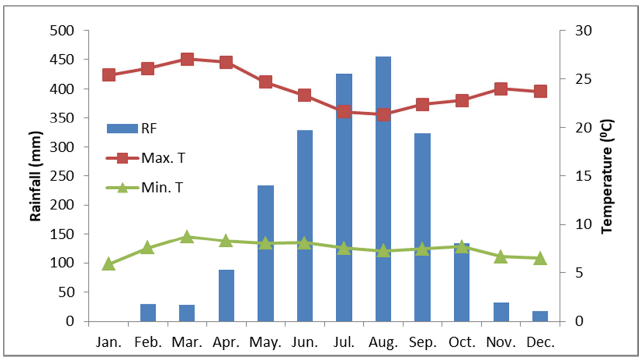

Figure 1. *Mean monthly rainfall and mean monthly maximum and minimum temperatures of the study area.*

The mean annual minimum and maximum temperatures of the study area were 7.5 and 24.1°C, respectively. The mean annual rainfall is 2097 mm with main wet season from May to September usually continued with a less pronounced wet period up to November (Figure 1).

2.2. Experimental Design and Procedures

Four levels of blended NPSB (100, 150, 200 and 250 kg ha^{-1}), three levels of urea (150, 250 and 350 kg ha^{-1}) were factorial combined and tested with control and recommended NP fertilizer rate and total of 14 treatments. The experiment was laid out in randomized complete block design with factorial arrangement in three replications. According to EthioSIS, nutrients level in 100 kg of NPSB (18.1N - 36.1 P_2O_5 – 0.0 K_2O + 6.7 S + 0.0 Zn + 0.71B) [5]. Sowing was done manually at a seed rate of 120 kg/ha using manual row maker with a spacing of 20 cm between rows. The blended fertilizers and DAP 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 loss of N to the atmosphere.

2.3. Data Collection

Plant height was measured from ground surface to the tip of the panicle at maturity from ten randomly sampled plants. Spike length was measured from the bottom of the spike to the tip of the spike excluding the awns from ten randomly spikes. The grain yield was determined from each experimental plot and adjusted to constant moisture levels of 12%. Harvest index was calculated from the ratio of grain yield to biological yield.

2.4. Data Collection

Initial Representative composite surface soil samples were collected from 0-20 cm depth at each experimental unit just before sowing were analyzed for texture, pH, organic carbon, total nitrogen, available phosphorus, exchangeable acidity and cation exchange capacity. Soil texture was determined using the hydrometer method [6]. The USDA textural triangle was used when classifying textural classes. Soil pH was determined by potentiometric methods at a 1:2.5 soil to water ratio as described by [7]. Soil organic carbon was determined by the Walkley-Black oxidation method [8]. Total nitrogen was determined by Kjeldahl digestion method [9]. Exchangeable acidity was determined by saturating the soil samples with 1M KCl solution and titrating with 0.02M NaOH as described by [10]. The cation exchange capacity (CEC) was determined by extraction with ammonium acetate [11]. Available P was determined by the Bray II method [12].

2.5. Data Collection

The partial budget analysis was employed for economic analysis of blended NPSB and urea fertilizers rates application for each treatment combination. 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 [13]. 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 by 10% to reflect the difference between the experimental field and the expected yield at farmers' fields and with farmer's practices from the same treatments [13].

2.6. Statistical Analysis

Analysis of variance (ANOVA) was performed using SAS statistical software 9.3 version [14]. Whenever the ANOVA detected significant differences between treatments, mean separation was conducted using least significant difference (LSD) at 5% level of significance.

3. Results and Discussion

3.1. Soil Physicochemical Properties of the Experimental Site

The analysis results of the study site indicated that the proportions of soil particle size distribution were 18, 24 and 58% sand, silt and clay respectively with a clay textural class (Table 1). The soil pH and exchangeable acidity were 5.35 (pH 1:2.5 H_2O) and 0.62 mg/100g, respectively. The pH was moderately acidic [15] which suggests the presence of substantial quantity of exchangeable H^+ ions which is associated with acidity. The organic carbon and total nitrogen contents of the soil were in the range of moderate [15]. Available P content of the site experimental was 12.15 mg kg^{3+} and rated as moderate range [16]; and it is indicative of soil capable of significant yield responses to application of the appropriate level of the nutrient. Similarly, Olsen and Dean, (1965) stated as the P content of less than 12 P kg ha^{-1} in soil indicates a crop response to P fertilizers, between 12 and 24 kg P ha^{-1} indicates a probable response. According to Tekalign and Haque, the cation exchange capacity (CEC) of the soil was 33.11 cmol (+) kg^{-1}, is high CEC [15].

Table 1. *Selected soil physicochemical properties before establishment of the experiment.*

Soil properties	Value
Textural class	Clay
Sand (%)	18
Silt (%)	24
Clay (%)	58
Bulk density (g cm^{-3})	1.25
pH 1:2.5 (H_2O)	5.35
Organic carbon (%)	2.93
Total N (%)	0.21
Available P (mg kg^{-1})	12.15
Exchangeable acidity ($cmol_{(+)}$ kg^{-1})	0.62
Cation exchange capacity (CEC) ($cmol_{(+)}$ kg^{-1})	33.11

3.2. Effects of Blended and Urea Fertilizer Rates on Yield and Yield Components of Barley

3.2.1. Plant Height

Results showed that application of different rates of NPSB blended and Urea fertilizer had highly significant ($P<0.001$) effect on plant height (Table 2). Application of combination blended fertilizer and urea rates (250 kg NPSB and 350 kg Urea ha^{-1}), (200 kg NPSB and 350 kg Urea ha^{-1}) and (250 kg NPSB and 250 kg Urea ha^{-1}) significantly increased plant height as compared to the recommended NP fertilizers and the control. The highest plant height (87.25, 86.27 and 85.82 cm) recorded in applications of (250 kg NPSB and 350 kg Urea ha^{-1}), (250 kg NPSB and 250 kg Urea ha^{-1}) and (150 kg NPSB and 350 kg Urea ha^{-1}) fertilizers rates, respectively whereas the lowest plant height (57.37 cm) obtained from negative control (no input) treatment. Similarly, [17] reported that Application of NPSZn rates ranging from 100 to 300 kg ha^{-1} showed statistically higher plant height than the recommended NP at Ofla site. [18] indicated that the maximum plant height (109.9 cm) was obtained from application of 200 NPSB kg ha^{-1} blended fertilizers.

Table 2. *Effect of blended NPSB fertilizer and Urea rates on Plant height of barley combined analysis in two cropping seasons.*

Urea (kg ha^{-1})	NPSB (kg ha^{-1})	Plant height (cm)		
		2018 year	2019 year	Combined Analysis
150	100	70.87b	83.23a	77.05bc
150	150	77.20ba	87.60a	82.40ba
150	200	76.87ba	86.73a	81.80ba
150	250	79.07ba	84.10a	81.58ba
250	100	76.87ba	84.37a	80.62ba
250	150	79.80ba	84.67a	82.23ba
250	200	80.87ba	84.77a	82.82ba
250	250	86.20a	86.33a	86.27a
350	100	80.07ba	81.17a	80.62ba
350	150	85.40a	86.23a	85.82a
350	200	84.67a	85.23a	84.95ba
350	250	88.47a	86.03a	87.25a
150	100 DAP	55.93c	82.05a	68.99c
0	0	47.47c	67.27b	57.37d
LSD (0.05)		12.215	9.7758	8.3779
CV (5%)		9.50	7.0	9.1
Significance		***	*	***

Note: *** Significant at $P < 0.001$, * significant at $P < 0.05$. Means along the column with the same letter are not significantly different.

3.2.2. Spike Length

Results showed that application of different rates of NPSB blended and Urea fertilizer had a significant (P<0.05) effect on spike length. Hence, the highest spike length (5.97 cm) was recorded from the application of blended (250kg NPSB and 350 kg Urea ha^{-1}) rate whereas the lowest spike length (4.47 cm) was in negative control treatment (Table 3). [17] reported that the highest spike length was recorded from the application of 300 kg of NPSZn ha at both sites. [18] reported that the maximum spike length (7.1 cm) was obtained from application of 200 NPSB kg ha^{-1} blended fertilizers.

Table 3. *Effect of blended NPSB fertilizer and Urea rates on Spike length of barley combined analysis in two cropping seasons.*

Urea (kg ha^{-1})	**NPSB (kg ha^{-1})**	**Spike length (cm)**		
		2018 year	**2019 year**	**Combined Analysis**
150	100	3.80bac	6.17	4.98bdc
150	150	3.67bc	6.90	5.28bac
150	200	3.53bc	6.40	4.97bdc
150	250	3.40bc	6.53	4.97bdc
250	100	3.47bc	7.07	5.27bac
250	150	4.00ba	6.90	5.45bac
250	200	4.53ba	6.43	5.48bac
250	250	4.60ba	6.83	5.72ba
350	100	4.13ba	6.70	5.42bac
350	150	4.13ba	6.97	5.55ba
350	200	3.87bac	6.77	5.32bac
350	250	4.93a	7.00	5.97a
150	100 DAP	2.67c	6.80	4.73dc
0	0	2.73c	6.20	4.47d
LSD (0.05)		1.2663	ns	0.7703
CV (5%)		19.80	6.8	12.7
Significance		*	ns	*

Note: *** Significant at P < 0.001, * significant at P < 0.05. Means along the column with the same letter are not significantly different.

3.2.3. Numbers of Seed Per Plant

The main effects of blended NPSB fertilizer and Urea rates were significantly (p < 0.05) affected on number of seed per plant (Table 4). The highest number of seed per plant (38.1) of barley was obtained from applications of (250 kg NPSB ha^{-1} and 350 kg Urea ha^{-1}) in combined over years. Conversely, the lowest number of seed per plant (27.9) was perceived in control plot. Application of blended fertilizer and urea rates (250 kg NPSB ha^{-1} and 350 kg Urea ha^{-1}) had increased number of seed per plant by about 36.6% as compared to the -v control (no input) and about 28.7% as compared to the positive control plot (100 NP + 150 Urea kg ha^{-1}) at all over cropping years combined analysis. Also, [17] reported that application of different rates of NPSZn blended fertilizer significantly influenced yield and yield components of wheat. Similarly, [18] found that the maximum number of kernels per spike (53) was obtained from application of 200 NPSB kg ha^{-1} blended fertilizers.

Table 4. *Effect of blended fertilizer and Urea rates on numbers of seed per plant of barley over two combined cropping seasons.*

Urea (kg ha^{-1})	**NPSB (kg ha^{-1})**	**Numbers of seed per plant**		
		2018	**2019**	**Combined Analysis**
150	100	25.7	34.1	29.9cde
150	150	26.8	38.6	32.7abcde
150	200	25.6	37.7	31.6bcde
150	250	26.0	36.6	31.3bcde
250	100	26.8	40.5	33.7abcde
250	150	26.5	37.5	32.0abcde
250	200	31.5	40.0	35.7abc
250	250	31.1	39.8	35.5bcd
350	100	32.3	40.6	36.5ab
350	150	33.8	38.0	35.9abc
350	200	29.7	35.2	32.4abcde
350	250	37.4	38.7	38.1a
150	100	22.5	36.8	29.6ed
0	0	20.3	35.4	27.9e
LSD (0.05)		10.857	ns	6.0665
CV (5%)		22.9	9.2	15.9
Significance		ns	ns	*

Note: * significant at *P* < 0.05, ns – no significant difference. Means along the column with the same letter are not significantly different.

3.2.4. Biomass Yield

The results of the analysis of variance showed that the main effect of blended fertilizer and urea rates significantly affected the biomass yield (Table 5). Hence, the highest biomass yield obtained from the treatments (250kg NPSB and 350 kg of urea ha^{-1}), (200 kg NPSB and 250 kg of urea ha^{-1}) and (250kg NPSB and 250 kg of urea ha^{-1}) fertilizers rates while, the lowest biomass yield was recorded from treatments that receive 0 kg of fertilizer (control) and positive control (100 kg NP + 150 kg of urea ha^{-1}), respectively. Similarly, Application of blended fertilizer and urea rates (250kg NPSB and 350 kg of urea ha^{-1}), (200 kg NPSB and 250 kg of urea ha^{-1}) and (250kg NPSB and 250 kg of urea ha^{-1}) had increased biomass yield by about 225, 208 and 203% as compared to the -v control (no input) and by 53, 45 and 42% as compared to the positive control (100 kg DAP + 150 kg of urea ha^{-1}), respectively. Similar, the maximum aboveground biomass (12.63 t ha) was obtained from 200NPSB kg ha^{-1} of blended fertilizer application [18]. This result agrees with the finding of [19] who found that application of 150 kg ha^{-1} NPSB blended fertilizer with compost increased the biomass by 11.5 t ha^{-1}. Similarly, [20] indicated that application of NPSZnB and Urea fertilizer was significantly improved the production of the dry biomass yield.

Table 5. *Effect of blended fertilizer and urea rates on Biomass yield of barley crop over two combined cropping seasons.*

Urea (kg ha^{-1})	**NPSB (kg ha^{-1})**	**Biomass yield (kg ha^{-1})**		
		2018 year	**2019 year**	**Combined Analysis**
150	100	4592.6ef	13541.7a	9067.1cd
150	150	4666.7e	18250.0a	11458.3abc
150	200	5333.3de	15833.3a	10583.3abcd
150	250	5296.3de	13041.7a	9169.0bcd
250	100	5259.3e	15625.0a	10442.1abcd
250	150	5777.8cde	17500.0a	11638.9abc
250	200	6481.5bcd	17958.3a	12219.9a
250	250	6777.8abc	18125.0a	12451.4a
350	100	7222.2ab	15833.3a	11527.8abc
350	150	7296.3ab	15541.7a	11419.0abcd
350	200	6963.0abc	16875.0a	11919.0ab
350	250	7925.9a	18333.3a	13129.6a
150	100 DAP	3444.4f	13750.0a	8597.2d
0	0	1111.1g	6958.3b	4034.7e
LSD (0.05)		1186.8	5576.5	2843.9
CV (5%)		12.7	21.4	23.4
Significance		***	*	***

Note: *** Significant at $P < 0.001$, * significant at $P < 0.05$. Means along the column with the same letter are not significantly different.

3.2.5. Grain Yield

The mean grain yield of barley was significantly (<0.001) affected by application of blended (NPSB) and Urea fertilizer rates in all farmers (Table 6). The highest grain yield (3668.6, 3580.8, 3564.5 and 3537.5 kg ha^{-1}) was obtained from applications of (100 kg NPSB ha^{-1} and 350 kg Urea ha^{-1}), (250 kg NPSB ha^{-1} and 350 kg Urea ha^{-1}), (250 kg NPSB ha^{-1} and 250 kg Urea ha^{-1}) and (150 kg NPSB ha^{-1} and 350 kg Urea ha^{-1}) in combined over years. Conversely, the lowest grains yield (958.1 kg ha^{-1}) was perceived in control plot. Similarly, [20] significantly lower mean grain yield (984 kg ha^{-1}) of wheat was obtained from control. Application of blended fertilizer and urea rates (100 kg NPSB ha^{-1} and 350 kg Urea ha^{-1}), (250 kg NPSB ha^{-1} and 350 kg Urea ha^{-1}), (250 kg NPSB ha^{-1} and 250 kg Urea ha^{-1}) and (150 kg NPSB ha^{-1} and 350 kg Urea ha^{-1}) had increased grain yield by about 283, 273, 272 and 269% as compared to the -v control (no input) and about 63, 59, 58 and 57% as compared to the positive control plot (100 kg NP and 150 kg Urea ha^{-1}) at all over cropping years combined analysis. This result agrees with the finding of [20] indicated that application of 250 kg NPSZnB ha^{-1} and 350 kg Urea ha^{-1} gave the higher grain yield 4888 kg ha of bread wheat. [17] reported that application of different rates of NPSZn blended fertilizer significantly influenced yield and yield components of wheat. Similarly, [21] reported that application of nutrients like K, S, Zn, g and B significantly increased grain yield and yield component of bread wheat as compare to the control.

Table 6. *Effect of blended fertilizer and urea rates on Grain yield of barley crop over two combined cropping seasons.*

Urea (kg ha^{-1})	**NPSB (kg ha^{-1})**	**Grain yield (kg ha^{-1})**		
		2018 year	**2019 year**	**Combined Analysis**
150	100	1406.6ed	4075.9ba	2741.3bc
150	150	1333.7e	5210.7ba	3272.2ab
150	200	1564.5ed	4830.6ba	3197.5ab
150	250	1650.3edc	4507.6ba	3079.0ab
250	100	1673.9edc	4677.3ba	3175.6ab
250	150	1703.4bedc	5104.6ba	3404.0ab

Urea (kg ha^{-1})	NPSB (kg ha^{-1})	Grain yield (kg ha^{-1})		
		2018 year	2019 year	Combined Analysis
250	200	1706.3bedc	4931.4ba	3318.9ab
250	250	1759.0bdc	5370.0a	3564.5a
350	100	1973.8bac	5363.4a	3668.6a
350	150	2332.9a	4742.2ba	3537.5a
350	200	2102.7ba	4704.7ba	3403.7ab
350	250	2365.9a	4795.8ba	3580.8a
150	100 DAP	688.8f	3805.0b	2246.9c
0	0	221.5g	1694.8c	958.1d
LSD (0.05)		401.82	1516.2	783.67
CV (5%)		14.9	19.8	22.1
Significance		***	**	***

Note: *** Significant at P < 0.001, ** significant at P < 0.01. Means along the column with the same letter are not significantly different.

3.3. Effects of Blended and Urea Fertilizer Rates on Relationships Between Grain Yield and Yield Components

The correlation between grain yield and yield components are presented in Table 7. Grain yield was positively correlated with biomass yield, harvesting index, plant height, spikes length, seeds per plant and the correlation was significant at (p< 0.01). Moreover, grain yield was most strongly correlated with biomass yield (*r* =0.955), followed by plant height (*r* = 0.984), spikes length (*r* = 0.954) and seeds per plant (*r* = 0.937). Similarly, biomass yield had positive and significant correlation (p< 0.001) with plant height (*r* = 0.974), spikes length (*r* = 0.966) and seeds per plant (*r* = 0.949). Similar results obtained by numerous authors [22-24] indicated that significant associations of barley grain yield with its yield components.

Table 7. *Correlation matrix among grain yield and yield components of wheat.*

Parameters	GY	BMY	HI	PH	SL	SPP
GY	1.000	0.955***	0.622**	0.969***	0.835***	0.791***
BMY		1.000	0.369ns	0.941***	0.892***	0.821***
HI			1.000	0.581*	0.239ns	0.269ns
PH				1.000	0.846***	0.755***
SL					1.000	0.915***
SP						1.000

Note: GY= grain yield; BMY= biomass yield; HI= harvesting index; PH= plant height; SPP= seeds per plant; SL= spikes length, *** Significant at p < 0.001, ** significant at p < 0.01, ** significant at p < 0.05.

3.4. Economic Benefit

Table 8 show economic analysis data of benefit, cost and marginal rate of return of treatments using partial budget techniques. Treatments that produced lower NFBs were not worth for investment. They are known as dominated and were marked "D".

Similarly, some of the treatments did not realize economically viable returns. However, results of the partial budget analyses revealed that maximum net benefit of 85,500.22 ETB ha^{-1} with an acceptable marginal rate of returns (MRR) 4225.4% was recorded in the treatment that received of blended and Urea fertilizer (100 kg NPSB and 350 kg Urea ha^{-1}) rate (Table 8). This combination generated 61,356.10 ETB ha^{-1} more compared to the negative control treatment and 32,856.84 ETB ha^{-1} more compared to the positive control (100 kg NP and 150 kg Urea ha^{-1}) treatment. High net return from the foregoing treatments could be attributed to the high yield whilst the low net returns to low yield. From the economic point of view, it was apparent from the above results that combined application of blended and Urea fertilizer (100 kg NPSB and 350 kg Urea ha^{-1}) rates is more profitable than the rest of treatment combinations.

Table 8. *Economic analysis of blended and urea fertilizer rates on barley over two years combined.*

Blended Fertilizer (kg ha^{-1})	Urea (kg ha^{-1})	Grain Yield (kg ha^{-1})	Gross Field Benefit (ETB)	Total Cost (ETB)	Net Benefit (ETB)	Marginal Rate of Return (%)
0	0	862.29	24144.12	0.00	24144.1	-
100 NPSB	150	2467.1	69080.76	3978.5	65102.3	1029.5
100 DAP	150	2022.2	56621.88	3978.5	52643.4	D
150 NPSB	150	2944.9	82459.44	4854.0	77605.4	2851.2
100 NPSB	250	2858.0	80025.12	5463.5	74561.6	D
200 NPSB	150	2877.7	80577.00	5729.5	74847.5	107.5
150 NPSB	250	3063.6	85780.80	6339.0	79441.8	753.8
250 NPSB	150	2771.1	77590.80	6605.0	70985.8	D

Blended Fertilizer (kg ha^{-1})	Urea (kg ha^{-1})	Grain Yield (kg ha^{-1})	Gross Field Benefit (ETB)	Total Cost (ETB)	Net Benefit (ETB)	Marginal Rate of Return (%)
100 NPSB	350	3301.7	92448.72	6948.5	85500.2	4225.4
200 NPSB	250	2987.0	83636.28	7214.5	76421.8	D
150 NPSB	350	3183.7	89145.00	7824.0	81321.0	803.8
250 NPSB	250	3208.0	89825.40	8090.0	81735.4	155.8
200 NPSB	350	3063.3	85773.24	8699.5	77073.7	D
250 NPSB	350	3222.7	90236.16	9575.0	80661.2	409.8

4. Conclusion

Application of different NPSB blended and Urea fertilizers rates had significantly influenced plant height, spike length, seed numbers per plant, biomass yield and grain yield of barley in all year and combined analysis. The highest (3668.6 kg ha^{-1}) grain yield response were obtained from the application of blended 100 kg NPSB and 350 kg Urea ha^{-1} fertilizers and was superior on grain yield by 63.3 % and 283 % to recommended NP fertilizer and control, respectively. Both biological and economic analysis showed that application of blended 100 kg NPSB and 350 kg Urea ha^{-1} fertilizers was optimum for barley production and could be recommended for the study area and similar agro ecologies.

References

[1] CSA. 2019. Area and production of major crops Agricultural Sample Survey 2018/19 (2011 E.C.). V1. Statistical Bulletin. 589. Addis Ababa, Ethiopia.

[2] Yihenew G. 2002. Selected chemical and physical characteristics of soil Adet research center and its testing sites in north-western Ethiopia.

[3] Wakene N., G. Fite, D. Abdena and D. Berhanu. (2007). Integrated use of organic and inorganic fertilizers for Maize production. Utilization of diversity in land use systems: Sustainable and organic approaches to meet human needs. Tropentag 2007. Witzenhausen.

[4] Abiye A., Tekalign M., D. Peden, and M. Diedhiou. (2004). Participatory on-farm conservation tillage trial in Ethiopian highland vertisols: Impact of potassium application on crop yield. Expl. Agriculture. 40: 369-379.

[5] EthioSIS (Ethiopian Soil Information System).2016. Soil fertility status and fertilizer recommendation, EthioSIS, report.

[6] Bouyoucos, G. J. 1962. Hydrometer method improved for making particle size analysis of soils. *Agronomy Journal,* 54: 464-465.

[7] Carter M. 1993. Soil sampling and methods of analysis. *Canadian Soil Science Society. Boca Raton, Florid: Lewis Publishers*, pp. 823.

[8] Walkley, A. and Black, C. A. 1934. An examination of the Degtjareff method for determining soil organic matter and proposed modification of the chromic acid titration method. *Soil Science,* 37: 29-38.

[9] Bremner, J. M. and Mulvaney, C. S. 1982. Nitrogen-total. In: Methods of Soil Analysis. Part 2: Chemical and Microbiological properties (eds. Page, A. L., Miller, R. H., and Keene, D. R.), *American Society of Agronomy,* Madison, Wisconsin. pp. 595-624.

[10] Rowell, D. L. 1994. Soil science: Methods & Applications. *Addison Wesley Longman Singapore Publishers (Pte) Ltd*., England, UK. pp. 350.

[11] Chapman, H. D., 1965. Cation exchange capacity by ammonium saturation. In: Black, CA. (Ed.). Methods of Soil Analysis. Agronomy part II, No. 9, American Society of Agronomy, Madison, Wisconsin, USA, pp: 891-901.

[12] Bray, H. R. and Kurtz, L. T. 1945. Determination of organic and available forms of phosphorus in soils. *Soil Science*, 9: 39-46.

[13] CIMMYT. (1998). From Agronomic Data to Farmer Recommendations: An Economics Training Manual.

[14] SAS. 2014. Applied Statistics and SAS Programming Language, 4nd ed. Cary, NC: SAS Institute.

[15] Tekalign M. and I. Haque. (1991). Phosphorus status of some Ethiopian soils, II. Forms and distribution of inorganic phosphates and their relation to available phosphorus. Tropical Agriculture. 68: 1: 2-8.

[16] Clements, B. and McGowen, I. 1994. *Strategic Fertilizer Use on Pastures: NSW Agriculture*, Agnote Reg. 4/57, Orange, NSW, Australia.

[17] Sofonyas, D., H. Fisseha, B. Hagos, M. Tsigabu, H. Molla, H. Girmay and B. Daniel. 2021. Evaluation of NPSZn Blended Fertilizer on Yield and Yield Traits of Bread Wheat (Tritcum aestivum L.) on Cambisols and Vertisols in Southern Tigray, Ethiopia In: Ethiop. J. Agric. Sci. 31 (2) 33-43.

[18] Melkamu H. S., Gashaw M., Wassie, H. (2019). Effects of different blended fertilizers on yield and yield components of food barley (*hordeum vulgare* l.) On nitisols at hulla district, southern ethiopia. Acad. Res. J. Agri. Sci. Res. 7 (1): 49-56.

[19] Woubshet D., Selamyihun K. and Cherukuri V. 2017. Effect of integrated use of lime, blended fertilizer, and compost on productivity, nutrient removal and economics of barley (*Hordeum vulgare* L.) on acid soils of high lands in West Showa Zone of Ethiopia. Int. J. of Life Sciences, 2017, Vol. 5 (3): 311.

[20] Tolera Abera, Bezuayehu Tola, Hirpa Legesse, Adane Adugna, Tolcha Tufa and Tesfaye Midega. 2020. Effects of Blended and Urea Fertilizer Rate on Yield and Yield Components of Wheat in Vertisols of Ambo District. World Journal of Agricultural Sciences Vol. 16 (4): 256-264.

[21] Mulugeta, E., S. Shure, C. Tilahun, C. Chala and B. Negash, 2017. Optimization of Fertilizer Recommendations for Bread Wheat at Sinana District of Bale Zone, Southeastern Oromia, Ethiopia. International Journal Science Qualitative Analysis, 3 (6): 55-60.

[22] Ortiz, R., Nurminiemi, M., Madsen, S., Rognli, O. A., Bjornstad, A., 2002. Genetic gains in Nordic spring barley breeding over sixty years. *Euphytica* 126, 283289.

[23] Abeledo, L. G., Calderini, D. F. and Slafer, G. A. 2003. Genetic improvement of barley yield potential and its physiological determinants in Argentina (1944-1998). *Euphytica,* 130: 325-334.

[24] Temesgen Desalegn, Getachew Alemu, Ayalew Adella, Tolessa Debele *and* Julián Gonzalo J. 2016. Effect of lime and phosphorus fertilizer on acid soils and barley (*Hordeum vulgare* L.) performance in the central highlands of Ethiopia, *Expl Agric*ulture volume pp 1-13C *Cambridge University Press* doi: 10.1017/S001447971600049.322.