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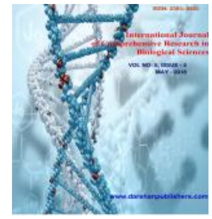

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**Research Article**

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

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## Abstract

Field experiment was conducted at Arjo Dedessa Sugar Factory during the 2015/2016 cropping season to investigate the effect of seed sowing methods and different rates of blended fertilizer on yield and yield components of Bread wheat (*Triticum aestivum*) crop. 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 factoraully 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 experimental 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 tallest plant (92.00cm), the maximum number of effective tillers plant$^{-1}$ (7.66), 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, the shortest plant (52.11cm and 59.55cm), the lowest number of effective tillers plant$^{-1}$ (1.5 and 5.33 ), 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

**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 particularly in the study area. So that, this research addresses this gap and formulated for the following objectives: To investigate the effect of seed sowing methods and different rates of blended fertilizer on yield and yield components of Bread wheat.

## 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 ($12m^2$area) 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, 34.7$P_2O_5$, 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,34.7$P_2O_5$,7.41S,2.23Zn,0.3B) |
| T3 | 150kg blended F with RS (25.95N,5.05$P_2O_5$,11.115S,3.345Zn,0.45B) |
| T4 | 200kg blended F with RS (34.6N,69.4$P_2O_5$,14.82S,4.46Zn,0.6B) |
| T5 | 100kg blended F with RS (17.3N,34.7$P_2O_5$,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,69.4$P_2O_5$,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,34.7$P_2O_5$,7.41S,2.23Zn,0.3B ) |
| T11 | 150kg blended F with BS (25.95N,5.05$P_2O_5$,11.115S,3.345Zn,0.45B) |
| T12 | 200kg blended F with BS (34.6N, 69.4$P_2O_5$, 14.82S, 4.46Zn, 0.6B) |
| T13 | 100kg blended F with BS (17.3N, 34.7$P_2O_5$, 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, 69.4$P_2O_5$, 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).

**Days to heading (DH):** The number of days from planting to a stage when 50% of the plants in a plot were produced spikes.

**Days to maturity (DM):** The number of days from planting to physiological maturity where 75% of the plants became mature in each plot.

**Grain filling period (GFP days):** The number of days from heading to maturity.

**Number of Tiller/plant (NT):** Tillers were counted on five randomly sampled plants from central rows of each plot.

**Plant Height (PH):** It was measured from ground level to the top of the spike excluding the awn of five randomly taken plants from the middle two rows measured in cm.

**Spike Length (SL):** the main spikes from the five sampled plants was measured in cm and averaged to represent the spike length in cm.

**Number of spikelets per spike (NSKPS):** The number of spikelets in main tillers of each of the five randomly plants from the central rows was taken.

**Number of Seed per Spike (NSPS):** number of seeds per spike from the five randomly sampled plants from the central rows of each plot was counted.

**Number of sterile spikeletes per spike (NSSKPS):** number of sterile spikelets per spike from the five randomly sampled plants from the central rows of each plot was counted.

**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.

**Biomass yield (**Qt/ha**):** Total weight of aerial biomass (including the grain) at maturity was measured from each plot and expressed as qt/ha.

**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 $ha^{-1}$.

**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.

**Micro nutrients (Zinc)**

Table 2 showed that the available zinc content of the study area was 7.38cmol (+) / kg of soil Micro nutrients such as Zn and B are required in small amounts for plant growth. If levels of this nutrients are too low, poor plant growth; reduced uptake and fixation of nutrients (for example, P in cell roots), nitrogen mobilization and in efficient water use by plants.

**Cation Exchange Capacity:** The CEC of the site is 35.451 meq /100g 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, in CEC. According to this classification, the soils of the study area have high CEC, which is a reflection of the very high clay.

**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 before 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

**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 fertilizer rate (blended) and sowing methods on days to heading**

Results show on Table 3 indicated that the analysis of variance of the data on days to heading revealed that fertilizer rate (blended) and sowing methods was significantly interacted to affect (P<0.05) days to heading. When averaged over treatments, the mean days to 50% days of heading of 200 kg blended fertilizer + 63.91 Kg of urea / ha under row sowing was 72.67 days, while lowest mean days was observed on plots treated with 0 Kg fertilizer under broad cast sowing (control) and 100 kg DAP + 100 kg urea / ha under broad cast sowing and reached 50% of heading at 60.33 and 60.66, respectively. This is because application of blend fertilizer (macro and micro) and urea, having higher rate of nitrogen nutrient prologs vegetative growth stage of wheat, but the control treatment 0 kg fertilizer and 100 kg DAP and 100 kg UREA showed shortest days which could be nutrient deficiency fastens to develop spike for wheat. This result in line with Aefa *et al*, (1997) in wheat crop row sowing vs, broad cast sowing increased the number of days to crop heading. On the other hand, contrary to this result Haflamu et al, (2009), reported that application of bended fertilizer and increase level of nitrogen fertilizer applications (up to 180 Kg / ha) facilitates the nutrient up take capacity and prevails available condition for cereals to head.

**Table 3.** Interaction effect of sowing methods and fertilizer rate on days to heading

| Treatments<br>Fertilizer rate | Sowing methods | |
|---|---|---|
| | **Row sowing** | **Broad cast sowing** |
| 0 kg fertilizer /ha | 61.33 | 60.33 |
| 100 kg blended fertilizer /ha | 64.7 | 63.00 |
| 150 kg blended fertilizer /ha | 65.7 | 63.33 |
| 200 kg blended fertilizer /ha | 66.00 | 65.33 |
| 100 kg blended fertilizer /ha + 101.52 kg of UREA /ha | 70.33 | 68.33 |
| 150 kg of blended fertilizer /ha + 82.71 kg of UREA /ha | 71.67 | 68.00 |
| 200 kg of blended fertilizer + 63.91 kg of UREA /ha | 72.67 | 70.33 |
| 100 kg DAP + 100 kg of UREA | 62.00 | 60.66 |
| Mean | 65:79 | |
| CV | 1.03 | |
| LSD (0.05) | 1.13 | |

**Effects of fertilizer rate blended and sowing methods on days to maturity and grain filling period**

The analysis of variance showed that the main factor fertilizer rate (blended) and sowing methods on days to maturity and grain filling period were significantly different (Table 4). The crops grown under 150kg blended + 82.71 kg of urea/ha and 200 kg blended fertilizer + 63.91 kg urea / ha matured 12 days later than crops grown under 0 kg fertilizer (control ). When averaged over treatments the highest mean days to 75% days to maturity of 200 kg blended fertilizer + 63.91 kg of urea / ha was 91 days (Table 4) which is statistically identical to 150 kg of blended + 82.71 kg of urea while, lowest mean days was observed on plots treated with 0 kg fertilizer (control) and 100 kg DAP 100 kg urea at 79 and 84 days (Table 4), respectively. Because of blended fertilizer + urea under row sowing, prolongs day to maturity by facilitating vegetative growth of cereals. Similar observation was recorded by Temesgen (2001) who reported that applications of NPK fertilizers with delayed tef maturity through the delay vegetative phase by seven days over the control treatment.

**Table 4.** Main effects of fertilizer rate (blended) and sowing methods on days to maturity and grain filling period

| S/N | Treatment | Parameter | |
|---|---|---|---|
| | Fertilizer rate | DM | GFP |
| 1 | 0Kg Fertilizer/ha | 79.16[e] | 18.66[cd] |
| 2 | 100Kg blended F/ha | 84.33[d] | 21.50[a] |
| 3 | 150Kg blended F/ha | 85.66[dc] | 21.16[ab] |
| 4 | 200 Kg blended F/ha | 87.00[bc] | 20.83[ab] |
| 5 | 100Kg blended F +101.52Kg Urea/ha | 88[b] | 20.00[bc] |
| 6 | 150 Kg blended F + 82.71 Kg of Urea/ha | 90.33[a] | 21.00[ab] |
| 7 | 200 Kg blended F+63.91 Kg. of Urea/ha | 91.16[a] | 20.5[ab] |
| 8 | 100Kg DAP+100Kg of Urea/ha | 84.33[d] | 18.33[d] |
| | **Sowing methods** | | |
| 1 | Row Sowing | 87.29[a] | 20.54[a] |
| 2 | Broad cast sowing | 85.20[b] | 19.95[b] |
| | Mean | 86.25 | 20.25 |
| | CV | 1.52 | 6.10 |
| | Significance level | ** | * |

Levels not connected by same letter in the same column are significantly different.
Where, DM= Days to maturity, GFP= Grain filling period

**Effects of fertilizer rate (blended) and sowing methods on plant height**

Results shown on Table 5 indicated that analysis of variance of the data on plant height revealed that interaction effect of sowing methods and fertilizer rates ($P<0.05$) on plant height. When averaged over treatments, the highest mean height 75.8 cm was recorded from of 150 kg blended fertilizer / ha with row sowing, while lowest mean plant height was observed from treatments that receive 0 kg fertilizer (control) with broad casting and 100 kg DAP + 100 kg of urea / ha as 47.46 and 55.67 cm, respectively. The plant height of plots that received 150 kg blended fertilizer / ha under row planting indicated a height increase by 37.38% compared to 0 kg fertilizer under broad cast planting (control) and 26.55 % to 100 kg DAP + 100 kg urea. This is in line with finding of Eshetayehu (2002), the highest plant height in wheat was obtained from treatments that received phosphorous under row planting. This might be due to the overcrowding of seeding rate for broadcasting (150 kg/ha) per unit area might have invited a series of intra-specific competition for nutrients, example N, which retarded elongation of stems.

**Table 5.**The interaction effect of sowing methods and fertilizer rate on plant height (cm)

| **Treatments. Fertilizer rate** | **Sowing methods** | |
|---|---|---|
| | **Row sowing** | **Broad cast sowing** |
| 0 kg fertilizer /ha (control1) | 56.67 | 47.46 |
| 100 kg blended fertilizer /ha | 68.43 | 56.53 |
| 150 kg blended fertilizer /ha | 75.8 | 61.73 |
| 200 kg blended fertilizer /ha | 74.73 | 61.86 |
| 100 kg blended fertilizer /ha + 101.52 kg of UREA /ha | 72.83 | 61.67 |
| 150 kg of blended fertilizer /ha + 82.71 kg of UREA /ha | 75.63 | 63.53 |
| 200 kg of blended fertilizer + 63.91 kg of UREA /ha | 75.53 | 68.46 |
| 100 kg DAP + 100 kg of UREA (Control 2) | 63.43 | 55.67 |
| Mean | 65:00 | |
| CV | 1.75 | |
| LSD (0.05) | 1.90 | |

**Effects of fertilizer rate (blended) and sowing methods on spike length**

Spike length was significantly affected by the main effect of fertilize rate (blended) and sowing methods (Table 6). Compared with 150 kg blended fertilizer / ha + 82.71 Kg urea / ha, the control treatments (0 kg fertilizer) and 100 kg DAP + 100 kg Urea gives lower spike length by 48.18% and 20.93% respectively. This result in line with result of Ramatullah *et al*, (2007); Muhammad *et al*,. (2009) and Amjed *et al*. (2011), who reported that increasing the level of nitrogen up to 180 kg / ha, with blended fertilizer application both macro and micro nutrient increase the spike length due to the application of those nutrients. On the other hand, contrary to this result Hussain *et al*., (1991) and Chaturvedi (2006), reported that application of nitrogen fertilizer has positive impact on all yield components of wheat when apply N fertilizer up to 60 kg per ha nitrogen and 28 kg phosphorous per hectare beyond this rate there was non significant effect on wheat components. Spike lengths of row sowed were significantly increased by 11.05 % over the broadcasting. This might be due to lack of intra-specific competition in row sowed plots for nutrients and space when compared to broadcasting ones.

**Effect of fertilizer rate (blended) and sowing methods on number of sterile spikelet per spike**

The analysis of variance showed that the main effect of fertilizer rate (blended) and sowing methods on number of sterile spikelet per spike were significantly different (Table 6). When averaged over treatments, the highest number of sterile spikelet's of 0 kg fertilizer (control) as 7 and 100 kg DAP + 100 kg urea as 5.33 respectively, while lowest mean number of sterile spikelet's was observed plots treated 200 kg blended fertilizer + 63.91 kg of urea as 2.5, even if statistically not different from all treatments that receive blended fertilizer.

The number of sterile spikelet's per spike that received blended fertilizer indicated number of sterile spike lets decrease by 66.66% compared to 0 kg fertilizer (control) and 53.27% to 100 kg DAP + 100 kg urea.

**Table 6.** Main effects of fertilizer rate (blended) and sowing methods on spike length, and number of sterile spike lets per spike.

| S/N | Treatment | Parameter | |
|---|---|---|---|
| | **Fertilizer rate** | SL (cm) | NSSKPS (no) |
| 1 | 0 kg Fertilizer / ha (Control 1) | $4.43^{d}$ | $7.50^{a}$ |
| 2 | 100 kg blended F / ha | $6.98^{bc}$ | $3.0^{c}$ |
| 3 | 150 kg blended F / ha | $7.86^{ab}$ | $2.66^{c}$ |
| 4 | 200 kg blended F / ha | $7.71^{ab}$ | $2.83^{c}$ |
| 5 | 100 kg blended F + 101.52 kg urea / ha | $8.08^{a}$ | $3.0^{c}$ |
| 6 | 150 kg blended F + 82.71 kg of urea / ha | $8.55^{a}$ | $2.83^{c}$ |
| 7 | 200 kg blended F + 63.91 Kg. of urea / ha | $8.45^{a}$ | $2.5^{c}$ |
| 8 | 100 kg DAP + 100 kg of urea / ha (Control 2) | $6.76^{c}$ | $5.33^{b}$ |
| | **Sowing methods** | | |
| 1 | Row Sowing | $7.78^{a}$ | 4.0a |
| 2 | Broad cast sawing | $6.92^{b}$ | 3.41b |
| | Mean | 7.35 | 3.70 |
| | CV | 10.80 | 25.18 |
| | Significance level | ** | ** |

Levels not connected by same letter in the same column are significantly different.
Where, SL= spike length (Cm), NSSKPS= Number of sterile spikelet's per spike.

**Effects of blended fertilizer (rate) and sowing methods on number of tiller per plant**

Table 7 indicated that the analysis of variance revealed that sowing methods and fertilizer rate (blended) had significant interaction effect (P<0.05%) on number of tiller. As shown on table 7, treatments that received 150 kg blended fertilizer / ha, and 100 kg blended fertilizer / ha + 101.52 kg urea / ha, 150 kg blended fertilizer + 82.72 kg of urea under row planting and 200 kg blended fertilizer + 63.91 kg of urea under row planting showed no significant and higher number of tiller (productive) plant than other treatments, where as treatments that received 100 kg blended fertilizer / ha, and 100 kg DAP + 100 kg urea results lower but significantly different from 0 kg of fertilizer (control). Compared with 150 kg blended fertilizer, 100 kg blended fertilizer + 101.52 kg urea / ha under row planting the control treatments 0 kg fertilizer (control) and 100 kg DAP + 100 kg urea gave lower number of productive tiller / plant by 78.56 % and 28.5 %, respectively.. This result is in agreement with Tan *et al*, (2003) due to row planting method wheat tillering number was significantly increases than broad cast sowing. The tillering number in broad cast was 4.75, while in row planting it was 7.41.

**Table 7.** The interaction effect of sowing methods and fertilizer rate on number of tiller per plant (No)

| Treatments Fertilizer rate | Sowing methods | |
|---|---|---|
| | **Row sowing** | **Broad cast sowing** |
| 0 kg fertilizer /ha | 2.00 | 1.00 |
| 100 kg blended fertilizer /ha | 6.67 | 5.00 |
| 150 kg blended fertilizer /ha | 9.33 | 5.67 |
| 200 kg blended fertilizer /ha | 8.00 | 5.33 |
| 100 kg blended fertilizer /ha + 101.52 kg of UREA /ha | 9.33 | 5.33 |
| 150 kg of blended fertilizer /ha + 82.71 kg of UREA /ha | 8.67 | 5.00 |
| 200 kg of blended fertilizer + 63.91 kg of UREA /ha | 8.67 | 6.67 |
| 100 kg DAP + 100 kg of UREA | 6.67 | 4.00 |
| Mean | 6.08 | |
| CV | 9.78 | |
| LSD (0.05) | 0.99 | |

**Effects of fertilizer rate (blended) and sowing methods on number of spikelets per spike**

Table 8 indicated that analysis of variance of the data on number of spikelet's per spike revealed that sowing methods and fertilizer rate (blended) was significantly interactions effect ($P<0.05$). Treatments that receive 150 kg blended fertilizer / ha, 200 kg blended fertilizer / ha, 100 kg blended fertilizer / ha + 101.52 kg urea / ha, and 200 kg blended + 63.91 kg of urea / ha under row sowing show no significant and higher number of spikelet's per spike than control treatment under row sowing.

**Table 8.** The interaction effect of sowing methods and fertilizer rate on number of spike lets per spike

| Treatments Fertilizer rate | Sowing methods | |
|---|---|---|
| | **Row sowing** | **Broad cast sowing** |
| 0 kg fertilizer /ha | 31.33 | 34.33 |
| 100 kg blended fertilizer /ha | 42.33 | 35.33 |
| 150 kg blended fertilizer /ha | 46.00 | 40.67 |
| 200 kg blended fertilizer /ha | 45.67 | 39.33 |
| 100 kg blended fertilizer /ha + 101.52 kg of UREA /ha | 48.00 | 39.00 |
| 150 kg of blended fertilizer /ha + 82.71 kg of UREA /ha | 45.00 | 42.33 |
| 200 kg of blended fertilizer + 63.91 kg of UREA /ha | 45.33 | 42.00 |
| 100 kg DAP + 100 kg of UREA | 42.00 | 35.00 |
| Mean | 40.85 | |
| CV | 4.28 | |
| LSD (0.05) | 2.91 | |

**Effects of fertilizer rate (blended) and sowing methods on number of seed per spike**

Results shown on Table 9 indicated that analysis of variance of the data on number of seed per spike revealed that sowing methods and fertilizer rate (blended) was significantly interactions effect (P<0.05). Treatments that receive 150 kg blended fertilizer / ha, 200 kg blended fertilizer / ha, 100 kg blended fertilizer / ha + 101.52 kg urea / ha, 150 kg blended fertilizer + 82.71 kg urea / ha and 200 kg blended + 63.91 kg of urea / ha under row sowing show no significant and higher number of spikelet's per spike than control treatment (0 kg fertilizer) and 100 kg DAP and UREA fertilizer under row sowing.

**Table 9.** The interaction effect of sowing methods and fertilizer rate on number of seed per spike

| Treatments<br>Fertilizer rate | Sowing methods | |
|---|---|---|
| | **Row sowing** | **Broad cast sowing** |
| 0 kg fertilizer /ha | 24.33 | 29.00 |
| 100 kg blended fertilizer /ha | 37.33 | 31.00 |
| 150 kg blended fertilizer /ha | 43.66 | 34.66 |
| 200 kg blended fertilizer /ha | 44.00 | 33.00 |
| 100 kg blended fertilizer /ha + 101.52 kg of UREA /ha | 43.66 | 34.00 |
| 150 kg of blended fertilizer /ha + 82.71 kg of UREA /ha | 44.00 | 38.00 |
| 200 kg of blended fertilizer + 63.91 kg of UREA /ha | 44.00 | 37.66 |
| 100 kg DAP + 100 kg of UREA | 36.33 | 29.66 |
| Mean | | 36.52 |
| CV | | 8.87 |
| LSD (0.05) | | 5.40 |

**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 10. 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) and 100 kg Dap and 100 kg UREA, 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. 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.

**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 10). 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, 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 harvest index**

Harvest index was significantly affected by the main effect fertilizer rate (blended) (Table1). 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.

**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 (Table10). 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 1). 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.

**Table 10.** 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] | 1.66042[a] | 1.69333[a] |
| 2 | Broad cast Sowing (BS) | 32.7983[b] | 2.9704[b] | 1.31000[b] | 1.54792[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).

## 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%.

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