American-Eurasian J. Agric. & Environ. Sci., 21 (2): 87-97, 2021
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2021.87.97

Effects of Blended (NPSB) and Urea Fertilizer Rate on Yield and Yield Components of Wheat in Ultisols of Liben Jawi District, Oromia, Ethiopia

Tolera Abera, Buzayehu Tola, Tolcha Tufa, Adane Adugna and Tesfaye Midega

Ambo Agricultural Research Center, Ethiopia Institute of Agricultural Research Institute (EIAR),
P.O. Box: 382, Ambo, West Showa, Oromia, Ethiopia

Abstract: Wheat production is achieved with under optimum application of recommended fertilizer and grain yield trends of newly released wheat varieties are low. This in view a field experiment was carried out on farmers field in 2018 and 2019 cropping season in Ultisol of Liben Jawi district to determine the effect of blended NPSB and urea fertilizer rate on growth, yield and yield components of recently release wheat variety (Wane). Three rates of urea (150, 250 and 350 kg N ha^{-1}) and four rates of blended NPSB (150, 200, 250 and 300 kg NPSB ha^{-1}) were purposely combined to 12 treatments and tested with negative control and recommended (64/20 kg NP ha^{-1}) was laid out in randomized complete block design with three replications. All growth yield and yield components of wheat were significantly affected with application of urea and blended NPSB fertilizer rates indicating the importance applying optimum fertilizer rate for better yield of wheat. Significantly higher (3919 kg ha^{-1}), grain yield in farm one with application of 250/150 kg urea/NPSB ha^{-1}, (5747, 5349 and 4857 kg ha^{-1}) grain yield in farm two, three and combined over farms were obtained from application of 250/300 kg urea/NPSB ha^{-1} fertilizer rates showing variation of farm field due to management history for crop production applied. The lower mean grain yield of wheat for three farms were obtained from control. Application of 250/250 kg urea/NPSB ha^{-1} gave higher net return of ETB 54068 ha^{-1} with marginal rate of return of 395% and value to cost ratio of ETB 7.58 per unit of investment followed by application of 250/100 and 150/100 kg urea/NPSB ha^{-1}. Therefore, application of 150/100 kg urea/NPSB ha^{-1} was produced better grain yield and economical feasible and recommended for improved wheat production in Ultisols of Liben Jawi and similar agro-ecologies in western Oromia.

Key words: NPSB · Wheat · Grain Yield · Nitrogen

INTRODUCTION

Gradually soil fertility decline due to continuous crop production for longer period of time reduces yield trends of crops. Increased risk of land degradation due to unsustainable land practices and climate change could affect crop productivity [1]. Currently, there is a need to advance sustainable crop production to reduce soil fertility in the area. Developing more sustainable agricultural practices to avoid a decrease in soil fertility and organic carbon contents and an increase in soil erosion is crucial [2]. Soil fertility degradation in regions is for most importance due to permanent and irreversible degradation of soil quality and productivity. Soil fertility management processes, the application of inorganic amendments is used for increasing yield and productivity. The use of fertilizers for soil fertility amendment with improved varieties of wheat could sustainably increase production and productivity [3]. Wheat (*Triticum aestivum* L.) is an essential crop for national and global food security [4]. It is King of the cereals and important staple food crop [5]. Nutritious food grain of all grains in the world and grows worldwide according to its genotypic adaptability [6]. In Ethiopia, wheat made up of 15.33% (48, 380, 740.91 quintals) of the grain cereal production in the country [7]. Its area coverage is 1, 747, 939.31 ha with a total production of 48, 380.741 t and 2.67t ha^{-1} yield [7]. However, the national yield of wheat is very low as compared to the global average yield.

Corresponding Author: Tolera Abera, Ambo Agricultural Research Center, Ethiopia Institute of Agricultural Research Institute (EIAR), P.O. Box 382, Ambo, West Showa, Oromia, Ethiopia.

Fertilizer application is responsible for the variation in yield potential of currently released wheat varieties. Teklu *et al*. [8] found both grain and straw yield of wheat varieties increased significantly up to the higher N fertilization rate (115 and 69 kg N ha^{-1}) at Chaffe Donsa and Akaki. Application of N fertilizer was improved crop yields [9-11]. Grain yield of bread wheat was significantly influenced by cultivar and N interaction, an indication that yield wheat varieties changed according to the level of N applied [12]. Application of 50-185 kg N ha^{-1} fertilizer rate for in wheat provide the most economical returns and application rates beyond these ranges would be both economically and environmentally unsustainable [13]. Stewart *et al*. [14]. estimated yield increases due to application of N and P fertilizer to be between 40 and 60% and wheat yield could be reduced by 26% without N application. Mean grain yield of wheat averaged across years and cultivars showed that N application contributed to 42.9 and 76.5% higher yield of wheat varieties as compared to no fertilization application [12]. Mean grain yield volume and structure of winter triticale were significantly affected by different doses of nitrogen fertilizer application and higher and lower mean grain yield was varied by 1.7 t ha^{-1} (53.6%) [15]. Raun *et al.* [16]. reported application of N at the right rate and time improves not only grain yield but also NUE for winter wheat. applying large quantities could lower N utilization efficiency or partial factor productivity [17].

Currently based on map of Ethiopian Soil Information System (EthioSIS) has confirmed that several nutrients (N, P, K, S, Zn, Fe and B) other than the common (nitrogen and phosphorus) [18]. Production of wheat can be limited by the deficiency of S and other nutrients, major prone areas of S deficiency are the central highlands and significant Response of mean grain yield and other yields components of wheat with application N, S and P [19]. Application of 200 kg blended NPS ha^{-1} supplemented with 46 kg N ha^{-1} produced higher grain yield and economic benefit or profitability of bread production [20]. Evaluation of blended fertilizer is very crucial to use as alternative fertilizer sources or replace based on potential yield advantage over the previously recommended Urea and DAP. Sulfur, born and zinc deficiencies are widespread in Ethiopian soils, while some soils are also deficient in potassium, copper, manganese and iron, which all potentially hold back crop productivity due to continued utilization of N and P fertilizer as per the blanket recommendation [18]. Thus, compound fertilizer (NPS) and three blended fertilizers (NPSB, NPSZnB and NPSZn) plus or minus potash fertilizer are needed to address the key nutrient deficiencies in the tested soils in Ethiopia [21].

Application of higher dose of boron could cause a decrease in the quantity of grain yield and its component parts of winter triticale [15]. Boron fertilizer topdressing is effective in the improvement of yields and yield quality [22]. Eggert and von Wirén [23]. reported that application boron strongly promoted water and nutrient uptake as well as biomass formation. [22] recommend to use boron up to 2.5 kg ha. Debnath *et al.* [24] found that higher mean grain yield of wheat from application of 120 kg N ha^{-1} and 2 kg B ha^{-1}. Also, Fakir *et al.* [25] Thakur and Mukhopadhyay [26] noted that a significant rise in wheat grain yield under the influence of boron fertilization. Iqbal *et al.* [27] concluded that application of boron to a seed dressing mixture ensured earlier and more uniform germination of seeds. Except the EthioSIS map, so far there is no information or research finding on the differential newly blended fertilizer responses to high yielding newly released bread wheat varieties in Liben Jawi district. Knowing the contribution blended (NPSB) fertilizer rate in maximizing wheat yield in the area are needed to be investigated to explore the yield potential of bread wheat. Therefore, the objectives were to determine optimum blended fertilizer (NPSB) and Urea fertilizer rate for wheat production in Ultisol of Liben Jawi district and assess economic feasibility of blended fertilizer and Urea fertilizer rates for sustainable wheat production in Ultisols of Liben Jawi district.

MATERIALS AND METHODS

The experiment was conducted on two and one farmer's field in 2018 and 2019 cropping seasons of humid highland agro-ecosystems of Liben Jawi district, Oromia Regional National State, western Ethiopia. It lies between 8°56'45.42"N, 8°57'59.16"N and 8°56'20.63"N latitude and 37°31'45.31"E, 37°29'46.46"E and 37°31'26.61"E and at an altitude of 2313, 2378 and 2327 meter above sea level in 20018/2019 and 2019/2020 cropping seasons. The mean annual rainfall of 1040 mm with unimodal distribution [28] It has a medium cool sub-humid climate with the mean minimum, mean maximum and average air temperatures of 8.9, 27.4 and 18.1oC, respectively [28]. The soil type is brown clay loam Ultisols [29].

The treatment used was three rates of nitrogen (150 250 and 350 kg N ha^{-1}) and four rates of blended NPSB (150, 200, 250 and 300 kg NPSB ha^{-1}) were purposely combined to 12 treatments and tested with negative control and recommended (64/20 kg NP ha^{-1}). The experiment was laid out in randomized complete block design in factorial arrangement with three replications. Wheat variety (Wane) was used. The plot size was 4.5 x 3m = 13.5m^2. The spacing used was 75 x 25 cm between rows and plants. The nitrogen rates from blended fertilizer were applied at the time of planting and the remaining nitrogen rates from urea was applied in split application first at knee height of maize and the remaining half at early tasseling of maize. All other agronomic management practices were applied as per recommendation for the maize production.

Pre soil sampling was collected before planting and treatment application and analyzed for some physicochemical properties of the soil at Kulumsa and Holetta Agricultural Research Center Soil and Plant Laboratory. Determination of soil particle size distribution was carried out using the hydrometer method [30]. Soil pH was measured using digital pH meter in 1:2.5 soil to solution ratio with H_2O. Exchangeable basis was extracted with 1.0 Molar ammonium acetate at pH7. Ca and Mg in the extract were measured by atomic absorption spectrophotometer while Na and K were determined using flame photometry [31]. Cation exchange capacity of the soil was determined following the modified Kjeldahl procedure [32] and reported as CEC of the soil. Percent base saturation was calculated from the sum of exchangeable basis as a percent of the CEC of the soil. Exchangeable acidity was determined by extracting the soil samples with M KCL solution and titrating with sodium hydroxide as described by McLean [33]. Organic carbon was determined following wet digestion methods as described by Walkley and Black [34] whereas kjeldahl procedure was used for the determination of total N as described by Jackson [35]. The available P was measured by Bray II method [36].

The plant height, grain yield and yield components of wheat were collected at physiological maturity and harvesting. The harvested grain yield was adjusted to 10 % moisture level [37, 38]. The adjusted seed yield at 12.5 % moisture level per plot was converted to grain yield as kilogram per hectare. The collected data were analyzed using SAS 9.4 software [39]. Mean separation was done using least significance difference (LSD) at 5 % probability level [40]. The economic (partial budget) analysis was used following [41]. The wheat grain valued at an average open market price of EB 900 per 100 kg. Labour cost for field operation was EB 60 per man-day. The yield was adjusted down by 10 % to reflect actual production conditions [41]. The cost of fertilizer Urea and Blended (NPSB) were EB 14.04 and 14.48 per 100 kg with current market price.

RESULTS AND DISCUSSIONS

Soil Physicochemical Properties of the Experimental Site Beforebefore Planting: The physicochemical properties of the soil before panting are indicated in Table 1. The textural distribution of soil was sandy clay loam. The pH of the soil 5.52 in farm 1, 5.75 and 5.95 in farm 2 and 3 found in strongly acidic to medium acidic range [42, 43]. The available phosphorous contents of the soil ranged from 7.76 to 12.58 mg kg^{-1} found in medium range [42-44]. The total nitrogen contents of the soil were 0.17 and 0.19 % in farm 1 and 2 found in low range and 0.25 in farm 3 in medium range [42-44]. The organic carbon contents of the soil were ranged between 2.31 to 2.45 % found in medium range [42-44]. The cation exchange capacity of the soil ranged from 14.02 to 16.74 cmol (+) kg^{-1} found in medium range [42-44].

Plant Height and Dry Biomass of Wheat: The mean of plant height and dry biomass of bread wheat are indicated in Table 2. Application urea and blended NPSB fertilizer rates significantly ($P<0.05$) affected the mean plant height of bread wheat. Similarly, Tagesse *et al*. [20] found that the mean plant height bread wheat was significantly affected by the application of blended NPS and nitrogen fertilizer rates. Significantly higher mean plant height of 90 and 102 cm in 2018, 98cm in 2019 and were obtained with application of 350/300 kg urea/NPSB ha^{-1} fertilizer rates while the lower 66 and 73 cm in 2018, 83cm in 2019 and 74 cm combined over years were recorded from control. Lemi and Negash [45] found that higher mean plant height 91cm wheat variety Ogolcho was obtained from application of at 100/100 kg NPSZnB/urea ha^{-1}. Also, Bekalu and Arega [46] reported that increasing the level of nitrogen from 0 to 60 kg ha^{-1} increased the mean plant height of bread wheat. The mean plant height of bread wheat was significantly increased as the application of urea and NPSB fertilizer rates increased across two years. Higher mean plant height of 92 cm in farm 2 as compared to 90cm in farm three and 85 cm in farm one.

Table 1: Selected soil physicochemical characterization of the experimental field before planting in liben Jawi

Farms	pH (1:2.5 H_2O)	Available P (mg kg^{-1})	Total N (%)	OC ---- (%)-----	OM	Cation exchange capacity (cmol(+) kg^{-1})	Clay ----------- % -----------	Silt	Sand	Texture
Farm-1	5.52	7.76	0.17	2.31	3.99	15.88	45	30	25	Sandy clay loam
Farm-2	5.75	9.48	0.19	2.39	4.12	14.02	47	32.5	22	Sandy clay loam
Farm-3	5.95	12.58	0.25	2.45	4.21	16.74	52	34.6	21.5	Sandy clay loam

Table 2: Effects of Urea and Blended (NPSB) fertilizer rate on mean plant height and grain yield of wheat in Ultisols of Liben Jawi district

		Plant height (cm)				Dry biomass (kg ha^{-1})			
		2018		2019		2018		2019	
Urea (Kg ha^{-1})	NPSB (Kg ha^{-1})	Farm 1	Farm 2	Farm 3	Mean	Farm 1	Farm 2	Farm 3	Mean
150	150	81c	85bc	91abc	85c	5455c	8394cd	9508bcd	7785e
150	200	85abc	92ab	89abc	89bc	6960abc	7848de	11683ab	8830cde
150	250	88ab	95ab	91abc	91abc	7192abc	9455bcd	8143d	8263de
150	300	88ab	93ab	92abc	91abc	7010abc	10091abcd	9778bcd	8960cde
250	150	86abc	95ab	87bc	89bc	7263abc	10303abcd	8333cd	8633de
250	200	86abc	92ab	91abc	89bc	6788abc	11545ab	9857bcd	9397bcd
250	250	87ab	97ab	89abc	91abc	8000ab	11808ab	8619cd	9476bcd
250	300	87ab	97ab	94ab	93ab	8111ab	12778a	12071a	10987a
350	150	83bc	93ab	88bc	88bc	5939bc	11061abc	8968cd	8656de
350	200	86abc	95ab	96ab	92ab	7424abc	12394ab	8762cd	9527bcd
350	250	91a	88abc	94ab	91ab	9121a	11727ab	9794bcd	10214ab
350	300	90a	102a	98a	97a	8253ab	12455ab	10619abc	10442ab
100	100	81c	85bc	73d	80d	5586c	8081de	4651e	6106f
0	0	66d	73c	83c	74d	3061d	5323e	7667d	5350f
LSD (5%)		5.0119	14.043	8.5915	5.7851	2013.5	2625.1	2029.7	1240.3
CV (%)		3.53	9.14	5.70	6.96	17.47	15.28	13.18	15.10

Means followed by different letter(s) in a column and rows are significant at 5% level of Probability

This indicates soil fertility status differences of the three farms due to farm land management history variation during crop production. Also, the attention and knowledge of farmers on the management of the farm field for crop production were different for sustainable use of the farm fields by keeping the fertility status of the farm field.

The mean dry biomass of bread wheat was significantly ($P<0.05$) affected by application of nitrogen and blended NPSB fertilizer rates. Significantly higher 9121kg ha^{-1} in farm one from application of 350/250 kg urea/NPSB ha^{-1} and 12778, 12071 and 1087 kg ha^{-1} from farm two, three and combined over farm were obtained with application of 250/300 kg urea/NPSB ha^{-1} fertilizer rates (Table 2). Likewise, Tagesse *et al.* [20] found that the mean dry biomass of bread wheat was significantly affected by the application of blended NPS and nitrogen fertilizer rates and high biomass yield was obtained from higher blended NPS and nitrogen fertilizer rate application. The lower dry biomass yield of bread wheat was recorded from control (Table 2). Lemi and Negash [45] found that significantly higher (10.20 t ha^{-1}) mean dry biomass yield of brad wheat varieties were obtained from application of 125/125 kg NPSZnB/urea ha^{-1} while the lowest (2 t ha^{-1}) mean dry biomass was from control. Similarly, Desalegn [47] found that significantly higher biomass yield (19750 kg ha^{-1}) was obtained with the application of 250 kg NPS ha^{-1} on Ogolcho variety and the lowest biomass yield (15833 kg ha^{-1}) was obtained from Liben variety without application of external fertilizer. Biomass yield of wheat significantly increased with application of nitrogen fertilizer [48]. Similar result was reported by Esayas [49]. Similarly, Abebe [50]; Dereje [51] reported that wheat biomass yield increased with increased rates of nitrogen fertilizer. Bekalu and Mamo [52] also reported that increasing N rates from 23 to 69 kg ha^{-1} significantly increased dry biomass of wheat by about 22.6%. Significantly higher 10233 kg ha^{-1} of bread wheat from farm two followed 9175 and 6869 kg ha^{-1} from farm thee and one indicating variation farm field fertility status history among farm used for the experiment.

Grain Yield and Thousand Seed Weight of Wheat: The mean gran yield and thousand seed weight of bread wheat due to application of blended NPS and nitrogen fertilizer rates application are indicated in Table 3.

Table 3: Effects of urea and Blended NPSB fertilizer rate on mean dry biomass and thousand seed weight of wheat in Ultisols of Liben Jawi district

		Grain yield (Kg ha^{-1})				Thousand seed weight (g)			
		2018		2019		218		2019	
Urea (Kg ha^{-1})	NPSB (Kg ha^{-1})	Farm 1	Farm 2	Farm 3	Mean	Farm 1	Farm 2	Farm 3	Mean
150	150	2242bc	3525cde	4127cd	3298e	56ab	39b	36abc	44ab
150	200	2788ab	3374cde	5270ab	3810cde	59ab	40ab	41a	47ab
150	250	2990ab	4071bcd	3254d	3438de	57ab	43ab	37abc	46ab
150	300	2889ab	3990bcd	4302bcd	3727cde	55ab	40ab	40ab	45ab
250	150	3919a	4535abc	3556d	4003bcde	58ab	41ab	37abc	45ab
250	200	2141bc	5101ab	3937cd	3726cde	51b	41ab	33abc	42b
250	250	3455ab	4323abcd	3333d	3704cde	59ab	41ab	34abc	45ab
250	300	3475ab	5747a	5349a	4857a	55ab	44a	38abc	46ab
350	150	2596abc	5081ab	3429d	3702cde	56ab	39b	33bc	43ab
350	200	3323ab	5455ab	3492d	4090bcd	56ab	42ab	34abc	44ab
350	250	3848a	5182ab	3952cd	4328abc	57ab	41ab	32c	43ab
350	300	3535ab	5667a	4746abc	4649ab	64a	42ab	39abc	48a
100	100	2384bc	2990de	1762e	2379f	59ab	41ab	35abc	45ab
0	0	1384c	2222e	3873cd	2493f	56ab	40ab	40ab	45ab
LSD (5%)		1233.1	1333.4	922.49	650.17	10.298	4.133	6.6644	10.298
CV (%)		25.10	18.16	14.15	18.59	10.76	6.01	10.94	9.92

Means followed by different letter(s) in a column and rows are significant at 5% level of probability

Application urea and blended NPSB fertilizer rate was significantly ($P<0.05$) affected mean grain yield of bread wheat in two farms in 2018, one farm in 2019 and combined over years. Tagesse *et al.* [20] found that the mean grain yield of bread wheat was significantly affected by the application of blended NPS and nitrogen fertilizer rates and the highest mean grain yield (6832 kg ha^{-1}) was obtained from application of 200/92 kg urea/NPS ha^{-1}. Significantly higher (3919 kg ha^{-1}) in farm one with application of 250/150 kg urea/NPSB ha^{-1}, 5747, 5349 and 4857 kg ha^{-1} in farm two, three and combined over farms were obtained from application of 250/300 kg urea/NPS ha^{-1} fertilizer rates. Similarly, Desalegn [47] found that significantly higher mean grain yield (7667 kg ha^{-1}) was obtained from Hidase and Ogolcho wheat varieties with the application of 250 kg NPS ha^{-1}.

There is an increase in yield of bread with increasing the amount of nitrogen in from urea and blended NPSB fertilizer rates application. This might be due to the role of nitrogen in increasing the vegetative growth of wheat which facilitates the photosynthesis efficiency contributed for improvement of better yield of wheat. Also, Fresew *et al*. [53] reason out that the increase in yield of wheat varieties with increasing N rates up to adequate level might be due to the role of N in increasing the leaf area and promote photosynthesis efficiency which promote dry matter production and increase yield. Likewise, mean grain yield of wheat increased with the higher levels of nitrogen than lower levels and control [48, 54]. Also, Assefa *et al.* [19]. found application of NPS fertilizer significantly affected grain yield and other yield components of wheat. Similarly, Pržulj *et al.* [55]; Yohannes and Nigussie [56]; Lemi and Negash [45] reported that the mean grain yield of wheat significantly increased with increasing rates of nitrogen. Aula *et al.* [12] reported that mean grain yield of winter wheat was significantly affected by nitrogen management and higher grain yield was obtained with adequate nitrogen application and lower from control. He further stated that improving wheat grain yield and meet the food needs of the ever-expanding human population, growing of new cultivars together with N fertilization may need to become an integral part of the farming operation in developing country which is true for western Showa.

Also, Shirazi *et al*. [57] concluded that highest grain yield was obtained from 120 kg N ha^{-1} as compared to 80 kg N ha^{-1}. Haile *et al.* [58] found that increasing N rate from 0 to 120 kg N ha^{-1} increased mean grain yield of bread wheat. Bereket *et al.* [48] also reported that increasing P rate from 20 to 30 kg P ha^{-1} increased grain yield of bread wheat by about 6.8%. Usman [59]. reported that the mean grain yield of wheat significantly affected by application of NPSB fertilizer rates and higher grain yield (5935 kg ha^{-1}) was obtained with application of 73/30 kg N P ha^{-1} whereas, the lowest grain yield (4866 kg ha^{-1}) was recorded from control. Fresew *et al.* [53] found that application of nitrogen increased drastically grain yield of the varieties tested as compared to the control in both growing years and optimum mean grain yields Menze and Tsehay varieties of wheat were obtained with application of 240 kg N ha^{-1}. The mean grain yield of bread of wheat was 4376, 3884 and 2926 kg ha^{-1} obtained from farm two, three and one and significantly varied across three farms and years. This might be due to the soil fertility status variation across farms due to management history of the farm field for crop production. Similarly, Fresew *et al.* [53] reported that variation across years among wheat varieties panted for two consecutive years. Vanlauwe *et al.* [60] reported a long-term interplay of geological and landscape conditions and plot-specific management have generated such often called within farm soil fertility gradients variations. Similarly, Mack [61] reported a wide range of management practices and production history at each site which subsequently affects treatment response of on-farm research; and each farmer managed his farm on his own way, such as applying either preplant or top dress N rates. The different levels of land use intensity and the ability of farmers to apply inputs (crop residues, manure, refuse, fertilizer) to some fields (homestead), yet exploiting others (distant fields) [60]. Tittonell *et al.* [62] reported heterogeneity in soil fertility in these smallholder systems is caused by both inherent soil-landscape and human-induced variability across farms differing in resources and practices. The variability in soil properties at farm scale was largely associated with inherent features of each site as well as with within farm variability [63].

The mean thousand seed weight of bread wheat was significantly ($P<0.05$) affected by application of urea and blended NPSB fertilizer rates. The thousand seed weight of bread wheat was ranged between 51 to 64g , 39 to 44g, 32 to 41g and 42 to 48 g from farm one, two three and combined over farms with application urea and blended NPSB fertilizer rates. The mean thousand seed weight of wheat did not show consistence increase trend with increasing with increasing rates of urea and blended NPSB fertilizer rates. In contrary, Alamzeb *et al.* [64] found that increased in thousand grains weight of wheat was recorded application of higher levels 150 and 125 kg N ha^{-1} (44 and 44 g), while the lower thousand grains weight (40g) was recorded from control.

Harvest Index of Wheat: The mean harvest index of bread wheat due to application of urea and blended fertilizer rates is indicated in Table 4. Application of urea and blended NPSB fertilizer rate s was significantly ($P<0.05$) affected the mean harvest index of bread wheat. The harvest index of bread wheat was ranged between 32.04 to 56.32, 36.73 to 45.92, 36.73 to 49.26 and 38.43 to 47.58 % obtained from farm one, two, three and combined mean over years with application of urea and blended NPSB fertilizer rates and it does not consistently follow the increasing trend of urea and blended NPSB fertilizer rate application. The mean harvest index of wheat was significantly higher 42.75 % from farm one followed by 42.61 and 42.37 % from farm two and three. The harvest index of bread wheat was varied from farm to farm and with application of urea and blended NPSB fertilizer rates. In contrary, Alamzeb *et al.* [64] found that increased in harvest index of bread wheat was obtained with application of higher 150 and 125 kg N ha^{-1} (38 %) while the lowest harvest index (34%) was recorded from control. Lemi and Negash [45] found that higher mean harvest index 54.33% of wheat variety Ogolcho was obtained from application of at 100/100 kg NPSZnB/urea ha^{-1}.

Effects of Urea and Blended NPSB Fertilizer Rates on Economic Feasibility of Wheat Production: The partial budget analysis due to application of urea and blended NPSB fertilizer rates on economic feasibility of wheat production is indicated in Table 5. The highest net benefit ETB 54064 ha^{-1} with marginal rate of return of 395% and value to cost ratio of ETB 7.58 per unit of investment was obtained with application of 250/250 kg urea/NPSB ha^{-1} for bread wheat production. The second and third net benefit ETB 45480 and 44452 ha^{-1} with marginal rate of return of 73 and 367 % and value to cost ratio of ETB 9.17 and 12.51 per unit of investment were obtained from application of 250/100 and 150/100 kg urea/NPSB ha^{-1} for wheat production. Higher values to cost ratio of 12.51 per unit of investment were obtained from application of 150/100 kg urea/NPSB ha^{-1} for wheat production.

Likewise, Lemi and Negash [45] found that the maximum net benefit ETB 50, 904ha^{-1} was obtained with application of 100 /100 kg NPSZnB/Urea ha^{-1} from Ogolcho variety of bread wheat. Also, Desalegn [47] found that higher net profit of ETB 73, 135 ha^{-1} with marginal rate return of 86% was obtained with application of 250 kg NPS ha^{-1} followed by net benefit of 71, 222 with marginal rate return of 1839% with application of 50 kg NPS ha^{-1} for Hidase variety of bread wheat. Dawit *et al.* [65]. (2015) recommended 92/20 kg NP ha^{-1} for production of wheat for moist and humid midland Vertosols areas of Arsi zone. Bekalu and Mamo [52] reported that application of 69 kg N ha^{-1} gave higher grain yield and economic benefit of wheat in southern part of Ethiopia. Application of 46/20 kg NP ha^{-1} are economical feasible and recommended to achieve sustainable bread wheat production on the sandy soils of Hawzen district [48].

Table 4: Effects of urea and blended NPSB fertilizer rate on mean dry biomass and thousand seed weight of wheat in Ultisols of Liben Jawi district

		Harvest index (%)			
		2018		2019	
Urea (Kg ha^{-1})	NPSB (Kg ha^{-1})	Farm 1	Farm 2	Farm 3	Mean
150	150	41.26ab	41.93ab	43.00ab	42.06ab
150	200	39.55ab	43.06ab	45.11ab	42.57ab
150	250	41.61ab	43.12ab	39.90b	41.54ab
150	300	41.00ab	39.40ab	43.54ab	41.31ab
250	150	56.32a	44.02ab	42.42ab	47.58a
250	200	32.04b	44.17ab	39.06b	38.43b
250	250	43.10ab	36.73b	38.48b	39.44b
250	300	42.58ab	44.93ab	44.16ab	43.89ab
350	150	43.52ab	45.92a	38.05b	42.50ab
350	200	45.08ab	44.08ab	40.29ab	43.15ab
350	250	42.16ab	44.07ab	40.29ab	42.17ab
350	300	42.91ab	45.66ab	44.66ab	44.41ab
100	100	42.24ab	37.93ab	37.88b	39.35b
0	0	45.21ab	41.50ab	49.26a	45.32ab
LSD (5%)		15.512	7.6673	9.7787	6.3954
CV (%)		21.62	10.72	13.75	16.02

Means followed by different letter(s) in a column and rows are significant at 5% level of Probability

Table 5: Effects of urea and blended NPSB fertilizer rate on economic profitability of wheat production in Ultisols of Liben Jawi district

Urea (Kg ha^{-1})	NPSB (Kg ha^{-1})	Grain yield (kg ha^{-1})	Adjusted Grain yield (kg ha^{-1})	Gross field benefit (EB ha^{-1})	Urea cost (EB ha^{-1})	NPSB cost (EB ha^{-1})	TCV (EB ha^{-1})	Net benefit (EB ha^{-1})	Value to cost ratio	MRR (%)
0	0	2493	2244	31412	0	0	0	31412		
100	100	2379	2141	29975	1404	1448	2852	27123	9.51	
150	100	3810	3429	48006	2106	1448	3554	44452	12.51	367
150	150	3298	2968	41555	2106	2172	4278	37277	8.71	
250	100	4003	3603	50438	3510	1448	4958	45480	9.17	73
150	200	3438	3094	43319	2106	2896	5002	38317	7.66	
250	150	3726	3353	46948	3510	2172	5682	41266	7.26	
150	250	3727	3354	46960	2106	3620	5726	41234	7.20	
350	100	3702	3332	46645	4914	1448	6362	40283	6.33	
250	200	3704	3334	46670	3510	2896	6406	40264	6.29	
350	150	4090	3681	51534	4914	2172	7086	44448	6.27	
250	250	4857	4371	61198	3510	3620	7130	54068	7.58	395
350	200	4328	3895	54533	4914	2896	7810	46723	5.98	
350	250	4649	4184	58577	4914	3620	8534	50043	5.86	

D = Dominated and Price of urea and NPSB 14.04 and 14. 48 EB kg^{-1} grain price = 14 EB kg^{-1}

Also, Assefa *et al*. [19] obtained higher economic benefit with the application of higher NPS levels 69, 20 and 20 respectively. Usman [59] reported that application of 100 kg NPSB ha^{-1} for Hidase and Kingbird and 150 kg NPSB ha^{-1} were economical feasible and recommended for of Bread wheat production. Dereje [51] found that application of 92 kg N ha^{-1} fertilizer application gave higher net benefit of ETB 79741 ha^{-1} with marginal rate of return of 980% was economically profitable and recommended for wheat production. Therefore, application of 150/100 kg urea/NPSB ha^{-1} was recommended for bread wheat production in Liben Jawi District.

CONCLUSION

Application of integrated use of urea and blended NPSB fertilizer rate were significantly improved growth, yield and yield components of bread wheat. Significantly higher (4857 kg ha^{-1}) mean grain yield of bread wheat was obtained with application of 250/300 kg N/NPSB ha^{-1}. Application of 250/250 and 250/100 kg N/NPSBha^{-1} gave higher net return of ETB 54064 ha^{-1} with marginal rate of return of 395% and value to cost ratio of ETB 7.58 per unit of investment and ETB 45484 with marginal rate return of 258% and values to cost ratio of EB 9.17 profit per unit investment for wheat production in Ultisols of Liben Jawi district. Therefore, application of 250/250 and 250/100 kg N/NPSB ha^{-1} was produced better grain yield and economical feasible and recommended for improved wheat production in Ultisols of Liben Jawi and similar agro-ecologies in western Oromia.

ACKNOWLEDGEMENTS

First, I would like to thank the almighty God who lives us and lead us to see seed of our work. The authors thank Natural Resources Management Research Process for funding the experiment. I am very grateful to Ambo Agricultural Research center management for providing all necessary equipment's and logistics during the research work. All the technical and field assistants of Natural Resources Management Research Process are also acknowledged for unreserved effort during executing the experiment. I want to thank farmers for providing us land for field research work and their assistance in field management too.

REFERENCES

1. Martini, D., F. Taddei, R. Ciccoritti, M. Pasquini, I. Nicoletti, D. Corradini and M.G. D'Egidio, 2015. Variation of Total Antioxidant Activity and of Phenolic Acid, Total Phenolics and Yellow Coloured Pigments in Durum Wheat (*Triticum turgidum* L. Var. durum) as a Function of Genotype, Crop Year and Growing Area. Journal Cereal Sciences, 65: 175-185.
2. Racioppi, M., M. Tartaglia, José M. De La Rosa, M. Marra, E. Lopez-Capel and M. Rocco, 2020. Response of Ancient and Modern Wheat Varieties to Biochar Application: Effect on Hormone and Gene Expression Involved in Germination and Growth. Agronomy, 10(5): 1-11.
3. Hamdi, L., A. Suleiman, G. Hoogenboom and V. Shelia, 2019. Response of the Durum Wheat Cultivar Um Qais (*Triticum turgidum* subsp. durum) to Salinity. Agriculture, 9: 135.
4. Dhillon, J.E. Eickhoff, L. Aula, P. Omara, G. Weymeyer, E. Nambi, F. Oyebiyi, T. Carpenter and W. Raun, 2020. Nitrogen management impact on winter wheat grain yield and estimated plant nitrogen loss. Agronomy Journal, pp: 1-14.
5. Ali, S., M. Shahid Ibin-i Zamir, M. Farid, M.A. Farooq, M. Rizwan, R. Ahmad and F. Hannan, 2016. Growth and yield response of wheat (*Triticum aestivum* L.) to tillage and row spacing in maize-wheat cropping system in semi-arid region, Eurasian Journal Soil Science, 5(1): 53- 61.
6. Hossain, I.I., I.S. Hossain, M.A. Rahman, A. Haque, S. Hasan and S. Haque, 2015. Yield potentials of recently released wheat varieties and advanced lines under different soil fertility. International Journal of Agronomy and Agricultural Research, 6(6): 91-99.
7. CSA, 2019. Area and production of major crops. Agricultural Sample Survey 2018/19 (2011 E.C.). V1. Statistical Bulletin. 589. Addis Ababa, Ethiopia.
8. Teklu, E., M. Tekalign, K. Selamyihun and A. Mesfin, 2000. Response of some durum wheat landraces to nitrogen application on Ethiopian Vertisols. In: CIMMYT. The Eleventh Regional Wheat Workshop for Eastern, Central and Southern Africa. Addis Ababa, Ethiopia: CIMMYT, pp: 229-238.
9. Mohammed, Y.A., J. Kelly, B.K. Chim, E. Rutto, K. Waldschmidt, J. Mullock, G. Torres, G. Kefalew and W. Raun, 2013. Nitrogen fertilizer management for improved grain quality and yield in winter wheat in Oklahoma. Journal of Plant Nutrition, 36: 749-761.
10. Omara, P., N. Macnack, L. Aula and B. Raun, 2017. Effect of long-term beef manure application on soil test phosphorus, organic carbon and winter wheat yield. Journal of Plant Nutrition, 40: 1143-1151.
11. Yi, Q., P. He, X.Z. Zhang, L. Yang and G.Y. Xiong, 2015. Optimizing fertilizer nitrogen for winter wheat production in Yangtze River region in China. Journal of Plant Nutrition, 38: 1639-1655.
12. Aula, L., P. Omara, E. Eickhoff, F. Oyebiyi, J.S. Dhillon and W.R. Raun, 2020. Effect of winter wheat cultivar on grain yield trend under different nitrogen management. Agrosystems, Geosciences and Environment, 1-7. 3:e20017.
13. Sapkota, T.B., L.K. Singh, A.K. Yadav, A. Khatri-Chhetri, H.S. Jat, P.C. Sharma, M.L. Jat and C.M. Stirling, 2020. Identifying optimum rates of fertilizer nitrogen application to maximize economic return and minimize nitrous oxide emission from rice–wheat systems in the Indo-Gangetic Plains of India, Archives of Agronomy and Soil Science, DOI: 10.1080/03650340.2019.1708332.
14. Stewart, W.M., D.W. Dibb, A.E. Johnston and T. J. Smyth, 2005. The contribution of commercial fertilizer nutrients to food production. Agronomy Journal, 97: 1-6.

15. Bielski, S., K. Romaneckas and E. Šarauskis, 2020. Impact of Nitrogen and Boron Fertilization on Winter Triticale Productivity Parameters. Agronomy, 10(279): 1-12. 10, 279.
16. Raun, W.R., J.B. Solie, G.V. Johnson, M.L. Stone, R.W. Mullen, K.W. Freeman and E.V. Lukina, 2002. Improving nitrogen use efficiency in cereal grain production with optical sensing and variable rate application. Agronomy Journal, 94: 815-820.
17. Omara, P., L. Aula, F. Oyebiyi and W.R. Raun, 2019. World cereal nitrogen use efficiency trends: Review and current knowledge. Agrosystems, Geosciences and Environment, Retrieved from https://doi.org/10.2134/age2018.10.0045.
18. ATA, 2013. EthioSIS (Ethiopian Soil Information System), (2013). Soil analysis report. Agricultural Transformation Agency (Unpublished).
19. Assefa, M., J.M.R. Semoka, N. Amuri and M. Tekalign, 2015. Wheat Response to Applied Nitrogen, Sulfur and Phosphorous in three Representative Areas of the Central Highlands of Ethiopia-I. International Journal of Plant & Soil Science, 8(5): 1-11.
20. Tagesse, A., B. Ketema and T. Tamado, 2018. Effect of Blended NPS Fertilizer Supplemented with Nitrogen on Yield Components and Yield of Bread Wheat (*Triticum aestivum* L.). Journal of Natural Sciences Research, 18(11): 90-96.
21. ATA, 2014. Soil Fertility Status and Fertilizer Recommendation Atlas for Tigray Regional State, Ethiopia. Ethiopian Agricultural Transformation Agency (ATA), A.A., Ethiopia.
22. Ahmad, W., M.H. Zia, S.S. Malhi, A. Niaz and S. Ullah, 2012. Boron deficiency in soils and crops: A review. In: Aakash, G. (Ed). Crop Plant in Tech: Shanghai, China, pp: 77-114.
23. Eggert, K. and N. Von Wirén, 2016. The role of boron nutrition in seed vigour of oilseed rape (*Brassica napus* L.). Plant Soil, 402: 63-76.
24. Debnath, C., M.A.N. Kaderand and N. Islam, 2014. Effect of nitrogen and boron on the performance of wheat. International Journal Environmental Science, 7: 105-110.
25. Fakir, O.A., M.A. Rahman and M. Jahiruddin, 2016. Effect of foliar application of boron (B) on the grain set and yield of wheat (*Triticum aestivum* L.). American Journal Experimental Agriculture, 12: 1-8.
26. Thakur, P. and D. Mukhopadhyay, 2018. Effect of boron and lime on yield assessment of wheat (*Triticum aestivum* L.). International Journal Current Microbiology Applied Sciences, 7: 1133-1140.
27. Iqbal, S., M. Farooq, A. Nawaz, A.U. Rehman and A. Rehman, 2012. Optimizing boron seed priming treatments for improving the germination and early seedling growth of wheat. Journal Agricultural Society. Sciences, 8: 57-61.
28. MAARC, 2019. Meteorological Station of Ambo Agricultural Research Center. Meteorological data of Ambo area for 1995-2019. Ambo, Oromia, Ethiopia.
29. Tolera, A., W. Dagne, E. Semu, B.M. Msanya, D. Tolessa and K. Haekoo, 2016. Pedological Characterization, Fertility Status and Classification of the Soils under Maize Production of Bako Tibe and Toke Kutaye Districts of Western Showa, Ethiopia. Ethiopian Journal of Applied Science Technology, 7(1): 1-17.
30. Dewis, J. and F. Freitas, 1984. Physical and chemical methods of soil and water analysis. FAO Soil Bulletin No. 10. FAO, Rome, pp: 275.
31. Van Reeuwijk, L.P., 2002. Procedures for Soil Analysis. 6th Edition. Technical Paper: International Soil Reference and Information Centre, Wageningen, The Netherlands.
32. 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.
33. McLean, E.O., 1965. Aluminum. In: Black, CA. (Ed.) Methods of Soil Analysis. Agronomy No. 9. Part II. American Society of Agronomy Madison, Wisconsin. USA, pp: 978-998.
34. Walkley, A. and C. A. Black, 1934. An examination of Degtjareff method for determining soil organic matter and the proposed modification of the chromic acid titration method. Soil Science, 37: 29-38.
35. Jackson, M.L., 1958. Soil chemical analysis. pp: 183-204. Prentice Hall, Inc., Engle Wood Cliffs. New Jersey.
36. Bray, R.H. and L.T. Kurz, 1945. Determination of total, organic and available forms of phosphorous in soil Soil Science, 59(1): 39-45.
37. Birru, A., 1979. Agricultural Field Experiment Management Manual Part III. IAR (Institute of Agricultural Research). Addis Ababa, Ethiopia, pp: 35-42.
38. Nelson, L.A., R.D. Voss and J. Pesek, 1985. Agronomic and Statistical Evaluation of Fertilizer Response, pp: 89.
39. SAS, 2012. SAS/STAT Software Syntax, Version 9.4. SAS Institute, Cary, NC. USA.

40. Steel, R.G.D., J.H. Torrie and D.A. Dicky, 1997. Principles and Procedures of Statistics, A Biometrical Approach. 3rd Edition, McGraw Hill, Inc. Book Co., New York, pp: 352-358.
41. CIMMYT, 1988. From agronomic Data to Farmer Recommendations: Economics Training Manual. Completely Revised Edition. Mexico, D. F, pp: 89.
42. London, J.R., 1991. Booker tropical soil manual: A hand book for soil survey and agricultural land evaluation in the tropics and subtropics. Longman, pp: 474.
43. Msanya, B.M., D.N. Kimaro, J.D.J. Mbogoni and G.G. Kimbi, 2000. Soils and Land Resources Report of Morogoro Urban District, Tanzania. Sokoine University of Agriculture, Faculty of Agriculture, Department of Soil Science, Morogoro, Tanzania. Ministry of Agriculture, ARI- Mlingano, National Soil Service, Tanga, Tanzania.
44. Tekalign, T., 1991. Soil, plant, fertilizer, animal manure and compost analysis manual. International Livestock Centre for Africa, No. B13. Addis Ababa, Ethiopia.
45. Lemi, A. and G. Negash, 2020. Effects of Variety and Fertilizer Rate on Yield of Bread Wheat (*Triticum aestivum*, L) Varieties in East Wollega Zone, Western Ethiopia. Agricultural and Biological Sciences Journal, 6(2): 60-71.
46. Bekalu, A. and A. Arega, 2016. Effect of the Time and Rate of N-Fertilizer Application on Growth and Yield of Wheat (*Triticum aestivum* L.) at Gamo-gofa Zone, Southern Ethiopia. Journal of Natural Sciences Research, 6(11): 111-122.
47. Desalegn, A., 2019. Effects of NPS Fertilizer Rates on Yield and Quality Attributes of Bread Wheat (*Triticum aestivum* L.) Varieties in Munessa District, Arsi Zone, Ethiopia. M.Thesis Research. Arsi University, pp: 71.
48. Bereket, H., H. Dawit, H. Mehretab and G. Gebremedhin, 2014. Effects of mineral nitrogen and phosphorus fertilizers on yield and nutrient utilization of bread wheat (*Tritcum aestivum*) on the sandy soils of Hawzen District, Northern Ethiopia. Agriculture Forestry Fisheries, 3(3): 189-198.
49. Esayas, L., 2015. Effect of blended fertilizers on yield and yield traits of durum wheat (*Triticum turgidum* var. durum) varieties in Ada district, Central Ethiopia. M.Sc. Thesis, Haramaya University, Haramaya, Ethiopia.
50. Abebe, G., 2012. Soil characterization and evaluation of slow-release urea fertilizer rates on yield components and grain yields of wheat and teff on Vertisols of Jamma District of South Wollo zone, Amhara Region. M.Sc. Thesis. Haramaya University, Haramaya, Ethiopia.
51. Dereje, D., 2018. Response of Lemu and Wane Bread Wheat (*Triticum aestivum* L.) Varieties to Nitrogen Fertilizer rates at Kulumsa, Southeastern Ethiopia. M. Sc Thesis, Hawassa University College of Agriculture, pp: 88.
52. Bekalu, A. and M. Mamo, 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 Sciences, 6(3): 168-175.
53. Fresew, B., D. Nigussie, M. Adamu and T. Tamado, 2018. Effect of nitrogen fertilizer rates on grain yield and nitrogen uptake and use efficiency of bread wheat (*Triticum aestivum* L.) varieties on the Vertisols of central highlands of Ethiopia. Agriculture & Food Security, 7(78): 1-12.
54. Bereket, H. and W. Yirgalem, 2012. Status survey of total plant and total and DTPA extractable soil copper, zinc, iron and manganese in different agro ecological zones, soils and districts of Tigray, Ethiopia. Tigray Agricultural Research Institute, Mekelle, Ethiopia.
55. Pržulj, N. and V. Momcilovic, 2011. Characterization of vegetative and grain filling periods of winter wheat by stepwise regression procedure II. grain filling period. Genetika, 43(3): 549-558.
56. Yohannes, E. and D. Nigussie, 2019. Effect of Rates and Time of Nitrogen Application on Growth, Yield and Yield Components of Wheat (*Triticum aestivum* L.) in Eastern Hararghe, Ethiopia. Journal of Natural Sciences Research, 9(11): 1-15.
57. Shirazi, S.M., Z. Yusop, N.H. Zardari and Z. Ismail, 2014. Effect of irrigation regimes and nitrogen levels on the growth and yield of wheat. Advances in Agriculture, pp: 1-6.
58. Haile, D., D. Nigussie and A. Amsalu, 2012. Nitrogen use efficiency of bread wheat: Effects of nitrogen rate and time of application. Journal of Soil Science and Plant Nutrition, 12(123): 389-409.
59. Usman, K., 2018. Effects of Blended (NPSB) Fertilizer Rates on Yield Components, Yield and Grain Quality of Bread Wheat (*Triticum aestivum* L.) Varieties at Kulumsa, South-Eastern Ethiopia. M.Sc Theisis. Haramaya University, pp: 74.

60. Esayas, L., 2015. Effect of blended fertilizers on yield and yield traits of durum wheat (*Triticum turgidum* var. durum) varieties in Ada district, Central Ethiopia. M.Sc. Thesis, Haramaya University, Haramaya, Ethiopia.
61. Mack, C.J., 2006. Validation of nitrogen calibration Strip technology for prescribing accurate top-dress nitrogen fertilizer. M.Sc. Thesis degree, Oklahoma State University, United States, pp: 40.
62. Tittonell, P., A. Muriuki, C.J. Klapwijk, K.D. Shepherd, R. Coe and B. Vanlauwe, 2012. Soil heterogeneity and soil fertility gradients in smallholder farms of the east African highlands. Soil Science Society of American Journal, 77: 525-538.
63. Tittonell, P., A.W. Muriuki, K.D. Shepherd, D. Mugendi, K.C. Kaizzi, J. Okeyo, L. Verchot, R. Coe and B. Vanlauwe, 2010. The diversity of rural livelihoods and their influence on soil fertility in agricultural systems of East Africa: A typology of smallholder farms. Agricultural Systems, 103: 83-97.
64. Alamzeb, M., S. Anwar, A. Iqbal, B. Parmar and M. Iqbal, 2017. Organic sources, nitrogen and tillage systems improve wheat productivity and profitability under semiarid climates. Journal of Pharmacognosy and Phytochemistry, SP1: 73-78.
65. Dawit, H., T. Kasu, A. Wubengeda, D. Tadese and M. Asrat, 2015. Agronomic and Economic Evaluation of the N and P Response of Bread Wheat Grown in Moist and Humid Midhighland Vertisols Areas of Arsi Zone, Ethiopia. African Journal of Agricultural Research, 10(3): 89-99.