

Effect of High Temperature and Drought Stress on Carbohydrate Translocation in Japanese Apricot ‘Nanko’ Trees

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Abstract

With the continuing trend of global warming, the adverse impact of high temperature and the inevitably accompanying drought stress on the growth of Japanese apricot trees (*Prunus mume* Siebold et Zucc.) are of concern. Therefore, the effects of these factors on photosynthesis and carbohydrate translocation were analyzed. An investigation was conducted at average daytime temperatures of 24°C, 30°C, and 34°C under both irrigated and drought conditions. The 34°C temperature was higher than the open air temperature by 5°C. Stable isotope ¹³C was administered to trees to determine carbohydrate positioning. Under the drought stress condition, the photosynthetic rate declined accompanied by temperature elevation, and at the highest temperature of 34°C, ¹³C concentrations in the twigs and roots were lower than those in the irrigated trees at 24°C. Two-way analysis of variance revealed a trend of ¹³C translocation to the young organs above ground, and old organs, while roots were affected by water status, temperature, and their combination, respectively. In the irrigated trees, the photosynthetic rate reduction was not detected, even at higher temperatures. However, translocation incompetence reflecting a decline in ¹³C concentration in the roots was observed at 34°C. These results indicate that the permissible diurnal average temperature during summer for the growth of Japanese apricot trees is approximately up to 30°C, and in the temperature range around this irrigation is helpful to facilitate regular functioning of carbohydrate translocation under drought stress conditions.

高温と乾燥ストレスがウメ ‘南高’ 樹体中の炭水化物転流におよぼす影響

地球温暖化が進行する中、高温およびそれに伴う乾燥ストレスがウメ樹体の生育に悪影響を与えることが懸念されている。そのため、これらがウメ樹の光合成や炭水化物転流に及ぼす影響を調査した。試験は灌水および乾燥条件下で、昼間の平均気温を 24°C、30°C および 34°C に設定して行った。なお、34°C は大気平均気温に比べて 5°C 高い温度である。炭水化物の動態を調べるため、安定同位体 ¹³C を樹体に供試した。乾燥ストレス条件では、光合成速度が気温の上昇にともない低下し、最も高温の 34°C では新梢中および根中 ¹³C 含量が 24°C・灌水条件に比べて少なくなった。二元分散分析を行った結果、地上部の若い器官への ¹³C 転流は水分条件に、地上部の古い器官への転流は温度に、根へ転流は水分条件と温度の両方に影響を受ける傾向が認められた。灌水条件の樹体では、高温でも光合成の低下が認められなかったが、34°C では根中の ¹³C 含量が少なく、転流阻害が起こっていることが示唆された。これらの結果はウメの夏季の日中の適温は 30°C までと考えられる。この範囲では乾燥条件下でも灌水により同化炭水化物の正常な転流が行われると考えられる。