Olive Flowering dependence on winter temperatures - linking empirical results to a dynamic model

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Abstract

Olive (*Olea europaea*) yield depends on the number of inflorescences forming in springtime. This number depends on the sufficiency of cold periods and the lack of warm ones during the preceding winter. Despite this basic understanding, a satisfactory quantitative model forecasting the expected flowering under natural temperature conditions is still lacking. Previous models simply sum the number of 'cold hours' during winter, as a proxy for flowering, but exhibit only mediocre agreement with empirical flowering values, possibly because they overlook the order of occurrence of different temperatures. Here, we tested the effect of heat spells of different durations on olive flowering and gene expression. We constructed a dynamical model, describing the response of a putative flowering factor to the temperature signal. The crucial ingredient in the model is an unstable intermediate, produced and degraded at temperature-dependent rates. Our model accounts not only for the number of cold and warm hours but also for their order. We used sets of flowering and temperature data to fit the model parameters, applying numerical optimization techniques. We validated the model outcomes and showed its robustness. This model is the first step toward a practical predictive tool that could be used under various temperature conditions.

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