Research Article

Effect of Balance Use of Fertilizers on Performance of Wheat Under Arid Climatic Condition

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Abstract | Nutrients play a key role in crop productivity. A field trial was conducted to evaluate the addition of macro and micronutrients on wheat growth and productivity. The experiment comprised of 10 treatments. The results showed that compared with control, addition of nutrients significantly increased plant height and the highest plant height (86.5 cm) was observed at 86:58:62.5 kg NPK/ha treatment. Maximum tillers/plant (3.1), spikelet's/plant (2.9), and spike length (8.9 cm) was found in 86-58-62.5-3 kg NPK + Zn/ha treatment. Furthermore, highest grains/spike (83.4), 1000 grain weight (4.3 g), and yield (6381 kg/ha) was found in 86-58-62.5-3 kg NPK + Br/ha treatment. Our results demonstrated that compared with sole addition of macronutrients, addition of both macro and micronutrients together practices that will make farmer wheat yield higher and more profitable.

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Introduction

Wheat is a major source of plant based nutrition for human and daily dietary needs. An assessment demonstrates that, Pakistan produces reduced yield as compared with other wheat-producing countries (China, India, USA Russia and France) (Hussain *et al.*, 2006). Scanty use of fertilizers poor seed quality, water logging, high input prices, lack of irrigation water, lower farmer education about the latest techniques in crop production beside imbalance use of chemical and organic fertilizers are some of the major factors in low wheat production (Ali *et al.*, 2018). Specific nutrients are categorically important for plant growth, yield and their life cycle (White *et al.*, 2012). Two types of nutrients, micro (Zn, Cu, B, Fe, and Mn) and macronutrients (N, P and K) are essential for plants to perform their own functions in growth and development. The farmer mostly use macronutrients (N, P, and K) are an important and recommended for high wheat yield (Watanabe *et al.*, 2007). While, the use of micronutrients with macronutrients is highly effective for wheat crop yield (Wang *et al.*, 2016). Micronutrients are needed in trace amount but adequate supply played an important role in yield improvements and positively effects on

cell physiology and on yield as well (Dimkpa and Bindraban *et al*., 2016).

In Pakistan, wheat is severely affected by Zn deficiency. Many researchers recognized Zinc deficiency in Pakistan in different cereals crops including wheat (Chatthaet *al*., 2017; Rafique *et al*., 2006). Latest survey reported 70% Zn is deficient in Pakistani soils. Zn deficiency is one of the third serious nutrients for wheat crops after Nitrogen (N) and phosphorus (P) (Amanullah and Inamullah, 2016; Akhtar, 2013).

Due to our less yield potential in Pakistan it is very important to design such a study which will address the issue of less yield potential (Agric. Stat. Pakistan, 2000-2001). We conduct an experiment to evaluate the effect of macronutrients on wheat yield and explore additive effects of macronutrients (NPK) with micronutrients.

Materials and Methods

The experiment was conducted at research farm of (PARC) Arid Zone Research Institute in, Bahawalpur, on November 27th 2018. Seeds of wheat cultivar Galaxy 2013 acquired from the Regional Agricultural Research Institute Bahawalpur and sown at rate of 120kg ha^{-1}in a 22.5 cm spaced row. Detailed physicochemical properties of soil are given in (Table 1) a randomized complete block design, with three replications were employed as an experimental design. The net plot size was maintained at1.8×6.0 m, the experiment comprised 10 treatments as followed:

Control	Value
T1	86kg N/ha
T2	58kg P/ha
T3	62.5kg K/ha
T4	86; 58kgNP/ha
T5	86; 62.5kg NK/ha
T6	58; 62.5kg PK/ha
T7	86; 58; 62.5kgNPK/ha
T8	86; 58; 62.5; 3kgNPK Zn/ha
T9	86; 58; 62.5; 3kgNPKBr/ha

Whole of P, K and one third of N was applied as basal dose. The remaining of N applied with 1st and 2nd irrigation four irrigation (3-acer inch each) were applied from sowing to harvesting. Crop was harvested on April, 15th 2019. The Statistical analysis was carried out with SAS version 8.0 for windows. For each variable measured the data was analyzed by one way ANOVA and treatment means were separated by LSD method at 5% probability level.

Table 1: *Physicochemical analysis of experimental soil.*

Characteristic	Value
Texture	Sandy loam
PH	8.10
Ec	0.35 dsm^{-1}
Exchangeable Na	0.20 mmolc $100g^{-1}$
Organic matter	0.95 %
Nitrogen	0.07%
Phosphorus	5.00 ppm
Potassium	177.0 ppm
Zinc	0.80 ppm
Boron	0.78 ppm
Iron	6.75 ppm

Results and Discussion

Plant height

The results showed that addition of various macro and micro nutrients have profound impact on plant height (Table 2). Maximum plant height (86.5cm) was found in NPK followed by NPK+Zn (86.1cm). Nitrogen and P addition resulted in significantly higher plant height (84.3cm) compared with NK (81.4cm) and PK (72.4cm) treatments. Whereas the Lowest plant height was recorded in control (68.3cm). Hussain *et al*. (2002) showed that NPK addition significantly increased plant height. Other researchers demonstrated that addition of macronutrients coupled with micronutrients such as Zn and Br significantly increased plant height (Nadim *et al*., 2012; Anjum *et al*., 2019).

Tillers/plant

Addition of various combinations of macro and micro nutrients significantly affected tillers/plant. Highest tillers/plant was observed in NPK+Zn (3.1) and NPK+Br (3.1) treatments respectively followed by NPK (3.0) treatment. There was no significant difference in tillers/plant in NPK+Zn, NPK+Br, and NPK treatments. PK treatment produced higher tiller/plant (2.5) as compared to NP (2.2) and NK (1.9) treatments. Lowest tillers/plant was found in control (1.3). The results of this study are compatible with those of (Hussain *et al*., 2002), who indicated that NPK addition significantly increased tillers/plant.

Table 2: *Effects of macro and micronutrients on wheat productivity.*

Treatments	PH	TP	SP	SL	GS	1000 GW	Y
Control	68.3 d	1.3 f	1.2 g	6.6 h	35.5 e	2.6 e	2435.0 g
86 kg N/ha	80.8 b	2.0 de	1.5 f	7.2 g	68.3 d	3.1 d	5001.5 e
58 kg P/ha	75.3 c	2.1 cd	1.7 e	8.1 e	77.2 abc	3.9 bc	5417.3 c
62.5 kg K/ha	69.8 d	2.2 c	1.8 de	7.6 f	74.0 cd	3.7 c	4634.6 f
86-58 kg NP/ha	84.3 ab	2.2 c	2.1 c	7.7 f	81.7 ab	3.8 c	5733.5 b
86-62.5 kg NK/ha	81.4 b	1.9 e	1.8 d	7.3 g	72.4 cd	3.1 d	5201.1 d
58-62.5 kg PK/ha	72.4 cd	2.5 b	2.1 c	8.6 b	74.6 bcd	3.8 c	5641.8 b
86:58:62.5 kg NPK/ha	86.5 a	3.0 a	2.5 b	8.4 c	78.1 abc	4.0 bc	6332.1 a
86-58-62.5-3 kg NPK Zn/ha	86.1 a	3.1 a	2.9 a	8.9 a	76.9 abc	4.1 ab	6336.1 a
86-58-62.5-3 kg NPKBr/ha	84.1 ab	3.1 a	2.9 a	8.3 d	83.4 a	4.3 a	6381.3 a

Values with different letters in a column differ significantly as determined by fisher's LSD at P < 0.05.
Note: PH: plant height; TP: tillers/plant; SP: spikelet's/plant; SL: spike length; GS: grains/spike; 1000 GW: 1000 grain weight; Y: yield.

Furthermore, a study demonstrated that addition of micronutrients such as Zn and Br significantly increased tiller/plant (Nadim *et al.*, 2012; Anjum *et al.*, 2019).

Spike length

The results presented in (Table 2) revealed that inorganic fertilization significantly affected spike length. Statistically highest spike length was observed in NPK+Zn (8.9cm) treatment followed by NK (8.6cm), NPK (8.4cm), and NPK+Br (8.3cm) treatments respectively. P addition significantly increased spike length (8.1cm) over K (7.6cm) and P (7.2cm) addition. Minimum spike length was found in control (6.6cm). Our results were consistent with those of (Firdous *et al.*, 2018) showed that NPK fertilization along with Zn increased spike length.

Grains/spike

According to the results presented in (Table 2) exogenous addition of macro and micronutrients significantly impacted grains/spike. Highest of grains/spike were noted in NPK+Br (83.4) followed by NP (81.7) treatment. In comparison with NPK+Zn treatment (76.9) higher number of grains/spike was found in NPK treatment (78.1) but there was no significant difference found between them. Lowest grains/spike was recorded in control treatment (35.5). Our results were in line with those of (Hussain *et al.*, 2002), who showed that NPK addition significantly increased grains/spike as compared to control. Another study showed that addition of micronutrients such as Zn and Br along with macronutrients significantly increased wheat number of grains/spike (Nadim *et al.*, 2012).

1000 grain weight

The results showed that various combination of both macro and micronutrients addition significantly impacted 1000 grain weight (Table 2). Maximum 1000 grain was observed in NPK+Br treatment (4.3gm) followed by NPK+Zn (4.1gm) and NPK (4.0gm) treatments. Lowest number of 1000 grain weight was recorded in control (2.6gm). Studies conducted in Pakistan demonstrated that NPK addition significantly increased wheat productivity (Hussain *et al.*, 2002). A research finding showed that addition of NPK along with Br significantly increased 1000 grain weight. A study (Nadim *et al.*, 2012) and (Firdous *et al.*, 2018) claimed that Zn addition significantly increased 1000 grain weight.

Grain yield Kg/ha

Addition of macro and micronutrients significantly impacted grain yield. Maximum grain yield was observed in NPK+Br (6381) treatment followed by NPK+Zn (6336) and NPK (6332) treatments. However, no significant difference was found among these three treatments. NP (5733) and PK (5641) treatments had substantial higher grain yield over NK (5201). Furthermore, it was observed that addition of P (5417) produced maximum grain yield compared with N (50001) and K (4634) addition. Lowest grain yield was recorded in control (2435). Our results were in agreement with those of (Hussain *et al.*, 2002), who stated that NPK addition significantly increased grain yield. A study by Anjum *et al.* (2019) showed that addition of NPK along with Br successfully increased wheat yield. In addition, NPK along with Zn input significantly increased wheat yield (Nadim *et al.*, 2012; Firdous *et al.*, 2018).

Novelty Statement

To the best of our knowledge this is the first study conducted on balance use of fertilizer on wheat under arid conditions.

Author's Contribution

Malik Muhammad Yousaf conceived idea and techniocal guidance. Muhammad Mohsin Raza technical input at every step and over all write up of paper. Mumtaz Hussain, Muhammad Jahangir Shah, Bashir Ahmad and Rao Wali Muhammad date collection. Samiullah data SPSS analysis. Adeel Abbas and Ijaz Ahmad technical assistants. Muhammad Zeshan rferences.

Conflict of interest

The authors have declared no conflict of interest.

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