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Evaluating the role of biopriming and nanopriming on the morphometric, biochemical, and yield parameters of Chickpea (*Cicer arietinum* L.) under drought stress☆

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ABSTRACT

This study evaluated drought mitigation potential of biopriming with plant growth promoting endophytic bacteria (PGPEBs) and nanopriming with their biological copper nanoparticles (CuNPs) and chemical CuNPs under polyethylene glycol (PEG-6000) induced moderate (MD-5%) and severe drought (SD-10%) in chickpea (*Cicer arietinum* L.). The crop harvested at 15 DDS (Days to drought stress) was analysed for morphometric and biochemical parameters of drought tolerant (DT), BG-4958 and drought sensitive (DS), ICC-1882 chickpea varieties. In morphometric traits of DT variety, N_1X led 384% increase in shoot dry weight (SDW) under MD while B_2 in root dry weight (RDW) under SD (418%). For DS variety, N_2X led 444% and 727% increase in SDW (MD) and RDW (SD), respectively. Amongst biochemical parameters, maximum increment was noticed in total chlorophyll content (TCC) by B_1 under MD (703%) as well as SD (1206%) in DT variety. B_1 also led highest increment (758%) in TCC of DS variety under SD while B_2 under MD (300%). B_2 resulted in 242% increment in total soluble carbohydrates (TSC) and 47% increase in total protein content (TPC) of DS variety under SD. N_1X and N_1Y led 318% and 100% increase in the activity of ascorbate peroxidase (APX) and peroxidase (POD) of DS variety. This variety exhibiting pronounced response was subjected to correlation analysis revealing highest correlation amongst morpho-biochemical traits under SD. Score plot in principal component analysis (PCA) of DS variety showed that biopriming and N_1X having higher score values for PC_2 mainly influenced by biochemical parameters also improved the yield parameters to a greater extent as analyzed on 120 DDS. Harvesting index, the ultimate indicator of the agricultural output remained insignificant in DT variety. On the other hand, B_2 and N_1X led highest harvesting indices under MD (94%) and SD (69%), respectively, in DS variety, owing to their higher grain yield than biological yield and higher score values influencing biochemical parameters under stress. The present study provides insights into the beneficial role of PGPEBs and biosynthesized CuNPs in mitigating the adverse effects of drought in chickpea.

1. Introduction

Plants are susceptible to several forms of abiotic stresses like drought, salinity, high or low temperatures, and heavy metal toxicity, during their life cycle. Different abiotic stresses cause more than half of the yield losses in major crops (Mickelbart et al., 2015). It also impacts the event and spread of microbes, bugs, and weeds by improving the competitive collaborations of weeds on crops (Ziska, 2010; Valerio et al., 2013). Drought is one of the most detrimental abiotic stress adversely affecting plant growth and development by disturbing many physiological processes. Water deficit stress primarily affects the thylakoid membranes causing reduction in photosynthesis which ultimately leads to decrease in yield. It also takes adverse toll on seed germination, transpiration rate, net photosynthetic rate, leaf relative water content

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