

## 杂种落叶松花器官发育过程研究

郝俊飞<sup>1</sup>, 王晨<sup>1</sup>, 徐黛曦<sup>1</sup>, 张磊<sup>1</sup>, 张含国<sup>1</sup>

(1. 林木遗传育种全国重点实验室(东北林业大学) 哈尔滨 150040)

**摘要:** 落叶松的良种供应受限于种子园产量的不稳定, 通过施肥、激素处理及树体管理等措施种子产量得到一定提高, 但未从根本上解决产量低、结实不稳定的情况。因此需要对落叶松的成花机理进行研究, 从而提高良种产量和稳定性。以杂种落叶松二代种子园为材料, 通过花期花量观测、形态解剖、激素测定、转录测序、外源激素处理等手段, 结合生殖芽形成到传粉全过程中形态水平、细胞水平、生理水平、基因表达水平的特征对杂种落叶松开花生物学特性, 花器官发育过程和成花诱导机理进行了研究, 为种子园高产稳产奠定理论基础。(1) 杂种落叶松花期为每年的4月10日左右到4月30日左右, 传粉期在4月25日前后, 传粉时雌配子体处于细胞化的游离核时期。在成熟雌雄球花和营养短枝的转录组中共鉴定出37条MIKC型的MADS-box基因。(3) 结合形态、解剖、生理和基因表达水平的特征确定了杂种落叶松成花诱导期, 并将杂种落叶松新生芽发育划分为6个阶段。(4) AP2/EREBP基因家族在成花诱导期显著富集, 表明该家族参与了落叶松成花诱导, 该时期的主要调控激素为赤霉素, 通过茎干注射可以提高枝条上新生芽的赤霉素含量, 处理时间越靠近成花诱导期促进结实效果越好。本地区杂种落叶松花芽形成时期在7月下旬至8月初, 在7月中下旬施加赤霉素能够调控落叶松开花相关基因的表达并提高结实量。

### Studies on the development of reproductive organs of hybrid larch

**Abstract:** The supply of improved varieties of larch is limited by the instability of seed orchard yield. The seed yield could be improved through fertilization, hormone treatment, tree management and other measures, but the situation of low yield and unstable seed setting has not been fundamentally solved. Therefore, it is necessary to study the flowering mechanism of larch, so as to improve the yield and stability of improved varieties. With the second generation seed orchard of hybrid larch as the material, the flowering biological characteristics, flower organ development process and flower induction mechanism were studied by means of flower volume observation, morphological anatomy, hormone determination, transcription sequencing, and exogenous hormone treatment, combined with the characteristics of morphological level, cell level, physiological level, and gene expression in the whole process from reproductive bud formation to pollination, establish a theoretical foundation for high and stable yield in seed orchards. The flowering period of hybrid larch is from April 10 to April 30 every year, and the pollination period is before or after April 25. The female gametophyte is in the stage of cellularized free nucleus during pollination. A total of 37 MIKC type MADS box genes were identified in the transcriptome of mature male and female cones and vegetative twigs. Combining the characteristics of morphology, anatomy, physiology and gene expression, the flower induction period of hybrid larch was determined, and the development of new buds was divided into six stages. (4) AP2/EREBP gene family was significantly enriched in the flowering induction period, indicating that this family was involved in the flowering induction of larch, and the main regulatory hormone in this period was gibberellin. The gibberellin content of new buds on branches could be increased by stem injection, and the closer the treatment time was to the flowering induction period, the better the effect of promoting seed setting was. The flower bud formation period of hybrid larch in this region is from late July to early August, and the application of gibberellin in the middle and late July can regulate the expression of flowering related genes of larch and increase the seed yield.