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Effect of biopores on simulated root growth, biomass and grain yield of water stressed spring wheat in a field scale crop model

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Soils are seldom without a network of biopores formed from decayed roots or other soil flora and fauna activity. While aspects of soil structure such as biopores are expected to influence root growth, root water uptake and nutrient uptake, their effect is seldom considered in crop and land surface models. In this study we coupled a 3-Dimensional root system architecture model to a field scale crop model and investigated the effect of biopores on the simulated root growth, above ground biomass and grain yield of water-stress spring wheat using two scenarios. In the first scenario, a biopore network is considered while in the second scenario no biopore network is considered in the soil. We assumed that biopores are relics of a pre-crop root system and we generated biopore networks that match with measured biopore densities. Our results show that, under dry spells and in relatively dense soils with a high water holding capacity, biopores enabled root growth and access to subsurface soil moisture in deeper soil layers which would have been less readily available without the biopores. Due to the access to subsurface soil moisture during dry spells, the scenario with a biopore network gave relatively higher biomass and grain yields for spring wheat compared to the scenario without biopores. As the frequency of dry spells during summer are expected to increase due to climate change, agronomic procedures that encourage the formation of biopores in soils could be a promising strategy to mitigate water-stress induced crop loses in rain-fed agriculture.