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Response of Bread Wheat (Triticum aestivum L.) to Different Blended Fertilizer Application A-Review

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Abstract
Wheat is the most important and widely cultivated crop of the entire world. It is principal food of human beings and Ethiopia is one of the important wheat producing countries in world. Wheat responds well to fertilizer application with balance nutrients for increased wheat productivity. Fertilizer is the most important input, which contributes significantly towards final grain yield of wheat and to exploit the inherited potential of cultivar, but productivity wheat for long time was low due to the absence of essential/unbalanced crop nutrition. To overcome this problem Ministry of Agriculture and Natural resource introduced different blended fertilizer according to soil test in different parts of the country. Recently farmers in most part of country are using this newly introduced blended fertilizers like NPS, NPSB, NPSBZn, which was replaced by, DAP, are most essential nutrient containing fertilizer which used for plant growth quality, yield as well as plays a fundamental role in metabolism and energy producing reaction. These blended fertilizers are currently fulfilling farmers/ producers demands by increasing their production and productivity as shown by different researchers. This review was mainly focused on the response of wheat to different blended fertilizers.
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INTRODUCTION

Wheat (*Triticum* spp.) is one of the major cereal crops grown in the highlands of Ethiopia and this region is regarded as the largest wheat producer in Sub-Saharan Africa (Eprem *et al*., 2000). In Ethiopia wheat has become one of the most important cereal crops ranking fourth both in total grain production (4.54 million tons) and area coverage (1.69 million hectare) next to teff, maize and sorghum (CSA, 2017). Though Ethiopian agro-climatic condition is suitable for wheat production, the productivity is low (2.67t ha-1) (CSA, 2017). This is because of depleted soil fertility, low levels of chemical fertilizer usage, limited knowledge on time and rate of fertilizer application, and the unavailability of other modern crop management inputs (Anderson and Schneider, 2010). As summarized by Tekalign *et al*. (2001), nitrogen (N) is deficient in almost all soils and phosphorus (P) is deficient in about 70% of the soils in Ethiopia. This low nutrient content is due to erosion and absence of nutrient recycling. Plants require a variety of elements for the growth and development of which N, P, K, S, Zn and, B are the most important of the essential nutrients to plants because they are required in large quantities for wheat productivity of bread wheat (Abebual *et al*., 2019). The application of appropriate application of fertilizer one of the agronomic practices that increase productivity wheat (Brady and Weil, 2002).

In Ethiopia, crop production has been focused mainly on the use and application of nitrogen and phosphorous fertilizers in the form of Di-ammonium phosphate (DAP) (18-46-0) and Urea (46-0-0) or blanket recommendation for the major food crops. Continuous application of nitrogen (N) and phosphorus (P) fertilizers without consideration of other nutrients led to the depletion of other important nutrient elements such as potassium (K), magnesium (Mg), calcium (Ca), sulfur (S) and micronutrients in soils (Abiye *et al*., 2004). Balanced fertilization is the key to sustainable crop production and maintenance of soil health. It has both economic and environmental consideration. An imbalanced fertilizer use results in low fertilizer use efficiency leading to less economic returns and a greater threat to the environment (Abiye et al., 2004).

Moreover, recently acquired soil inventory data revealed that the deficiencies of most of nutrients such as, nitrogen (86%), phosphorus (99%), sulfur (92%), born (65%) and zinc (53%) are widespread in Ethiopian soils (Ethio-SIS, 2013). By considering this, many researchers are conducting research on improving crop productivity of wheat through application of different blended fertilizer. Dagne (2016) observed that the maximum mean grain yield (8399.7 kg ha-1), stover yield (8553.1 kg ha-1) and total biomass yield (16867.7 kg ha-1) were recorded from blended fertilizers, whereas the lowest were recorded for the control in maize.

The responses of blended fertilizer on wheat were conducted on two varieties Wane and Kingbird. The numbers of productive tillers per plant were significantly affected by the interaction effect of varieties and fertilizer rates. The result showed that the maximum number of productive tiller (7.7) and (6) were recorded from 300 kg NPSB + 100 kg Urea ha Wane and Kingbird varieties respectively. The highest result of Wane and Kingbird verities were improved by 42.9% and 26.7% respectively as compared to the lowest number of productive tillers per plant at control (Rut-Duga *et al.,* 2019). Abebaw and Hirpa, (2018) reported that blended fertilizer and sowing

method significantly affect plant height. When averaged over treatments, the highest mean height 75.8 cm was recorded from of 150 kg blended NPSZB 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 paper was, therefore carried out with objective to review effect of different blended fertilizer on yield and yield components of bread wheat.

The Role of Fertilizers in Crop Production

Fertilizer usage plays a major role in the universal need to increase food production to meet the demands of the growing world population. Fertilizer application resulted in marked crop yield increases, which for most crops was more than hundred percent (Mengel and Kirkby, 1996). The extent to which fertilizers are used still differs considerably between various regions of the world (Mengel and Kirkby; 1996). The quantity of fertilizer nutrients required for optimum crop production depends on the inherent capacity of the soil to supply adequate levels of nutrients to growing plants the yield potential of the crop variety grown (Tilahun *et al;* 1996) and the availability and cost of fertilizers and climatic conditions prevailing during the crop-growing season (Baligar and Bennett; 1986).

Plants require nutrients in balanced amounts depending on their stage of development and yield levels. For optimal nutrition of crops, a sufficient concentration of the individual nutrients should be present in the plant leaves at any time. For fast-growing crops and high yields, the daily nutrient supply must be adequate, especially during the period of maximum requirement. It is clear that both N and P are essential elements in their structural, biochemical and physiological roles contributing to crop growth. Furthermore, the dependence of crop growth on N and P is a quantitative one. Virtually all of the compounds that participate in metabolism, cell growth and tissue development contain N and/or P. Therefore, diminished levels of N and P have many ramifications that result in quantitative decreases in the rate of growth, and ultimately yield. Commonly, decreases in either N or P, which is likely under low-nutrient conditions, leads directly to decreases in the levels of the critical compounds required to sustain high rates of growth. It should be no surprise, therefore, that there is frequently a close correlation between crop yield and the amount of N and P that the plants have accumulated (MoANR 2010).

The quantity of fertilizer nutrients required for optimum crop production depends on the inherent capacity of the soil to supply adequate levels of nutrients to growing plants, the yield potential of the crop variety grown (Tilahun *et al;* 1996) and the availability and cost of fertilizers and climatic conditions prevailing during the crop-growing season. Due to the recent release of improved high yielding bread wheat varieties adapted to heterogeneous environmental conditions in Ethiopia, wheat grain yield potential has significantly increased and area coverage has substantially expanded (Hailu; 1991). Recently released cultivars are highly responsive to improved crop management systems and require higher rates of nutrients' applications. One of the basic limiting factors for wheat yields on highland plateau of Ethiopia is poor soil fertility, especially the deficiency of the two macronutrients, nitrogen and phosphorus (Asnakew *et al*., 1991).

Effect of Different Blended Fertilizer on Growth and Yield of Wheat

Days to 50% heading and 90%physiological maturity

Appropriate supply of the nutrients like N, P K, S, and B and ZN are currently essential for growth and development of wheat crop. Abebual *et al*, 2019) reported that increasing blended fertilizer, N.P, S, ZN and B, significantly increase plant growth and development of wheat. As indicated, that indicated that the combination of NP fertilizer with K, S, Zn and B, enhanced the early heading of wheat. However Abebaw and Hirpo (2018) stated that that application of blend fertilizer (macro and micro) and urea, having higher rate of nitrogen nutrient prolongs 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.

Diriba, Shiferaw G, *et al*., (2019) reported that, blended fertilizer significantly affected days to heading and maturity. The longest days to heading (71.7) and physiological maturity (113.0) was observed at 300 Kg of NPSB application with supplementary urea. The shortest dates of heading and physiological maturity were observed for both varieties (61.3) and (106.2) at control, respectively. This difference could be attributed to the application different rates of blended fertilizer rates for bread wheat varieties. However, Tilahun and Tamado, (2018 showed that days to 50% heading and days to 90% physiological maturity were not significantly affected by of blended NPS fertilizer rates. Similarly Tegesa *et al., (*2018) stated that application of blended did not have significant effect on days to heading, but days to physiological maturity was highly significantly affected by blended NPS fertilizer on bread wheat. Abebual *et al.,* (2019) reported that days to 50% heading and days to 90% physiological maturity significantly ($P<0.01$) affected by blended fertilizer application as compared to control treatment. Application blended fertilizer formulations resulted reduced the days to 50% heading by 11 days and significantly reduced days to attain maturity than the control treatment. as concluded that the combination of NP fertilizer with K, S,

Zn and B, enhanced the early heading and brought earliness in days to 90% physiological maturity than unfertilized plot wheat. Tagesa *et al.,* (2018) reported that application of Blended NPS fertilizer did not influenced days to heading but days to 90% physiological maturity significantly influenced by application of blended fertilizer.

Plant height

Abebual *et al* (2019) showed that there were significant variations (P< 0.001) among the fertilizers types on wheat height. Application of blended fertilizer significantly increased plant height as compared to the control. Similarly, the recommended NP fertilizers also significantly increased plant height as compared to the control. However, supplementation of S, B and Zn to the recommended NP fertilizers did not bring about a significant difference in plant height. The increment in plant height might be due to increase in cell elongation and more vegetative growth attributed to different nutrient content of blended fertilizer containing NPS and micronutrients. additionally Sulphur is one of the essential nutrients for plant growth and it accumulates 0.2 to 0.5% in plant tissue on dry matter basis. It is required in a similar amount as that of phosphorus (Ali *et al.,* 2008). It is also building block of protein and a key ingredient in the formation of chlorophyll (Duke and Reisenaue, 1986). Tazeh *et al*. (2012) stated that application of compost and sulphur might reduce soil pH, increase phosphorous, and some micronutrient availability in soil. The increasing of sulfur content up to 100 kg ha^{-1} caused a significant increase in wheat root and shoot growth as well as nutrient uptake. Without adequate S, crops cannot reach their full potential in terms of yield or protein content (Zhang *et al.,* 1999). It is required for the synthesis of S containing amino acids such as, cysteine and methionine. Their deficiency results in stunted growth, reduced plant height, tillers, spikelets and delayed maturity. Sulfur deficient plants have also less resistance under stress conditions (Doberman and Fairhurst, 2000).

On the other hand, the least plant height in unfertilized plots might have been due to low soil fertility level that result low height in plants, plant growth and development may be retarded significantly if any of nutrient elements is less than its threshold value in the soil or not adequately balanced with other nutrient elements (Landon, 2014).

Abebaw and Hirpa, (2018) reported that blended fertilizer and sowing method significantly affect plant height. When averaged over treatments, the highest mean height 75.8 cm was recorded from of 150 kg blended NPSZB 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. Similarly, Tegesa, *et al* (2018) reported that significant effect of blended fertilizer on plant height, in which application of blended NPS fertilizer, 100, 150, and 200 kg/ha produce mean value 74.8, 83.6, and 81.07cm on plant height respectively. This is due to the Phosphorus (P) is the second key plant nutrient required in large quantities for growth and productivity of crops. It has a role in cell division, stimulation of early root growth, hastening plant maturity and energy transformation within the cell and in fruiting and seed production. Because it is a constituent element of nucleoproteins, which are involved in the cell reproduction processes (Miller and Donahue, 1997).

Tilahun and Tamado, (2018 showed main effects of blended NPS significantly affect plant height. Increasing the amount of NPS, rates significantly increased plant height. The maximum application rate of blended NPS (200 kg ha-1) r resulted in the highest plant height (79.59 cm) while application of application of 100kg NPS blended fertilizer produce 77.53cm. The increased plant height in response to increasing rate of NPS blended fertilizer was due to nitrogen effect on the Blended fertilizer, which has the vital role of N fertilizer in promoting the vegetative growth, and resulted in significant increase in plant height.

Diriba, *et al*., (2019) reported that, application of blended fertilizer(NPSB significantly affected plant height of bread wheat, as indicated that increasing of blended fertilizer increased plant height in which the highest(95.5cm) plant height was observed due to the application of the 300NPSB fertilizer rate as compared with control treatment which was 75.6cm.

Effect different blended fertilizer on yield components and yield

Abebual *et al* (2019) studied that the application of blended fertilizers significantly influenced number of total and effective tiller per plant. Application of blended fertilizer significantly increased number of total and effective tiller per plant as compared to the control. The minimum number of total and effective tillers per plant was recorded at control. Diriba, *et al*., (2019) reported that Number of productive tillers per plant was significantly influenced by the interaction effect of varieties and fertilizer rates. The response of the crop in terms of number of effective tillers in Wane (7.7) and Kingbird (6.0) varieties were higher at 300 Kg of NPSB application. Wane variety at 200 kg NPSB (7.0), 250 kg NPSB (7.3) and 300 kg NPSB (7.7) fertilizer rates applications was statistically non-significant. The lowest numbers of effective tillers (4.4) were recorded for both varieties at control plot; which might be due to the role of N in accelerating vegetative growth of plants. Similarly Baraich *et al*. (2012) conducted that

application of 90 kg ha^{-1} P fertilizer resulted in maximum values for plant height (84.05 cm), number of tillers (6.36 plant^{-1}), spike length (10.85 cm), number of grains (66.33 spike^{-1}), seed weight (48.38 g) and grain yield (4504.33 kg ha-1). While analyzing the increase percent in growth and grain yield components in treated plots over control, it was observed that 90 kg P ha^{-1} treatment resulted in an increase of 103.11% in plant height, 97.51% in tillers plant^{-1}, 90.01% in spike length, 84.04% in number of grains spike-1, 92.82 % in seed index and 115.89 % in grain yield ha^{-1} over control. Damene (2003) reported that an increase in the number of spikes was significantly higher due to the application of 40 kg P ha^{-1} than that recorded the application of 20 and 10 kg P ha^{-1} and the control, while no significant differences were observed between 30 and 40 kg P ha^{-1}. Kaleem *et al*., (2009) who recorded maximum yield of 3557 kg ha^{-1} by the application of 128- 128 kg ha-1 (NP) ratio 1:1 which was indicating importance of phosphorus at its highest dose in achieving maximum wheat productivity.

Tegesa, *et al* (2018) reported that significant effect of blended NPS fertilizer on both total and productive number of tillers of bread wheat, as reported that application of blended fertilizer increases total productive tillers per plant. Frehiwot (2014) also reported that N and P fertilizer had potential role in number of total and effective tiller production per plant. On other hand, Hailu, (2014) showed that applications of blended fertilizers (NPS+ZnB) were on parity with the blanket recommendation of DAP and Urea fertilizers and gave significantly higher number of total and effective tillers of wheat. However, Tilahun and Tamado, (2019) also showed that application of the blended NPS fertilizer had not shown significant difference on tillers of wheat.

Field experiment conducted at Tiyo district in Eastern Arsi, Ethiopia on farmer's field showed that grain yield, aboveground dry biomass and numbers of productive tillers were significantly affected by the interaction effect of varieties and fertilizer rates. The highest seeds per spike (53.9), thousand-kernel weight (37.3 g), and straw yield (9071.7 kg ha-1) were recorded from 300 kg NPSB ha-1 application along supplementary urea. Higher grain yield was harvested from Wane (4236 kg ha-1) variety at 300 kg NPSB ha-1 fertilizer rate (Diriba, *et al*., 2019).

Field experiment was conducted during 2017 cropping season in Siyadebrenawayu district, central Ethiopia with the objective to evaluate the effect of different blended fertilizer formulation of S, B, Zn and K on yield and yield components of bread wheat found that yield and yield components of bread wheat was significantly affected by the treatments except 1000-grain weight. The highest above ground dry biomass yield (14.29 tha-1), highest grain yield (5.77 tha-1) and straw yield (8.51 tha-1) was recorded from additional application of S, B, and Zn (11.1S, 0.15B, 3.3Zn) kgha-1,) kgha-1. The application of blended fertilizer 175 NP 11.1S, 0.15B, 3.3Zn increased the straw and grain yield by 35.45% and 19% respectively as compared to the recommended NP fertilizer(175kg ha-1 (Abebual *etal,.*2019).

Field experiment was carried out on farmer's field at Arsi Negelle, Central Ethiopia reveal that, that interaction effect of blended NPS and supplemented N significantly ($p < 0.05$) influenced number of total tillers and total productive tillers per m^2 where, highest total tillers (343.3) and productive tillers (306.7) per m2 were recorded at the combination of 150 kg NPS ha-1 and 92 kg N ha-1. Similarly, main effect of blended NPS was significantly ($p < 0.05$) influenced grain yield where maximum grain yields (5274 kg ha-1) at the highest application of 200 NPS kg ha-1 (Tilahun and Tamado, (2018).

Abebaw and Hirpa, (2018) studied revealed that yield and yield contributing characters were influenced significantly by different rate of blended fertilizer and sowing methods. 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 NPSZnB 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 -1and 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. Study conducted at Debub-Ari woreda, South Ethiopia, showed that the significant effects of fertilizers were observed on wheat yield and yield components. The application of 200 kg (14N-21 P2O5-6.5S- 1.2Zn-0.5B) per ha and the remaining nitrogen (41 kg urea /ha-1) top dressed, resulted 36.8 and 57% grain yield and harvest index improvement (Tsegaye *etal*., 2018).

Similarly the study conducted at Angecha testing site of Areka Agricultural Research center, southern Ethiopia stated that importance application of on yield of wheat NPSCu (combination of Cu with macronutrients NPS) fertilizers in improving yield of wheat. In which the highest grain yield (4500 kg ha-1) and biomass (12.17 t ha-1) was obtained by application of NPSCu @ a rate of 69 N, 72 P2O5, 13 S kg ha-1) + 600 gm although not significantly differ from other rates of NPS and NPSCu except NPS @ lowest (46/54/10) rate. Inclusion of Cu on the NPS blend improved wheat production at Angecha and increased grain yield by only 12.8%. Application of 69,72,13 kg ha-1+ 600 gm Cu ha-1 (NPSCu) increase wheat yield by 7% over 69,72,13 kg ha-1 NPS (Yehuala and Tsadiku,2019).

Conclusion

In Ethiopia nutrient deficiency especially in addition to NPK, luck of other micro and macro element causing low production and productivity of different crops in different parts of the country. However, currently in the Ministry

of Agriculture of Ethiopia has been recently introduced a new compound fertilizer like the one NPS, NPSB, NPSBZn, and NPSBZnCu containing are introduced to overcome this nutrient insufficiency. More over as many researcher concluded that the production and productivity of wheat crop was increase due to the application of appropriately soil recommended blended fertilizers across in different regions of the country. Therefore, application of soil test based blended fertilizer could be best means to boost production and productivity of wheat in Ethiopia.

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