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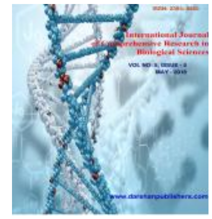

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Research Article

EFFECTS OF FERTILIZER RATE (BLENDED) AND SOWING METHODS ON YIELD OF BREAD WHEAT (*Triticum aestivum*) AND ITS ECONOMIC PROFITABILITY IN WESTERN ETHIOPIA

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Abstract

Field experiment was conducted at Arjo Dedessa Sugar Factory during the 2015/2016 cropping season to evaluate the economic profitability of blended fertilizer on Bread wheat (Triticum aestivum) production. The treatments consisted of four rates of blended fertilizer (0, 100, 150, 200 kg ha$^{-1)}$, three rates of blended fertilizer + urea (100 + 101.52, 150 +82.71, 200 +63.91 kg ha^{-1}), one rates of DAP + urea (100 +100 kg ha^{-1}) and two sowing methods (row and broadcasting). The two factors combined factorailly and arranged in randomized complete block design (RCBD) with three replications. An improved wheat variety 'Tay (ET-12D4) HAR 604(1)' was used as a test crop. Data were analyzed using one way and two way ANOVA through SAS, mean comparison was done using fisher's LSD at 0.05 probability level. The soil at the experimental site was sandy loam in texture (57% sand, 27% silt, & 16% clay). The soil of the experimntal site is slightly acidic (pH-6.25) with high organic matter content (7.2%). The results revealed that yield and yield contributing characters were influenced significantly by different rate of blended fertilizer and sowing methods. The highest grain yield (29.583 qt ha^{-1}) and the highest straw yield (6.10 qt ha^{-1}) were obtained from 200 kg blended fertilizer + 63.91 kg of urea. In contrast, minimum grain yield (12.125 qt ha^{-1}and 18.194 qt ha^{-1} and straw yield (37.78 qt ha^{-1}) were observed when 0 kg fertilizer and 100 kg of DAP +100 kg of urea applied. From our result we conclude that application of 200 kg blended fertilizer plus 82.71 kg urea /ha under row sowing provided high yield. But 100 kg blended fertilizer recommendation under row planting was the best optimum rate recommended to the farmers which have the highest Net economic benefit comparing to the other treatments.

Keywords: blended fertilizer, blanket fertilizer, soil property, row sowing, broad cast sowing and Tay

Introduction

Wheat was one of the first domesticated food crops and for 8,000 years has been the basic staple food of the major civilizations of Europe, West Asia, and North-East Africa. Demand for wheat in the developing world is expected to increase by 60% by 2050 (Rosegrant and Agcaoili, 2010; CIMMYT, 2012).

Ethiopia is the second---largest wheat producer in Africa next to South Africa. Wheat is one of the major staple crops in the country in terms of both production and consumption. In terms of caloric intake; it is the second---most important food in the country behind maize (FAO, 2014). In Ethiopia, the major challenges facing agriculture are low productivity, low use of improved farm inputs, and dependency on traditional farming and rain fall. As a result, food insecurity and poverty are prevalent in the country. There are two varieties of wheat grown in Ethiopia: durum wheat, accounting for 60 percent of production, and bread wheat, accounting for the remaining 40 percent (Bergh *et al*., 2012). Oromia accounts for over half of national wheat production (54 percent), followed by Amhara (32 percent); Southern Nations, Nationalities and Peoples (SNNP) (9 percent); and Tigray (7 percent) (CSA, 2013). Of the current total wheat production area, about 75 percent is located in the Arsi, Bale and Shewa wheat belts (MOA, 2012). Wheat accounts for about 10 to 15 percent of all the calories consumed in country (Berhane *et al*., 2011; FAO, 2014). Although the ratio of imported wheat to domestic production has declined in recent years, wheat production self-sufficiency is only about 78 percent (CSA, 2013; USDA, 2013).

Wheat yields in Ethiopia are relatively low. Recent estimates show that wheat farmers in Ethiopia produce on average 2.1 t/ha^{-1}, which is well below the experimental yield of above 5 t/ha (Haile, 1991; MOA, 2010; 2011; 2012,). This low production and productivity is mainly Fertilizer application rates on fertilized lands are estimated at 48 kg / ha, well below the average recommended rates of 200 kg / ha (Spielmanetal.,2011; Endale, 2010; MOA, 2010 ;2011, 2012) and the way farmer's plant wheat seeds also contribute to low wheat productivity. Traditionally, Ethiopian farmers, plant wheat seed using hand broad casting at high seed rates, reduce yield because uneven distribution of the seeds makes hand weeding and hoeing difficult, and plant competition with weeds lowers wheat growth and tillering, it also decreased in water use efficiency and fertilizer efficiency (Krezel and Sobkowicz, 1996).

For many years, farmers in Ethiopia have relied largely on imported Urea and DAP to meet their fertilizer input demands. In 2012/13, imports of DAP and Urea by Ethiopia are estimated to have reached 400,000 tones and 320,000 tons, respectively. While, fertilizer uptake has increased of late, yields have not increased in a proportionate manner. Consequently, in 2011, the government launched its Ethiopia soil fertility mapping project, helped by funding from Plant Production and Protection Division (AGP) of the Food and Agriculture Organizations (FAO) of the United Nations. Preliminary results have been generated from 225 administrative districts which show Ethiopia's soils to be deficient in a range of nutrients, including sulphur, boron, potassium, zinc and copper, underlining the need to treat plant nutrients to use in a more prescribed manner. Since deficiency of micro nutrients is reported in Ethiopian soils necessitate the application of nutrient sources and determine the rate that reduces such deficiency. Blended fertilizers containing both macro (nitrogen, phosphorous) and micro elements (boron, zinc) may possess this characteristic. High population pressure and fragmented cultivated land associated with land degradation, resulted in soil fertility decline in Western Ethiopia this leads to low productivity in different major cereal crops. Single mineral fertilizer application alone and with blanket recommendation cannot maintain the productivity potential of the major crops and soil fertility. So that, there is a need of soil based fertilizer application with blended (macro and micro nutrients) to optimize productivity potential of the major crops but no more further research has been conducted yet in relation of blended fertilizer on wheat production in western Ethiopia and its economic profitability particularly in the study area. So that, this research addresses this gap and formulated for the following objectives: To evaluate the effect of seed sowing methods and different rates of blended fertilizer on yield and yield components of Bread wheat and its economic profitability.

Materials and Methods

The experiment was conducted at Arjo Didessa sugar factory, on luvi soil type and improved wheat variety HAR 604 was used for the study propose. The trail was conducted during the main season of 2016. The treatment consisted of four rates of blended fertilizer (0, 100, 150, 200 kg ha^{-1}), three rates of blended fertilizer + urea (100 + 101.52, 150 +82.71, 200 +63.91 kg ha^{-1}), one rates of DAP + urea (100 +100 kg ha^{-1}) and two sowing methods (row and broadcasting). Totally, there were 16 treatment combinations. The two factors combined factorailly and arranged in randomized complete block design (RCBD) with three replications. The size of each plot were 3m wide and 4m long (12m^2area) with 0.5m and 1m space between plot and block, respectively. Each treatment was assigned randomly to the experimental units within the blocks.

The land was ploughed two times by New Holland tractors, which have 180 Hp and harrow at once to make the land level for uniform germination and easier seed soil contact. The seed rates were used 150 kg ha^{-1} for broad casting and 100 kg ha^{-1} for row sowing. Broad cast sowing was accomplished according to farmers' practices manually by hand and experienced persons. The distance between rows was 20cm.

The chemical composition of blended fertilizer consists of 17.3N, 34.7P_2O_5, 7.41S, 2.23Zn, and 0.5B in percentage. In three rate of blended fertilizer additional, 101.52 kg urea ha^{-1}, 82.71 kg urea ha^{-1}, 63.91 kg urea ha^{-}1 was added to make up the short fall of nitrogen fertilizer. For the broadcast method of fertilizer application, the recommended rate of DAP + urea, blended fertilizer, blended fertilizer + urea was broad casted at the time of sowing, whereas, for the row method of fertilizer application the recommended rate was drilled at the time of sowing. Weed and other agronomic practices were applied following of the recommendation for the crop and weeding was done manually as required.

Soil samples, an average of five, were collected from the experimental field (0-30 cm depth) by Auger sampler using zigzag line before planting and a composite sample of approximately 1 kg was taken after thoroughly mixing of the sub-samples. Similarly, surface soil samples of the same depth was taken just after harvesting accomplished from three representative points for each plots separately and a composite sample was made.

Treatment and fertilizer combinations used in the experiment presented as follows

Table 1.Treatment and fertilizer combinations.

Treatment code	Treatments
T1	0kg F with RS
T2	100kg blended F with RS (17.3N,34.7P_2O_5,7.41S,2.23Zn,0.3B)
T3	150kg blended F with RS (25.95N,5.05P_2O_5,11.115S,3.345Zn,0.45B)
T4	200kg blended F with RS (34.6N,69.4P_2O_5,14.82S,4.46Zn,0.6B)
T5	100kg blended F with RS (17.3N,34.7P_2O_5,7.41s,2.23Zn,0.3B) +101.52 kg urea
T6	150kg blended F with RS (25.95N, 5.05P2O5, 11.115S, 3.345Zn, 0.45B) +82.71 kg urea.
T7	200kg blended F with RS (34.6N,69.4P_2O_5,14.82S,4.46Zn,0.6B) +63.91kg urea
T8	100kg DAP +100kg urea with RS
T9	0kg F with BS
T10	100kgblended F with BS (17.3N,34.7P_2O_5,7.41S,2.23Zn,0.3B)
T11	150kg blended F with BS (25.95N,5.05P_2O_5,11.115S,3.345Zn,0.45B)
T12	200kg blended F with BS (34.6N, 69.4P_2O_5, 14.82S, 4.46Zn, 0.6B)
T13	100kg blended F with BS (17.3N, 34.7P_2O_5, 7.41s, 2.23Zn, 0.3B) +101.52 kg urea
T14	150kg blended F with BS (25.95N, 5.05P2O5, 11.115S, 3.345Zn, 0.45B) +82.7kg urea.
T15	200kg blended F with BS (34.6N, 69.4P_2O_5, 14.82S, 4.46Zn, 0.6B) +63.91kg urea
T16	100kg DAP +100kg urea with BS

Where, N: Nitrogen, P_2O_5: phosphorous, S: Sulfur, Zn: Zinc, B: Boron, F: Fertilizer, BS: Broad cast sowing, RS: Row sowing.

Data collection and measurements

The following under mentioned soil samples, yield and yield components were measured, counted and analyzed before and after harvest of bread wheat crop.

Total nitrogen: This was determined using Kjeldahl method (Jackson, 1973).

Available Phosphorus: This was determined using the Olsen (NaHCO3) extraction method (Olsen and Sommer, 1982) and the NaOH fusion method (Smith and Bain, 1982), respectively.

Available potassium: This was determined using neutral normal NH4OAC method (Pratt, 1965).

Organic carbon: This was determined using Wakley and Black method (1934).

Available sulfur: This was determined by treating 10 gm of 2 mm sieved soil with 25 ml 0.01 M of $CaCl_2.2H_2O$ extract ant and filtered.

Extracted Zinc: This was determined by using Houba, *et al*. method, 1989.

Soil pH: This was determined in a 1:2.5 soil water suspension using glass electrode pH meter (Von Reeuwijk, 1992).

Cation exchange capacity (CEC): of the soil was determined from ammonium-saturated samples that were subsequently replaced by sodium (Na) from a percolating sodium chloride solution.

Texture: texture was carried out using the hydrometer method (Day, 1965).

Thousand Seeds Weight (TSW): Grain weight of thousand seeds sampled at random from total grain harvest of the experimental plot was recorded on analytical balance expressed in gm.

Grain yield (Qt/ha): Grains obtained from each unit plot were sun dried and weighed carefully and finally converted to qt/ha.

Harvest index: It was calculated from the ratio of the total grain yield threshed to the total biomass yield harvested from each plot.

Straw yield (Qt/ha.): Straw obtained from each unit plot including the straw of the sample plants of respective unit plot was dried in sun and weighed to record the final straw yield plot^{-1} and converted to qt ha^{-1}.

Economic analysis

The cost and benefits associated with each different rate of blended fertilizer, blended fertilizer + urea and DAP and urea were compared using partial budgeting, which included only costs and benefits that varied from the control, i.e. costs of variable inputs (fertilizer), grain yield and straw yield was used as means of income and analyzed using in CIMMYT(1988) approach. When we calculate the costs of production variable inputs (fertilizer cost) were taken. The costs of different rate of fertilizer (blended) was calculated as for DAP=1550 birr / qt, urea=1350 birr / qt and blended fertilizer 1600 birr / qt , then it was calculated for each treatment depending on the amount used and converted to per hectare scale. The other costs (seed and crop husbandry agronomic management costs that do not vary among the treatment are not included in this cost analysis. The costs of fertilizers were according to the local market price in Jimma Arjo woreda DAP and UREA, the costs of blended fertilizer were taken from Gutie Blended Fertilizer Company.

To decide the last recommendation, the value of production was estimated together with calculating the variable production costs of different rate of blend fertilizer and additional nitrogen fertilizer. Because of farmers cannot achieve the same yield on the same piece of experimental units and treatments at his farm land, due to poor crop husbandry practices, high post harvesting losses and in appropriate harvesting technology and larger area; an adjusted yield was needed and calculated by subtracting 10% of the yield.

The analysis was done based on the current price of wheat grain and chemical fertilizers. The benefits were taken in the analysis notably the grain yield and the straw yield from each treatment according to the local market and then converted in to birr per hectare (grain yield and straw yield from each treatment according to the local market and then converted into birr per hectare (grain yield=800 birr / qt, and 40 birr / qt for straw yield). (Table 4)

After calculating net benefit by subtracting variable costs from the gross benefits, treatments were ranked from the lowest to the highest variable costs. The dominant analysis was carried out to identify the superior (non-dominated) and inferior (dominated) treatments. In this process the superior treatments were selected and the inferior treatments were rejected.

A treatment is said to be inferior when a treatment has net benefits less or equal to those of a treatment with a lower cost) and a treatment was said superior when no other option exists offering a greater net benefit at equal or lesser cost. Marginal rate of return was calculated by dividing marginal benefit to marginal costs of successive two treatments. This tells that the amount of additional net benefit for each unit cost incurred.

In order to make farmer recommendations from the marginal rate of return, the minimum acceptable rate of return was considered 100%. The treatment with highest net benefit among the treatments with greater than 100% MRR and highest net benefit was selected as the best recommendation for farmers.

Statistical analysis

The data obtained from the field were subjected to analysis of variance (ANOVA) using SAS, version 9.0, General linear model procedures (SAS Institute, 2004) and mean separation was by least significant difference (LSD) test.

Results and Discussion

Soil properties before harvesting

Total Nitrogen: The total nitrogen in the study site was high (0.360 %). According to Booker (1991), N content < 0.1 was rated as very low, 0.1-0.2 % has poor, 0.2-0.3 % as moderate, 0.3-0.4 % has high and greater than 0.4 is very high. Moreover, Tekalign *et al*, (1991) classified soil according to N availability as very low, poor, moderate and high with < 0.05%, 0.05-0.12%, 0.12-0.25% and > 0.25 %, respectively. Generally the high nitrogen content of the soil might be due to high vegetation cover, virgin land and high crop residue from the fields.

Available P: Available P content of the experimental site is 4.022 ppm. According to Olsen Chapman, P classified as , soils with available P of <3ppm very low, 4-7ppm low, 8-11ppm medium, 12-20ppm high, >20ppm very high. Therefore, the soil in the experimental site classified as very low (Table 2)

Available K: Available k content of the experimental site is 13.24 ppm. According to Booker (1991) classified soil k availability of < 0.05% as very low, 0.05-0.12% as poor, 0.12-0.25% as moderate and > 0.25% as high. According to this rating, soil of the study area has moderate available potassium.

Organic carbon and organic matter content: The total organic carbon of the experimental fields is 4.172% which is rated as medium. According to Booker 1991 total OC % of the soil greater than 10 was rated as high, 4-10 as medium and less than 4 as low. Medium organic carbon content could be due to high organic matter inputs of the area which is rated as 7.193. Moreover, the Netherlands commission of the ministry of agriculture and fisheries (1985) classified soils having total organic C % greater than 3.50, 2.51-3.5, 1.26-2.5, 0.60-1.25 and less than 0.6 is categorized as very high ,high, medium, low, and very low respectively. On the contrary, most cultivated soils of Ethiopia are medium to low in there organic matter content due to low in amount of organic materials applied to the soil and removal of biomass from the field (Yihenew, 2002).

Micro nutrients (Zinc and Boron): Table 3 showed that the available zinc content of the study area was 7.38cmol (+) / kg which is rated as low Basu (2011). Micronutrients such as Zn and B are required in small amounts for plant growth. If levels of this nutrients are too low, this can lead to poor plant growth; reduced uptake and fixation of nutrients (for example, P in cell roots), nitrogen mobilization and in efficient water use by plants.

Electrical conductivity and Cation Exchange Capacity: Cation Exchange Capacity (CEC) is an important parameter of soil, because it give an indication of the type of clay minerals present in the soil, soil texture, organic matter content of the soil and its capacity to retain nutrients against leaching (Sahlamedihin, 1999).

In general, soils high in CEC contents are considered as agriculturally fertile. The CEC of the site is 35.451 cmol (+) / kg soil which is high (Landon, 1991) indicated good agricultural soil. According to Landon (1991), top soils having CEC greater than 40 cmol (+) / kg are rated as very high and 25-40 cmol (+) / kg as high. Those top soils with 15-25, 5-15 and < 5 cmol (+) / kg of soil are classified as medium, low, and very low respectively. According to this classification, the soils of the study area have high CEC, which is a reflection of the very high clay. The soil electrical conductivity content of the study area was recorded as 0.095 dS/m and the value falls in a range of 0-4dS/m. This result indicates that EC of the soil is rated as low (Richard, 1954). Soil EC can be related to specific soil properties that affect crop yield, such as topsoil depth, pH, salt concentrations, and available water-holding capacity, and as such can help explain yield variation.

Soil pH: The ph of the soil, with 6.25 value, was categorized as slightly neutral as indicated in Table 3. The pH of the soil between (5.00 - 7.55) was found within the suitable range for crop production (Sahlamedihin, 1999). So that the pH level of the study is conducive for wheat production as normal soil pH for wheat is recorded to be from pH of 6.25 - 7.5 arrange appropriate condition for most wheat verities (Seifu, 1993).

Soil Texture: The soil at the experimental site was sandy loam in texture (57% sand, 27% silt, & 16% clay).

Soil properties after harvesting

Total nitrogen: Soil nitrogen after harvest decrease, because of blend fertilizer and N fertilizer (urea) has little or no considerable effect on N content of the soil (after harvesting) probably due to the mobile nature of this plant nutrient. Furthermore, N loss through various mechanisms, e.g., leaching, denitrification, volatilization, though might not be measured, played major role. Generally, the applications of blended fertilizers, blend fertilizer + urea, and DAP and urea under the two sowing methods had no nitrogen nutrient boosting in soil after harvest.

Available K: Available potassium after harvest was decrease, this result in harmony with Tsedale *et al*. (2002), who reported that application of both macro and micro nutrient source fertilizer induces over mining to the macro nutrients.

Available P: Soil phosphorus after harvest was increase; this is because of addition of blended fertilizers at time of sowing increases which may increase its availability. Miller and Danahaue (1995) noticed that almost no phosphorous is lost through leaching and relatively little mineralization of phosphate in the soil. So that, fixation is major loss of available phosphorous. This result in contradict with Tsedale *et al*. (2002), who reported that application of both macro and micro nutrient source fertilizer induces over mining to the macro nutrients.

Extracted Zinc: The results on table (2) shows that the application of Zn containing fertilizer could help to minimize further mining of Zn from soil but it aggravates primarily macro nutrient mining (N, & K). Consequently, blended fertilizer containing zinc had the ability of facilitating macro nutrient uptake for further mining by its turgore pressure. This is in harmony with Habtegebrial (2012), who reported that high available phosphorus found in soil or applied to it in Zinc deficient soil caused Zn deficiency. This is also agreed with Fassil and Yamoah, (2009) who reported that clay soils reduce the availability of Zn unless proper application and managements have been taken.

Table 2. The physico - chemical properties of the soil before sowing and after harvesting

Soil Parameters	Soil Sample	
	Before planting	After harvest
PH	6.25	6.825
Ec ms/cm	0.095	0.188
CEC cmol (+) / kg soil	35.451	33.96
C %	4.172	4.175
OM%	7.193	7.199
TN%	0.360	0.359
AP PPM	4.022	10.856
AK PPM	13.24	11.05
Ex. Zn cmol/kg	7.38	9.65
ASH cmol/kg	3.75	7.25
Texture	Sandy loam	

*EC: Electrical Conductivity, CEC: Cation Exchange Capacity, C: Organic Carbon, OM: Organic Matter, TN: Total Nitrogen, AP: available phosphorous, AK: Available Potassium, Ex. Zn: Extracted Zinc, AS: Available sulfur.

Effects of fertilizer rate (blended) and sowing methods on thousands seed weight

The results of analysis of variance revealed that the main effect of fertilizer rate (blended) and sowing methods significantly affected thousands seed weight (Table 3). However, the interaction effect of fertilizer rate (blended) and sowing methods were not significant. Numerically the highest seed weight (37.3 gm) was found treatments that receive 100 kg blended + 101.52 kg of urea / ha, although statistically identical to plots that receive 100 kg blended fertilizer, 150 kg of blended fertilizer, 200 kg of blended fertilizer, 150 kg blended fertilizer + 82.71 kg of urea and 200 kg blended + 63.91 kg of urea and lowest (30.300g) was obtained from treatments that receive 100 kg of DAP + 100 kg of urea (control), though statistically not significant plots that receive 0 kg of fertilizer (control). Higher seed weight is a reflection of improved nutrient use efficiency as a result of increased application of nitrogen level and blended fertilizer, respectively. This is in line with Muhammad *et al.* (2009), who reported that applying both micro (especially Zn,B) and macro nutrient and when N -level application increase there is a positive impact on yield component of wheat crop especially on 1000 seed weight. This result is harmony with Shuaib *et al*. (2009) who said when applying both micro (especially Zn,B) and macro nutrient and when N –level application increase there is a positive impact on yield component of wheat crop especially on 1000 seed weight.

Effects of fertilizer rate (blended) and sowing methods on Biomass yield

The results of the analysis of variance showed that the main effect of fertilizer rate (blended) and sowing methods significantly affected the bio mass yield (Table 3). However the interaction effect of fertilizer rate (blended) and sowing methods were found non significant. Among the treatments 200 kg blended fertilizer + 63.91 kg of urea / ha, 150 kg of blended fertilizer / ha + 82.71 kg of urea/ha, 100 kg of blended fertilizer + 101.52 kg of urea/ha, 200 kg of blended fertilizer,150 kg of blended fertilizer and 100 kg of blended fertilizer / ha produced the highest biomass yield, while, the lowest biomass yield was recorded from treatments that receive 0 kg of fertilizer (control 1, 49.91 qt/ha) and 100 kg DAP and 100 kg of urea , 60.16 qt/ha) respectively. Because zinc is an important element that presents in plant enzymatic systems. Various authors reported that biomass yield of wheat increased with increased rate of Zn application (Ali *et al*., 2009 and Grewal *et al.*, 1997) and in addition to the above authors, this result in agreement with Muhammod *et al, (*2009) and Amjed *et al*, (2011) which says that the above ground biomass increase when applying by increasing the level of of nitrogen up to 150 kg of nitrogen per ha. But this on contrary to Haftamu *et al*, (2009) who said that the above ground biomass result getting from N-69 kg per ha was highest compare to 92 kg per ha.

Effects of fertilizer rate (blended) and sowing methods on Grain yield

The results of the analysis of variance showed that the main effect of fertilizer rate (blended) and sowing methods significantly affected the mean grain yield Table 3. However, the interaction effect of fertilizer rate (blended) and sowing methods were not significant. Among the treatments 200 kg blended fertilizer + 63.91 kg of urea /ha produced the highest grain yield (29.583 qt/ha), although statistically non-significant to treatments of 100 kg of blended fertilizer,150 kg of blended fertilizer, 200 kg of blended fertilizer, 100 kg blended fertilizer + 101 .52 kg of urea, while the lowest (12.125 qt/ha) and (18.194 qt / ha) was found plots treated with 0 kg fertilizer (control 1) and 100 kg Dap and 100 kg UREA (control 2), respectively. This result signifies that the response of the soil B, Zn and S blended was significantly higher. Comparable yield increment of the blended fertilizer over the DAP and urea source fertilizer could be associated with the additional nutrients involved in the blended fertilizer (Zn, B, and S) other than N and P. In line with this, Halvin *et al*., (2005) reported that application of P and Zn nutrients in soils which are marginal deficit in P, Bo, and Zn improves crop yield, indicating positive interaction of P and Zn. Moreover, El- Majid *et al*., (2000) showed that grain yield was significantly increased with increasing levels of Zn and Boron (B). Although, high P availability or application in plants, commonly known as p - induce deficiency. So that, application of Zn, Boron and deficient soils could improve wheat yield.

Positive and higher response to blended fertilizer is an indication of soils deficiently on the nutrients like S, B and Zn. This result in harmony with Arif *et al*., (2006)., Amjed *et al*. (2011) who said that the grain yield increase when apply both macro and micro nutrients and when applying by increasing the level of nitrogen up to 150 kg of nitrogen per hectare. But this result on contrary to Haftamu *et al*., (2009) who said that the result getting from N=69kg per ha was higher comparable to N=92 kg per ha. In addition, this result is in agreement with the findings of Mishra and Tiwari (1999), who reported that row Planting and placement of fertilizers in rows have shown maximum yield on wheat than broadcasting. Row sowing method with reduced seed rate showed an increment in grain yield by 12.67% over broadcasting. This might be due to the fact that longer spike length (more seed number per spike), and much more number of effective tillers in row sowing than that of broadcasting which are directly related to yield.

Effects of fertilizer rate blended and sowing methods on harvest index

Harvest index was significantly affected by the main effect fertilizer rate (blended) (Table3). Among the treatments 200 kg blended fertilizer / ha, 100 kg blended fertilizer + 101.25 kg of urea / ha produced the highest harvest index, Although statistically identical to plots that receive 100 kg blended fertilizer / ha, 150 kg blended fertilizer / ha, 150 kg blended fertilizer + 82.71 kg of urea / ha and 200 kg blended fertilizer + 63.91 kg of urea /ha, while the lowest harvest index was recorded from plots that receive 0 kg of fertilizer (control). This low harvest index might be associated with lack of nutrients and not easily available form for the crop to use. This result in harmony with Yosef (2013) Mohammed *et al (*2009),. who reported that application of B, Zn with NPK increase on yield components of wheat especially on harvest index and grain yield.

Straw yield

The results of the analysis of variance showed that the main effect of fertilizer rate (blended) and sowing methods significantly affected the mean grain yield Table 3. However, the interaction effect of fertilizer rate (blended) and sowing methods were not significant. Among the treatments 200 kg blended fertilizer + 63.91 kg of urea /ha produced the highest straw yield (44.28 qt/ha), although statistically non-significant to treatments of 150 kg of blended fertilizer, 200 kg of blended fertilizer, 100 kg blended fertilizer + 101 .52 kg of urea and 150 kg blended fertilizer + 82.71 kg of urea, while the lowest (37.785 qt/ha) and (41.96 qt / ha) was found plots treated with 0 kg fertilizer (control 1) and 100 kg Dap and 100 kg UREA (control 2), respectively.

Table 3. Main effects of fertilizer rate (blended) and sowing methods on thousands seed weight, Bio mass yield, grain yield, harvest index and straw yield.

S/N	Treatment	Parameters				
	Fertilizer rate	**TSW (gm)**	**BY (Qt / ha)**	**GY (Qt/ha)**	**HI (%)**	**SY (Qt/ha)**
1	0 kg F / ha	30.433[b]	49.91[c]	12.125[c]	14.53[c]	37.785c
2	100 kg blended F / ha	34.667[a]	67.58[ab]	28.402[ab]	42.02[ab]	39.178bc
3	150 kg blended F / ha	35.550[a]	71.25[ab]	29.235[ab]	41.03[ab]	42.015ab
4	200 kg blended F / ha	34.950[a]	67.833[ab]	29.514[ab]	43.50[a]	38.319ab
5	100 kg blended F + 101.52 kg urea / ha	37.333[a]	67.833[ab]	29.54[ab]	43.54[a]	38.319ab
6	150 kg blended F + 82.71 kg of urea / ha	35.833[a]	70.58[ab]	29.430[ab]	41.69[ab]	41.15ab
7	200 kg blended F + 63.91 kg of urea / ha	35.833[a]	73.833[a]	29.583[a]	40.06[ab]	44.28a
8	100 kg DAP + 100 kg of urea / ha	30.300[b]	60.16[b]	18.194[bc]	29.26[bc]	41.96bc
	Sowing methods					
1	Row Sowing (RS)	35.9417[a]	3.0479[a]	1.5000[a]	1.6604[a]	1.69333[a]
2	Broad cast Sowing (BS)	32.7983[b]	2.9704[b]	1.31000[b]	1.5479[a]	1.62292[a]
	Mean	34.36	3.009	1.405	1.604	1.658
	CV	9.78	15.91	21.748	20.37	19.122
	Significance level	**	*	**	*	**

Levels not connected by same letter in the same column are significantly different.
Where, TSW= thousands seed weight (gm), BY, bio mass yield (qt/ha), GY, grain yield (qt/ha), HI, harvest index (%), and SY, straw yield (qt/ha).

Calculating of the yield, gross benefit, costs that vary and net benefit

Table 4: Costs that varies (fertilizer) and benefits (grain and straw) of each tremens based on the CIMMYT, 1988 procedure

s.n treatment name	cost that vary birr/ha	GY qt/ha	Adjusted GY Qt/ha	Gross GY birr/ha	SY Qt/ha	Adjusted SY Qt/ha	Gross SY birrt/ha	Gross benefit birr/ha	net income birr/ha
1.0 kg F (control 1)	0	12.125	10.9125	8,730	37.785	34.0065	1360.26	10,090.26	10,090.26
2.100 kg DAP +100 kg urea (con.2)	2900	18.194	16.3746	13,099.68	41.96	37.764	1510.56	14,610.24	11,710.24
3.100 kg blended F	1600	28.402	25.5618	20,449.44	39.178	35.2602	1410.408	21,860.34	20,260.34
4.150 kg blended f	2400	29.235	26.3115	21,049.2	42.015	37.8135	1512.54	22,561.74	20,161.74
5.200 kg blended f	3200	29.514	26.5626	21,250.08	38.319	34.487	1379.484	22,629.56	19,429.56
6.100 kg blended +101.52 kg of urea	2970.5	29.54	26.586	21,268.8	38.293	34.4637	1378.548	22,647.34	19,676.82
7.150 kg blended +82.7 kg of urea	3516.45	29.430	26.487	21,189.6	41.15	37.035	1444.365	22,633.96	19,117.51
8.200 kg of blended +63.91 kg of urea	4062.78	29.583	26.6247	21,299.76	44.28	39.852	1434.672	22,734.43	18,671.65

Crops grown under blended fertilizer showed straw yield increment by 5.23% over treatments that received 100 kg DAP + 100 kg UREA ha. This might be due to the fact that crops supplied with adequate nutrients have more vegetative growth, longer linear growth rate and more dry matter accumulation which directly related to an increment in straw yield. Similar to this study, Mason *et al*, (1992-93) reported that an increase in the straw yield of barley with an adequate supply of N fertilizer.

Results of the economic analysis for all treatments using partial budget analysis method (Table 4) showed that net income for all treatments was higher than 0 kg fertilizer and 100 kg DAP and 100 kg UREA. However, net field incomes are different from profits because in partial budget analysis only costs that vary are included, and the other production costs were excluded. As a result, in order to compare each treatment, first there is a need to adjust the grain and straw yields for balancing the yields with farmers production. By taking the costs that vary among treatments (fertilizer cost) was calculated based on the field price and converted to birr per hectare as described in Table 4.

The result in table 4 showed that the net benefit of all treatments was record a positive and higher net benefit. The net benefit of the treatments ranges from 10,090.26 birr/ha (control), 11,710.24 birr/ha (100 kg dap + 100 kg urea fertilizer) and 20,260.348 birr/ha (100 kg blended fertilizer). The benefit cost ratio of all treatments was also greater than 1.5 even the treatment that record the lowest net benefit but it cannot conclude that by comparing treatment by their net benefit only, there should be another step called dominance analysis which is indicated in Table 4 below.

Determination of Dominance Analysis

Table 5. Dominance analysis of the treatments

S/N	Treatment name	Cost that vary (birr/ha)	Net income (birr/ha)	Dominance
1	0 kg F (control 1)	0	10,090.26	-
2	100 kg DAP +100 kg urea (con.2)	2900	11,710.24	Do
3	100 kg blended F	1600	20,260.348	UN
4	150 kg blended f	2400	20,161.74	DO
5	200 kg blended f	3200	19,429.564	DO
6	100 kg blended +101.52 kg of urea	2970.52	19,676.82	DO
7	150 kg blended +82.7 kg of urea	3516.45	19,117.515	DO
8	200 kg of blended +63.91 kg of urea	4062.78	18,671.652	DO

D= stands Dominated (treatments dominated by other treatments), UN= stands for un dominated (treatments not dominated by other treatments) & - stands for check.

The dominance analysis was conducted after the costs that vary and net benefit was calculated (Table 5). Based on the result table 5 shows the result of the dominance analysis that treatments that receive 100 kg DAP + 100 kg UREA, 200 kg blended, 150 kg blended, 100 kg blended + 101.52 kg UREA, 150 kg blended + 82.7 kg of UREA and 200 kg of blended + 63.91kg of UREA per hectare was dominated by the other treatments .The above result indicated that those dominated treatments shows that the cost of production of those treatments increase but their net benefit does not increase when we compare with the other treatments. This indicates that those treatments have low net benefit when we compare with their costs of the other treatments. This is because of their net benefit decreases as their cost increases due to this reason; those treatments were rejected for next MRR analysis. While treatments received 100 kg of blended fertilizer was un dominated treatments which have higher net benefit as their cost increases.

Table 6. The marginal rate of return of the treatments that was not dominated by other treatments

S/N	Treatment name	Cost that Vary among treatments (birr/ha)	Marginal cost in (birr/ha)	Net benefit (birr/ha)	Marginal net benefit (birr/ha)	MRR (%)
1	0 kg F (control 1)	0	0	10090.26	0.00	-
2	100 kg blended F	1600	1600	20,260.348	10,170.088	635.6305

MRR = stands Marginal Rate of Return

The marginal rate of return of the non dominated treatments in Table 6 shows that 100 kg of blended treatments record a positive marginal rate of return 635.6305. According to CIMMYT (1988), on farm-economic analysis of major cereals training reported that MRR that range from 50% to 100% was the minimum recommended rate in most agricultural production and it is better when the MRR was >100 %. Treatments that receive 100 kg of blended fertilizer was received 635.6305 which indicates that by investing one birr on these treatments there was high rate of returns which was 6.35 birr benefit without including costs that not vary among treatments. Generally out of the eight fertilizer rate in this experimental study conducted, one treatment of them record positive MRR. So that treatments that receive 100 kg blended fertilizer record the highest MRR acceptance range and so, farmers use this optimum rate of blended fertilizer than other treatments which is cost effective and economically feasible.

Conclusion

Based on the results of this study, it is generally concluded that, application of blended fertilizer and different rate of urea gives consistency high grain yield of the study area showing that the soil of the study area is deficient in phosphorous while high in nitrogen content. Since by applying blended and urea fertilizer application with row planting yield can increase by 38 % over the blanket fertilizer recommendation of DAP and urea. These shows that different rate of blended fertilizers and blended fertilizer + urea are useful to attain the growth and transformation plan (2) of the government boosting yield by more than 50%. Result of economic analysis also showed that 200 kg blended fertilizer + urea / ha recommendations with row planting are ideal to obtain higher yield in the study area. But 100 kg blended fertilizer recommendation under row planting was the best optimum rate recommended to the farmers which have the highest Net economic benefit comparing to the other treatments.

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