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Sulphur-nitrogen interactive effects on wheat yield and nutrient concentration

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Introduction: Advances in the technology of plant nutrition have markedly increased nitrogen utilization. At the same time, increasing crop yields together with increasing nitrogen supply and the reduced use of sulphur-containing fertilizers may lead to sulphur gradually becoming a yield limiting factor. Under Egyptian conditions, the use of sulphur is very important due to its effect on soil properties and increasing the availability of certain nutrients. Thus, the aim of this work was to investigate the effect ofsoil applied N levels when combined with various levels of elemental sulphur on wheat yield and yield components as well as mineral and chemical constituents of wheat grains.

Materials & Methods: Field trials were conducted in sandy clay loam soil (Organic Matter1.89%, Calcium Carbonate 2.88%, pH7.82, Total N 0.08%, available P 13.6 ppm, available Fe, Zn, Mn and Cu 19.3. 22.53, 15.20 and 3.54 ppm, respectively. The experiment included 12 treatments which were the combinations of 3 levels 120,180and 240 kg Nh⁻¹, respectively with 4 levels of elemental sulphur (0, 1.2,2.4 and 4.8tonnes Sha⁻¹) respectively. Urea (46.5%) was added in two equal doses at 21and 35 days from sowing. A basal dressing of potassium sulphate (48% K₂SO₄) and calcium supper phosphate (15.5% P₂O₅) repre¬senting 48 kg K₂SO₄ and 48 kg P₂O₅ respectively were applied. Total N, total P and K, Zn, Cu and Mn contents were determined with flame photometry. The total carbohydrate was determined. The experimental design was split –plot design with four replicates and the data were subjected to the proper statistical analysis. Treatment means were compared according to Duncan's multiple range test.

Results & Discussion: The data showed that highest significant grain yield was recorded when wheat was fertilized with nitrogen at the N2 level (180 kg Nh⁻¹); further increases in the applied N level could not increase the productivity of wheat plants. Sulphur application and the interaction effect had significant effects on grain yield and the heaviest weight ofgrains was recorded when wheat plants were fertilized with sulphur at 2.4 ton ha⁻¹. Moreover, wheat plants responded to the combined application of sulphur and nitrogen at N2 level (180 kg Nh⁻¹) with any sulphur addition (1.2, 2.4 and 4.8 ton ha⁻¹). On the other hand, seed index criterion was not influenced by applied N or sulphur application. The interaction effect between nitrogen and sulphur was also significant on straw weight and the biological yield of wheat plants. Such results could clearly indicate that sulphur application at (1.2, 2.4 and 4.8 ton ha⁻¹) caused better utilization of nitrogen when combined with it at the recommended dose N2 level (180 kg Nh⁻¹) which was reflected in the wheat productivity. The beneficial effect of the combined urea-sulphur application may be attributed to the alkaline effect of urea which increases the soil pH temporarily after its addition and hence partly neutralizes the acidic effect of sulphur in the soil. Significant effects on the total carbohydrate concentration in wheat grains were recorded due to applied N, sulphur levels and their interaction S x N. The stimulatory effect of sulphur on the total carbohydrate formation is well esta¬blished because it is a component of the hormones thiamine and biotin which control carbo-hydrate metabolism. Thus, using sulphur in the presence of applied nitrogen as well as the interaction effect (S x N) resulted in significant increases P and K concentrations in wheat grains. The highest NPK concentrations in wheat grains resulted from the N3 level (240 kg Nh⁻¹) combined with either 1.2, 2.4 or 4.8 tonne Sha⁻¹. Sulphur application at 2.4 and 4.8 tonne ha-1 gave the highest significant effect on Cu and Mn concentrations in wheat grains. On the other hand, it seems that Zn concentration was depleted at these sulphur application levels. The highest concentration of Zn, Cu and Mu was recorded when N3 level (240 kg Nh⁻¹) when combined with 1.2and 2.4 or 4.8 ton ha⁻¹. The data indicated that sulphur had a beneficial effect on solubility and availability of the plant nutrients especially the micronutrients such as Zn, Mn, and Cu.

Conclusion: It could be concluded from these results that it is preferred to combine sulphur with urea at the recommended doses for wheat production to increase the efficiency and better utilization of urea under such alkaline soils.

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