

P122

Study on hydroxy fatty acid contents changes and physiological responses under abiotic stresses in transgenic *Camelina*

Hyun-Sung Kim¹⁾, Hyun-Sook Lee¹⁾, Hyun-Gyu Lim¹⁾, Won Park²⁾, Hyun-Uk Kim³⁾,
Kyeong-Ryeol Lee⁴⁾, and Sung-Ju Ahn^{1)*}

¹⁾ Department of Bioenergy Science and Technology, College of Agriculture and Life Sciences, Chonnam National University, Gwangju, Republic of Korea

²⁾ Bioenergy Crop Research Institute, National Institute of Crop Science, Rural Development 14 Administration, Muan, Republic of Korea

³⁾ Department of Bioindustry and Bioresource Engineering, Plant Engineering Research Institute, Sejong University, Seoul, Republic Korea

⁴⁾ Department of Agricultural Biotechnology National Institute of Agricultural Science, Rural Development Administration, Jeonju, Republic of Korea

Abstract

Hydroxy fatty acid (HFA) is an important industrial resource that known to be extracted from seeds of Castor or Lesquerella. However, mass production of HFA from those crops are difficult because of their behavior or life cycle. In this study, we applied HFA synthesis related gene FAH12, RcPDAT1, RcLPCAT, RcDGAT2, and RcPDCT on bioenergy crop *Camelina sativa*. Furthermore, we determined NaCl or cold stress tolerance changes of transgenic *Camelina*. *RcFAH12*, *RcPDAT1*, *RcLPCAT*, *RcDGAT2*, and *RcPDCT* genes were cloned into multigene expression vector which is engineered with seed specific promoter of FAE1 or Napin. Combination of HFA genes multi-expression vector constructs were divided into Set3 (*RcFAH12*, *RcPDAT1-2*, *RcLPCAT*), Set4 (*RcFAH12*, *RcDGAT2*, *RcPDAT1-2*, *RcLPCAT*), and Set5 (*RcFAH12*, *RcDGAT2*, *RcPDAT1-2*, *RcLPCAT*, *RcPDCT*). Transgenic HFA synthesis *Camelina* plants were generated using agrobacterium-mediated vacuum infiltration system. Results of fatty acid composition of T1 transgenic *Camelina* seeds analyzed by GC-MS showed 9.5, 9.0, and 13.6 % of HFA contents in Set3#6, Set4#8, and Set5#10, respectively. Therefore, seeds of T2 generation were harvest from Set5#10 which is shown highest HFA contents, and, 17.7, 8.1 and 10.5 % of HFA contents were determined in Set5#10-5, Set5#10-8, and Set#10-10, respectively. However, 7.7% of C18:2 and 22.3 % of C18:3 among unsaturated fatty acids were decreased in Set5#10-5 than WT. Meanwhile, we confirmed abiotic stress responses in T2 transgenic *Camelina* Set5#10-5 and Set5#10-10 under 0, 100, 150, and 200 mM NaCl or 25, 15, and 10 °C temperature for 5 weeks. Both Set5#10-5 and Set5#10-10 showed lower growth in height than WT in control and NaCl condition. Growth of leaf length and width were similar in WT and Set5#10-10 but lower in Set5#10-5 under NaCl stress. Number of opened flowers showed that both transgenic *Camelina* were lower than WT under normal condition. But, WT and Set5#10-10 showed similar opened flower number in 100 and 200 mM NaCl. In cold stress, 15 and 10 °C treatment for 5 weeks did not showed significant changes in between WT and both transgenic lines even they showed different growth rate in control condition. Taken together, growth and development are delayed by expression of exogenous HFA related genes in transgenic lines but relative abiotic stress sensitivity is similar with WT. In conclusion, reduced C18:2 or C18:3 fatty acid composition of seed by HFA synthesis is resulted from lack of resource supplement for development at seedling stage but it is not affect NaCl and cold stress tolerance.

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Corresponding author* Sung-Ju Ahn,

Address : Gwangju 61186, Republic of Korea, Tel : +82-62-530-2052

E-mail : asjsuse@jnu.ac.kr