Impact of elevated atmospheric carbon dioxide and water deficit on flower development and pyrethrin accumulation in pyrethrum

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Abstract

Crop responses in a changing climate reflect the interplay among rising temperature, changing rainfall patterns and increasing atmospheric Carbon dioxide (CO₂) concentrations. Exposure of plants to elevated atmospheric CO₂ not only induces the changes in primary metabolism, but also leads to complex alterations in secondary metabolism. Elevated CO₂ could delay the onset of water deficit and counterbalance negative effects of water deficit on plant growth by increasing water use efficiency. Pyrethrum (Tanacetum cinerariifolium) is commercially grown for extraction of pyrethrin in the achenes of the flower heads. Pyrethrin is classified as terpenoid and widely used as a natural insecticide. The response of pyrethrum, a perennial crop producing important secondary metabolites, to climate change is not known. In this experiment, plants were subjected to two water treatments (well-watered and water deficit) at two atmospheric CO₂ concentrations (ambient CO₂: 390 ppm and elevated CO₂: 700 ppm). Watering treatments were applied throughout the flowering period, until physiological maturity of flowers. Selected growth, yield, phenological and physiological traits were measured to understand the effects of elevated atmospheric CO₂ and water deficit on flower development and pyrethrin accumulation. The results of this experiment showed that exposure to elevated atmospheric CO₂ throughout the flowering period, significantly increased flower yield and pyrethrin yield per plant (Figure. 1) at physiological maturity due to the production of more flowers. Elevated CO₂ treatments significantly increased the rate of flower development resulting in shorter flowering period and lower pyrethrin yield per flower compared to ambient CO₂ treatments. Exposure to water deficit during the post-anthesis period significantly reduced flower yield and total pyrethrin yield compared to well-watered treatments. The interaction of water deficit with elevated atmospheric CO₂ increased the rate of flower development

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resulting in shorter flowering period and lower pyrethrin yield. Adequate soil moisture for flower development increased the rate and duration of pyrethrin accumulation resulting in higher pyrethrin yield per flower.

**Figure 1**: Comparison of flower size and flower head diameter at physiological maturity

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**References**

