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Blooming Date Predictions Based on Japanese Apricot 'Nanko' Flower Bud Responses to Temperatures during Dormancy

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Abstract. Flower bud development and the timing of blooming are mainly affected by genotype-dependent chilling requirements (CRs) during endodormancy and subsequent heat requirements (HRs) during ecodormancy. However, little information is available regarding the responses of flower buds to temperatures during endodormancy and ecodormancy in japanese apricot. We exposed japanese apricot 'Nanko' trees to various temperatures to estimate the CRs and HRs using development index (DVI) models specific for the endodormant (DVI_{endo}) and ecodormant (DVI_{eco}) stages. These models were based on the experimentally determined development rate (DVR). The DVR_{endo} value was calculated as the reciprocal of the chilling time required to break endodormancy. The relationship between the DVR_{endo} value and temperature was estimated using a three-dimensional curve. Our results indicated that 5–6 ºC was the most effective temperature for breaking endodormancy in 'Nanko' flower buds. Additionally, exposure to -3 ºC negatively affected endodormancy release, whereas 15 ºC had no effect. We also determined that the DVR_{eco} values for temperatures between 5 and 20 ºC were the reciprocal values of the time required for blooming after endodormancy release. The values outside this range were estimated using linear functions. The DVI was defined as the sum of the DVR values ranging from 0 to 1. Models for predicting the blooming date were constructed using the functions of sequentially combined DVI_{endo} and DVI_{eco} models. The accuracy of each model was assessed by comparing the predicted and actual blooming dates. The prediction of the model in which DVI_{eco} = 1 corresponded to a 40% blooming level and DVI_{eco} =0 was set to DVI_{endo} = 0.5 had the lowest root mean square error (RMSE) value (i.e., 3.11) for trees in commercial orchards exposed to different climates. Our results suggest that the developed model may have practical applications.

ウメ‘南高’花芽における休眠期の温度反応性に基づく開花日予測

花芽発達および開花期は主に品種依存的な自発休眠期の低温要求量（CR）およびその後の他発休眠期の高温要求量（HR）の影響を受ける．しかし，ウメにおける花芽の自発休眠期および他発休眠期の温度反応性に関してはまだ知見が少ない．そこで本研究では，ウメ‘南高’樹を様々な温度条件で生育させ，自発休眠期および他発休眠期特異的な発育指数（DVI_{endo} および DVI_{eco}）モデルを用いて CR および HR を推定した．これらのモデルは，実験的に決定される発育速度（DVR）に基づくものである．DVR_{endo} 値は自発休眠が覚醒するために必要な低温時間の逆数で計算し，DVR_{endo} 値と温度との関係は三次曲線で近似した．この結果からは，5～6℃が最も‘南高’花芽の自発休眠覚醒に効果的であることが示された．さらに，-3℃は自発休眠覚醒に対して負の効果を持ち，15℃では覚醒効果はなかった．また，5～20℃における DVR_{eco} 値についても自発休眠覚醒後，開花までに必要な時間の逆数として決定し，この温度以外の値は線形関数で推定した．DVI は DVR 値を 0～1 の範囲で積算する値として定義し，開花日予測モデルは DVI_{endo} と DVI_{eco} モデルを連続的に計算する関数として構築した．モデルの精度を予測開花日と実測開花日との比較で評価したところ，開花率が 40%となるときを DVI_{eco}=1 と定義し，DVI_{endo}=0.5 の時点を DVI_{eco}=0 と設定したとき，異なる気候条件の生産園地における予測値を用いた二乗平均平方根誤差（RMSE）は最も小さくなった（3.11）．この結果からは，開発したモデルは実用的に応用が可能なものであると考えられる．