Mycorrhizal colonisation in sunflower under limitations to radiation source or carbohydrate sink

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One of the most important mutualistic interactions between plants and soil microorganisms is mycorrhizae, which is formed between the arbuscular mycorrhizal fungi (AMF) and plant roots. Owing to the exchange of carbohydrates and nutrients with a positive balance towards the host plant, root colonisation with AMF generally has positive effects on plant growth. Sunflower is a C_3 mycorrhizal specie with the head in an apical and dominant position, which is related to leaf-senescence pattern that may lead to a characteristic flux and availability of carbohydrates in the host. To our knowledge, there is lack of information about how changes in the source or the sink of photosynthates can affect plant growth and carbon accumulation, and consequently the relationship with arbuscular mycorrhizal colonisation (AMC) of sunflower. The aim of this work was to analyse indigenous AMC in relation to growth and total soluble carbohydrates (TSC) in sunflower. In order to promote contrasting TSC concentrations, we modified the radiation source by shading and the carbohydrate sink by manipulating reproductive sinks at different phenological stages during the grain-filling period in two field experiments. We assessed plant dry matter, TSC in stems, and root AMC from flowering until final harvest. We found that AMC increased during the grain-filling period. Both a sink and a source limitation reduced AMC. AMC was negatively related to TSC and the relationship was affected by shading. A linear model described the relationship between AMC and TSC in plants submitted to the removal of the reproductive organs. The results support the idea that AMC are controlled by carbon, which could be related, at least in part, to their obligate dependence on the host. They also contribute to understanding of the distribution of resources in the plant, a key goal in elucidating mycorrhizal symbiosis and its contribution to crop production.