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**Research Article**

# Assessment of coherent impacts of selenium and urea on the growth and physiological attributes of wheat (*Triticum aestivum* L.)

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**Abstract**

A study was conducted to examine the effect of selenium and urea on the growth of wheat plant. Plants were grown in the pots by using different concentrations of selenium and urea. The treatment levels were in the form of control with 0 % urea and selenium while others were kept as (4 mg $SeL^{-1}$ + 1% urea), (4 mg $SeL^{-1}$ + 3% urea), (4 mg $SeL^{-1}$ + 5% urea) and (6 mg Se $L^{-1}$ + 1%), (6 mg $SeL^{-1}$ + 3%), (6 mg $SeL^{-1}$ + 5%). Observed growth parameters were root length, shoot length, root fresh weight, shoot fresh weight, root dry weight, shoot dry weight, leaf length, grain weight, total plant height while physiological were chlorophyll a and chlorophyll b content, and percentage of nitrogen, proteins, starch, lipids, iron and zinc in the grain. Results showed that there was significant increase in both growth and physiological parameters with increasing concentration of combined urea and selenium as compared to that of control.

**Keywords**: Growth; Physiology; Selenium; Urea; Wheat

## Introduction

Common wheat (*Triticum aestivum* L.), considered as a significant source of human dietetic proteins, is one of the furthermost imperative cereal crops in the whole world. Quality of wheat yield as well as bread making are mainly reliant on environmental factors, genotype, nitrogen management, and agronomic techniques [1]. In many emerging countries, wheat is a principal source of everyday micronutrients and calories, particularly in resource-poor communities [2]. Wheat (*Triticum aestivum* L.) is known as the main source of nourishment for more than 35% of the population of the world, providing calories of more than 45% and protein of more than 40% to the population of the world [3].

Selenium basically links to the first of the recognized groups and deliberated as a

micronutrient [4]. Selenium is known as a naturally occurring component, which is crucial for animal and human health in insignificant amounts, but when spent in large quantity, it may also be damaging. The suggested range for everyday intake of selenium for adult group is from 50 to 200–400µg [4, 5]. It plays an active part as an antioxidant, general immune function regulator and thyroid hormone [6]. Selenium has several significant physiological functions in the life of the plant, comprising plant growth and boosting germination of seeds when utilize in low quantities [7]. It also upsurges production of dry matter by aggregating the carbohydrates production and their buildup in the plastids, particularly starch, and regulating the water amount inside the plant body. It also boosts the development of anti-stress plant hormones, just like ethylene, salicylic acids and jasmonic, snowballing the ability of plant to face oxidative stress by boosting the resistance system of plant to free radicals and antioxidants, postponing plant ageing, defending plants from infection with aphids, fungi, spiders, etc. plant diseases and others [8]. Plants can voluntarily take up selenium in the form of selenite, selenate, and organic selenium species. Selenite and selenate are documented as the main selenium sources in exogenous selenium fertilizers only because of their great bioavailability, though, their uptake, translocation, and transformation vary amongst plant cultivars and types. Accumulation of selenium is less when plants are exposed to selenite than that direct exposed to selenite [9].

The usage of synthetic fertilizers in the field of agriculture is important for supporting the growing population internationally. New studies demonstrate that the quantity of mineral nitrogen fertilizer used in agriculture in the European Union amplified from 10.8 million tons in 2011 to 11.6 million tons in 2017, while production of European cereal augmented only from 270.8 thousand tons to 284.9 thousand tons [10]. Marketable fertilizers satisfy the demand of global food about 40l% to 60%. The application of nitrogenous fertilizers is usually greater due to basic requirement of the cereal's development and growth. The nitrogen is considered as a basic component that fuels the crop growth as well as development, uptake of potassium and phosphorus, harvest and quality of grain [11, 12]. Nitrogenous (N) fertilizer is known as an indispensable element for greater yield of wheat production, but can be promptly exhausted by the means of ammonia volatilization and runoff during the process of transformation in soil, consequential in low usage efficacy [13].

Urea ($CO(NH_2)_{2)}$ is reflected as one of the chief nitrogenous fertilizers, and its nitrogen content is 46%. Nitrogen is one of the essential components for plants and requests it in great amounts as compare to other nutrients [14], and it performs to fortify the growth of plants as it enters the composition of proteins, chlorophyll, amino acids and in the plant cell composition. Nitrogen composites make up approximately 1% to 5% of the dry weight of the protoplasm of plant cell. It is deliberated as one of the constituents of the chlorophyll pigment, which is basically accountable for the green color in plants and performs a crucial function in the process of photosynthesis and is involved in the nucleic acids synthesis, synthesis of cytokinins, the synthesis of ADP and ATP and in the establishment of the natural growth hormone recognized as indole acetic acid (IAA), which is constructed from the amino acid tryptophan [15].

## Materials and Methods

The experiment was conducted at the Botanical Garden of Bahauddin Zakariya University Multan during the year 2021-2022. Plastic pots of size 12 inches were filled with sandy loam textured soil having

pH 7.69. Certified seeds of wheat variety Punjab-2011 were taken from local seed dealer at Multan. Seeds of wheat were sown in well prepared pots arranged in Completely Randomized Block Design (CRBD) having three replicates with control and all treatments of urea and selenium. Sodium selenite was used as source of selenium while simple fertilizer as urea was used in the experiment. Sodium selenate ($Na_2SeO_4$) was mixed once with soil filled pots with the concentration of 0mg/kg of soil as control while rests of treatments were 4mg/kg and 6mg/kg of soil. Similarly, urea was supplied 0% as control while other treatments were 1%, 3% and 5% per liter of water during each week till the onset of harvest. These treatments were denoted (T0A0 as control), (T1A1=1% urea + 4mg Se), (T2A1= 3% urea + 4mg Se), (T3A1= 5% urea + 4mgSe), (T0B0= control), (T1B1= 1% urea + 6mgSe), (T2B1=3% urea +6mgSe) and (T3B1= 5% urea +6mgSe). Treatments of urea were supplied in each week at fix interval of time while pots were kept moisture by tap water. After seven weeks of treatment, harvest was done and samples were collected for the analysis of growth and physiological parameters in the form of fresh and dry weights of root, length of root and shoot, leaf area, size and weight of grains. While physiological parameters were observed in the form of chlorophyll a, b and percentage of lipid, starch, zinc and iron. Growth parameters were measured by simple measuring scale and digital balance. Similarly, chlorophyll contents were measured by following the method of [7]. While zinc, protein, lipid and iron in the grain were measured by following the method of **[15]**.

Analysis of variance for all the considered parameters was executed using software Statistix 8.1.

## Results and Discussion

### Effect of urea and selenium on the growth parameters of wheat crop

As shown in the (Table 1) there has been significant increase in all growth parameters of wheat crop as compared to that of the control. In the presence of 4mg of Se, there was subsequent increase in the fresh weight of root and shoot at the 1% which was recorded maximum as 13.4 and 25.6 g respectively as compared to that of control. Similarly, at 5% of urea there was also seen increase in the fresh weights of shoots and roots which was 15.7 and 28.6 g respectively in the presence of 4 mg of Se as compared to that of control. In case of dry weights same trend was also noted with the level of increase as 1% < 3% <5% at 4 mg Se as compared to the control. Same trend was also seen in case of leaf surface area of plant which increases from 1% to 5% as 4.1 and 6.5 cm respectively. When the level of Se increased to 6mg, there was significant increase in all parameters of growth with increasing the percentage of urea from 1% to 5% as compared to that of control. This trend also showed that both Selenium and urea produced significant increase in growth parameters and increasing trend was noted higher in case of 6mg Se with 5% urea.

### Effect of urea and selenium on the physiological parameters of wheat crop

Effect of urea along with selenium has been shown in (Table 2). The results showed that at par growth attributes, similar findings were also found in case of physiological parameters. At the 4 Se $L^{-1}$ and 6 Se $L^{-1}$, with 0% urea, 1% urea, 3% urea and 5% urea, the chlorophyll a and chlorophyll b contents were found maximum 15.700 mg/100g & 18.633mg/100g under both doses of selenium as compared to that of control. Similar results were also obtained in case of percentage of nitrogen in the grain that remained 21.3 & 24.2 under both levels of selenium respectively. The percentage of protein was

noted as 13.9 and 11.2 in case of 6 mg & 4 mg Se respectively in the presence of 5% of urea. Similar results were also found in case of amount of lipid and starch in the grain with pattern of gradual increase from 1% to 5% of urea in the presence of 4 & 6mg of selenium. The combined effect of selenium and urea on the percentage of iron in grain was also found with the gradual trend in which the maximum was 4.9667 and 4.4% was recoded at 5% of urea in case of 4 and 6mg of selenium. The percentage of zinc was also found in line with the same trend in which at 5% of urea in case of 4mg selenium was 21.3% while at 6mg of selenium was 24.2% as compared to that of control. Here in case of physiological attributes the effects of both selenium and urea was also found similar with the order of 5%>3% > 1% while 6mg of selenium was > than 4mg of selenium.

The currents results have been found correlating with the findings of **[8, 16]** in which it was observed that urea produced impacts urea on the growth and physiology of plants. Their experimental results demonstrated that the combination of foliar applications of selenium and urea considerably increased all physiological parameters. Also **[17]** observed the similar foliar effects on the growth and physiochemical parameters in which selenium produced considerably positive impacts on the growth and physiology of plants. The conclusion of **[18]** about the foliar applications of selenium on brassica plants based on yield and productivity are also supporting the current findings under same environmental circumstances. The study of **[19]** about fertilization of selenium has confirmed the enhancing capacity of urea in which liquid fertilizer DAM-390 (30 kg of N/ha) significantly increased the growth of wheat plant. Similarly, **[20]** investigated that the interface possessions between diverse nitrogen proportions and selenium application which meaningfully stimulated growth constraints compared with nitrogen and/or selenium alone treatments, with regard to all quality and growth characters. The results of this study are also being supported by the research work of **[21]** in which it was observed that the effects of $SeO_4$ enriched urea produced positive effects on rice crop. **[22]** also found that the combination of both urea and selenium play an important role in the growth and physiology of plants and considered as essential components for the growth of plants which satisfying these results. The findings of **[23]** also showed that Se reduced the Na and K ratio and also enhanced Ca and nitrogen uptake in wheat plants. Finally, Se even at low application was found helpful in averting salinity-mediated harm. While **[24]** described that selenium improved cellular functions just like mineral nutrition homeostasis, membrane stability, photosynthesis, antioxidant response, and therefore increase plant growth as well as development under metal stress which is depicting the current study. Additionally, **[15]** have also found that contents of carbohydrates as well as total nitrogen increased, supporting biomass accumulation and wheat production under Cd stressed environment.

From the above finding and previously recorded results, it can be concluded that selenium can play a positive role in uplifting the various attributes of plants and its potential increases many folds when combines with the nitrogenous fertilizers like urea. This study also demonstrated that if Se and urea are applied in foliar forms, then prominent impact can be observed as in this study both growth and physiological characters of plants have been increased significantly.

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**Table 1. Combined effect of selenium and urea on the growth parameters of wheat crop**

| Treatments | Root length (cm) | Shoot length (cm) | Shoot fresh weight (g) | Shoot dry weight (g) | Root fresh weight (g) | Root dry weight (g) | Leaf length (cm) | Grain weight (g) | Total plant height (cm) |
|---|---|---|---|---|---|---|---|---|---|
| T0A0 | 41.600±0.55f | 7.5333±0.30e | 12.300±0.26f | 8.7333±0.40f | 24.767±0.41e | 18.333±0.15F | 3.4333±0.15f | 0.6333±0.11e | 8.2667±0.11f |
| T0B0 | 44.367±0.30de | 8.1000±0.34d | 13.400±0.45e | 10.000±0.26e | 25.933±0.85d | 19.867±0.35de | 4.4000±0.2e | 0.9333±0.23d | 9.8667±0.05de |
| T1A1 | 43.833±0.92e | 8.0333±0.20sde | 13.400±0.55e | 10.000±0.26e | 25.633±0.58de | 19.267±0.77e | 4.1333±0.30e | 0.8667±0.05d | 9.5333±0.32e |
| T2A1 | 45.767±0.92cd | 8.5333±0.11cd | 14.367±0.51d | 10.600±0.17d | 27.233±0.45c | 20.600±0.26cd | 5.2000±0.79d | 1.2667±0.11c | 10.067±0.41d |
| T3A1 | 47.300±1.01b | 9.0667±0.23c | 15.733±0.28c | 11.933±0.49c | 28.600±0.7b | 22.367±0.68b | 6.5667±0.32b | 1.4000±0.1bc | 11.333±0.45b |
| T1B1 | 46.033 ±0.68bc | 8.9000±0.26c | 14.800±0.79d | 11.467±0.11c | 27.500±0.7c | 21.367±0.41c | 5.8667±0.30c | 1.3667±0.05bc | 10.633±0.15c |
| T2B1 | 47.400±1.04b | 10.833±0.35b | 16.900±0.36b | 12.567±0.30b | 29.500±0.52ab | 23.200±0.3b | 7.5333±0.25a | 1.5000±0.1b | 11.533±0.35b |
| T3B1 | 49.467±0.90a | 12.267±0.49a | 18.000±0.43a | 13.773±0.50a | 30.000±0.45a | 24.833±0.65a | 8.0667±0.15a | 1.8000±0.1a | 12.567±0.25a |

**Table 2. Combined effect of selenium and urea on the physiological parameters of wheat crop**

| Treatments | Chlorophyll a content (mg/100g) | Chlorophyll b content (mg/100g) | Percentage of nitrogen in grain | Percentage of protein in grain | Percentage of lipids in grain | Percentage of starch in grain | Percentage of iron in grain | Percentage of zinc in grain |
|---|---|---|---|---|---|---|---|---|
| T0A0 | 10.667±0.50g | 12.833±0.65g | 18.533±0.25e | 8.0333±0.51f | 0.2667±0.11f | 0.6667±0.11e | 2.1333±0.20f | 0.7667±0.15f |
| T0B0 | 12.733±0.68ef | 14.733±0.77ef | 20.967±0.80cd | 9.4333±0.50e | 0.5667±0.15e | 1.3333±0.11d | 2.7333±0.11e | 1.2333±0.05de |
| T1A1 | 12.000±0.45fg | 14.167±0.30f | 19.233±0.35e | 9.3333±0.5e | 0.5667±0.05e | 1.2333±0.15d | 2.6667±0.11e | 1.1000±0.26e |
| T2A1 | 13.867±0.60de | 15.533±0.55de | 20.467±0.30d | 10.067±0.51de | 0.7667±0.05de | 1.7333±0.11c | 3.4333±0.15d | 1.4667±0.11cd |
| T3A1 | 15.700±0.9bc | 16.933±0.77c | 21.333±0.45bc | 11.267±0.77c | 1.0667±0.15bc | 2.2667±0.11b | 3.9333±0.23c | 1.8667±0.11b |
| T1B1 | 14.400±0.78cd | 16.333±0.55cd | 22.100±0.55b | 10.900±0.3cd | 0.8333±0.05cd | 1.7333±0.11c | 3.5333±0.30d | 1.5667±0.005c |
| T2B1 | 16.167±0.45b | 18.067±0.37b | 23.467±0.57a | 12.400±0.78b | 1.1333±0.25b | 2.3333±0.11b | 4.4000±0.2b | 1.9333±0.23b |
| T3B1 | 18.633±1.35a | 19.900±0.7a | 24.267±0.11a | 13.900±0.51a | 1.5333±0.11a | 2.7333±0.11a | 4.9667±0.20a | 2.3333±0.11a |

## Conclusion

It can be concluded from the above findings that both urea and selenium act as growth boosters in plants applied at certain levels and also their impacts are increased manifolds when supplied together.

## Authors' contributions

Planned and designed the experiment: K Dad & F Zhao, Performed the experiment: R Hassan & K Javed, Data collection: M Shakar & T Fatima. Analyzed the data: M Imran & STH Shah, Wrote the paper: M Nawaz.

## References


1. Horvat D, Dvojković K, Novoselović D, Tucak M, Andrić L, Magdić D & Drezner G (2022). Response of Wheat Yield and Protein-Related Quality on Late-Season Urea Application. *Agron* 12(4): 886.
2. Yeasmin M, Lamb D, Choppala G & Rahman MM (2022). Selenium Accumulation and Speciation in Chickpea (*Cicer arietinum*) Impacted by S in Soils: Potential for Biofortification. *ACS Agric Sci & Technol* 2(1): 135-143.
3. Ramkissoon C, Degryse F, da Silva RC, Baird R, Young SD, Bailey EH & McLaughlin MJ (2019). Improving the efficacy of selenium fertilizers for wheat biofortification. *Sci Rep* 9(1): 1-9.
4. Tamás M, Mandoki ZS & Csapó J (2010). The role of selenium content of wheat in the human nutrition. A literature review. *Acta Uni Sapientiae Aliment* 3: 5-34.
5. Premarathna L, McLaughlin MJ, Kirby JK, Hettiarachchi GM, Stacey S & Chittleborough DJ (2012). Selenate-enriched urea granules are a highly effective fertilizer for selenium biofortification of paddy rice grain. *J of Agric and Food Chem* 60(23): 6037-6044.
6. Ouyang Y & Norton JM (2020). Short-term nitrogen fertilization affects microbial community composition and nitrogen mineralization functions in an agricultural soil. *Appl and Environ Microbiol* 86(5): e02278-19.
7. Arnon D (1949). Copper enzymes in isolated chloroplasts polyphenoloxidase in Beta Vulgaris. *Plant Physiol* 24: 1-15.
8. Khalil AT & Al-Aareji JM (2022). Role of Foliar Spray with Selenium and Urea On Growth, Flowering, And Yield of Strawberry (Fragaria X Ananassa Duch.) Cv. Camarosa. *Texas J of Agric and Biol Sci* 5: 14-21.
9. Seadh SE, Raya A & El-Denasory MM (2013). Effect of selenium foliar application treatments on the growth and yield of wheat. *J of Plant Prod* 4(10): 1429-1436.
10. Luo HW, He LX, Du B, Wang ZM, Zheng AX, Lai RF & Tang XR (2019). Foliar application of selenium (Se) at heading stage induces regulation of photosynthesis, yield formation, and quality characteristics in fragrant rice. *Photosynth* 57(4): 1007-1014.
11. Ghafoor I, Hasnain MU, Ikram RM, Khan MA, Iqbal R, Hussain MI, & Sabagh AE (2022). Effect of slow-release nitrogenous fertilizers on dry matter accumulation, grain nutritional quality, water productivity and wheat yield under an arid environment. *Sci Rep* 12(1): 1-10.
12. Lara TS, de Lima Lessa JH, de Souza KRD, Corguinha APB, Martins FAD, Lopes G & Guilherme LRG (2019). Selenium biofortification of wheat grain via foliar application and its effect on plant metabolism. *J of Food Comp and Ana* 81: 10-18.
13. Gao S, Zhang S, Yuan L, Li Y, Wen Y, Xu J & Zhao B (2022). Humic Acids Incorporated into Urea at Different Proportions Increased Winter Wheat Yield and Optimized Fertilizer-Nitrogen Fate. *Agron* 12(7): 1526.
14. Mălinaş A, Vidican R, Rotar I, Mălinaş C, Moldovan CM & Proorocu M (2022).

Current Status and Future Prospective for Nitrogen Use Efficiency in Wheat (*Triticum aestivum* L.). *Plants* 11(2): 217.

15. Zhang Y, Shi R, Rezaul KM, Zhang, F & Zou C (2010). Iron and Zinc Concentrations in Grain and Flour of Winter Wheat as Affected by Foliar Application. *J of Agric Food Chem* 58: 12268–12274.
16. Yassen AA, Safia MA & Sahar MZ (2011). Impact of nitrogen fertilizer and foliar spray of selenium on growth, yield and chemical constituents of potato plants. *Aus J of Basic and Appl Sci* 5(11): 1296-1303.
17. Rawal N, Pande KR, Shrestha R & Vista SP (2022). Nutrient use efficiency (NUE) of wheat (Triticum aestivum L.) as affected by NPK fertilization. *PloS One* 17(1): e0262771.
18. Radawiec A, Rutkowska B, Tidaback JA, Gozdowski D, Knapowski T & Szulc W (2021). The impact of selenium fertilization on the quality characteristics of spring wheat grain. *Agron* 11(11): 2100.
19. Ducsay L & Lozek O (2006). Effect of selenium foliar application on its content in winter wheat grain. *Plant Soil and Environ* 52(2): 78.
20. Wang M, Ali F, Qi M, Peng Q, Wang M, Bañuelos GS & Liang D (2021). Insights into uptake, accumulation, and subcellular distribution of selenium among eight Wheat (*Triticum aestivum* L.) cultivars supplied with selenite and selenate. *Ecotoxicol and Environ Safety* 207: 111544.
21. Obsa Z, Dejene M & Chala G (2022). Effect of Blended NPSB and Urea Fertilizers Rate on Yield and Yield Component of Wheat on Nitisols at Welmera Districts, Central Highlands of Ethiopia. *World* 7(1): 28-33.
22. Abdallah HR (2020). Effect of foliar application with urea, benzyladenine and dry yeast on flowering and fruiting of Minneola Tangelo trees to reduce the severity of alternate bearing phenomena. *Middle East J* 9(4): 893-933.
23. Elkelish AA, Soliman MH, Alhaithloul HA & El-Esawi MA (2019). Selenium protects wheat seedlings against salt stress-mediated oxidative damage by up-regulating antioxidants and osmolytes metabolism. *Plant Physiol and Biochem* 137: 144-153.
24. Hasanuzzaman M, Garcia P, Zulfiqar F, Parvin K, Ahmed N, Fujita M & Nahar K (2022). Selenium supplementation and crop plant tolerance to metal/metalloid toxicity. *Front in Plant Sci* 2957.