CHAPTER 12

BOTANY

Doctoral Theses

01. HEMBRAM (Maloti)
Characterization of Transgenic Lines of the Oilseed Crop, Brassica juncea L. (Indian mustard) Generated Using Gibberellin Biosynthesis gene (*GA3OX4*), Gibberellin Signaling Gene (*RGL3*) and a Peptide Deformylase gene (*DEF2*) for Enhancement of Seed Size and Analysis of Combinatorial Effects of *GA3OX4* and *RGL3* Genes.
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Abstract

India's production of oilseed crops was ~39.59 million tons in 2023–24, which contributes to ~40% of the domestic demand for edible oil. In India, Brassica juncea (Indian mustard) is the second most important oilseed crop and is cultivated in 9.18 million hectares. Improving the seed size of mustard could contribute to increased production and decrease the demand-supply gap. This study describes the characterization of transgenic lines generated earlier in our laboratory for improvement of seed size in mustard based on three independent strategies (i) overexpression of a gibberellin biosynthesis gene (GA3OX4) (ii) antisense-based inhibition of a gibberellin signaling gene (RGL3) and (iii) over-expression of a peptide deformylase gene (DEF2). Homozygous, single-locus GA3OX4 and RGL3AS transgenic lines were developed and subjected to analyses of seed diameter, hundred- and thousand-seed weight, yield per plant and plot-level seed production in three growing seasons. The GA3OX4 and RGL3AS transgenic lines revealed a significant increase over untransformed plants for the above parameters with a significant increase in seed production in plot-level studies. qRT-PCR studies revealed increased expression levels of GA3OX4 and reduced expression of RGL3 in corresponding transgenic lines during various stages of seed development. Histological studies indicated an extended period of seed development and increased cell division in transgenic plants contributing to their increased seed size. Gene pyramiding experiments were conducted using promising GA3OX4 and RGL3AS transgenic lines and the resulting progeny was assessed in different generations (F1 – F4) for seed size. The combinatorial effects of these genes resulted in a further increase in seed size as compared to parental transgenic lines. We also identified one promising single-locus homozygous DEF2 transgenic line that showed significant increase in seed size as compared to untransformed plants. Transgenic lines generated in this study would contribute towards India's efforts in achieving self-sufficiency in oilseed production.

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