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Sulfur Fertility Management As Strategy to Enhance Chickpea Agronomic Performance

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Recently, significant efforts in agronomic research have focused on the topic of protein transition. This is because the current protein supply system is mainly based on animal sources, which are associated with significant negative impacts on both natural ecosystems and human health. Within the protein transition, legumes play a central role both for their high protein content, and because are already present in the traditional diets of many cultures. Chickpea (*Cicer arietinum* L.), is one of the most common pulses, characterized by high protein concentration and an overall optimal nutritional profile. However, its inclusion in modern cropping systems is often limited, mainly for its low productivity. In terms of fertility management, the Leguminosae family is among the botanical families with the highest demand for sulfur. In the form of cysteine and methionine, sulfur is a fundamental constituent of protein, and S-containing compounds, such as glutathione and N-acetylcysteine, have an important role in plants stress tolerance. Furthermore, sulfur affects the metabolism of symbiotic nitrogen-fixing bacteria and consequently pulses nodulation and growth. Main sources of available sulfur for plants uptake are organic matter mineralization and atmospheric depositions. The latter were significantly reduced in recent years due to stricter environmental regulations on the sulfur content of fossil fuels. Therefore, if an external supply of organic matter is not locally available, crops can undergo to S deficiency, with consequent reduction in biomass and therefore final yield. In our study, we assess the application of two doses (equal to 30-60 kg S ha^{-1}) of gypsum ($CaSO_4x2H_2O$) to two commercial varieties of chickpea ('Pascià', 'Reale'), in comparison to an unfertilized control. Trial was performed at field level at the Experimental Centre of University of Pisa (San Piero a Grado – Pisa province). Chickpea was sown in plots (18 m^2) at 40 plants m^{-2} during 15/05/2024, arranging plots in a randomized block design with 3 replicates. During crop cycle, nutritional status was monitored through weekly determination of Normalized Difference Vegetation Index (NDVI), using proximal sensing equipment (Greenseeker®–Trimble). Destructive sampling was performed at seed maturity (2024, August 22) on a 1.35 m^2 area. Our results shows that the application of gypsum was beneficial to chickpea, regardless the application rate. More specifically, sulfur fertilization

increased crop yield on average from 1.3 t ha^{-1} to 2.5 t ha^{-1} in 'Pascià' and from 1.5 t ha^{-1} to 2.1 t ha^{-1} in 'Reale'. Moreover, Harvest Index, increased from 0.54 to 0.57, indicating an improvement in production efficiency. After flowering, NDVI monitoring indicate higher values in the plots that received S fertilizer compared to the unfertilized control, suggesting higher vegetative activity during pod filling stage. The lack of differences in plots fertilized with different S application rates, indicates that under the experimental conditions tested, the application of 30 kg S ha^{-1} on chickpea, can be sufficient to significantly improve seeds yield. Trials will be repeated for the second year. Moreover, further studies will focus on the effects of sulfur in determining the qualitative profile of chickpea seeds.