

马尾松二代无性系种子园子代父本分析及花粉散布

谭小梅^{1,2*}, 周志春^{1**}, 金国庆¹, 张一¹

¹中国林业科学研究院亚热带林业研究所, 浙江富阳 311400

²重庆市林业科学研究院, 重庆 400036

TAN Xiao-Mei^{1,2*}, ZHOU Zhi-Chun^{1**}, JIN Guo-Qing¹, and ZHANG Yi¹

¹Research Institute of Subtropical Forestry, Chinese Academy of Forestry, Fuyang, Zhejiang 311400, China

²Chongqing Academy of Forestry, Chongqing400036, China

- 摘要
- 参考文献
- 相关文章

Download: PDF (494KB) HTML (1KB) Export: BibTeX or EndNote (RIS) Supporting Info

摘要 目前国内较早建立的马尾松(*Pinus massoniana*)二代种子园正陆续进入正常开花结实期。研究马尾松二代种子园花粉散布和自由授粉子代的父本组成, 可为生产上指导马尾松高世代种子园的规划和遗传管理提供理论依据。该文利用筛选的11对SSR引物, 对马尾松二代无性系种子园内8个无性系单株的320个自由授粉子代和48个候选父本进行了扩增, 并采用最大似然法对子代进行父本分析。结果表明: 11个位点共检测到61个等位基因, 每个位点的等位基因数在2 - 11之间, 平均为5.55个。试验亲本和子代群体的总平均观测杂合度(H_o)、期望杂合度(H_e)及多态信息含量(PI_C)分别为0.428、0.433和0.387。在80%的可信度水平下可为232 (72.50%)个子代确定其父本。平均每个采种母树与19个父本产生子代。在自由授粉状态下, 马尾松二代种子园自交率为1.72%, 自交现象很弱, 其交配方式以异交为主。绝大多数亲本无性系的雄性繁殖适合度在1.00% - 4.00%之间, 候选父本平均繁殖适合度为2.17%, 平均形成5个后代。马尾松有效花粉的散布距离和固定交配距离的父本繁殖适合度均符合正态分布, 两者呈显著负相关, 其主要散布距离集中在0 - 100 m, 而检测到的最大散布距离为192 m。种子园花粉污染率较低, 仅为4.06%。总体看来, 树冠南面子代亲本交配距离较北面有增加的趋势, 但树冠南、北面子代父本组成并未表现明显的规律。

关键词: 雄性繁殖适合度 父本分析 马尾松 花粉散布 二代无性系种子园

Abstract: *Aims* The earlier second generation seed orchards of *Pinus massoniana* have been going to normal blossom stage in China. Our objective was to study the pollen dispersal and constitution of the male parents of open-pollination progenies to provide a theoretical basis for the design and genetic management of advanced generation seed orchards.

Methods We identified 320 open-pollination progenies from 8 clone individuals and 48 clones as candidate male parent using 11 polymorphic SSR loci. CERVUS was used to assign the paternity of each progeny based on maximum likelihood analysis.

Important findings We detected 61 alleles at 11 loci, and the number of alleles ranged from 2 to 11 (average of 5.55). The average observed and expected heterozygosity (H_o and H_e) were 0.428 and 0.433, respectively, and the average polymorphic information content (PI_C) was 0.387. Among 320 progenies, 232 progenies (75.50%) could be assigned paternity at a confidence level of 80%. Progenies were produced by each mother tree with 19 male trees. The self-crossing rate reached 1.72% in open-pollination condition, and outcrossing was the primary mating mode. The reproduction contribution varied from 1.00 to 4.00% for most male parents, with an average of 2.17% (produced 5 progenies). Strong negative correlation existed between pollination distance and reproductive success of male parents with the same mating distance. In accord with a normal distribution, the main pollination distance ranged from 0 to 100 m; maximum dispersal distance was 192 m. The pollen contamination ratio was 4.06%. Compared with the north progenies of crown, there was an increasing trend of the mating distance of parents in the south progenies of crown, while there was no obvious trend in the male parent numbers of the south and north progenies of crown.

Keywords: male reproductive success, paternity analysis, *Pinus massoniana*, pollen dispersal, second generation clonal seed orchard

收稿日期: 2011-03-08; 出版日期: 2011-09-01

基金资助:

Service

- ▶ 把本文推荐给朋友
- ▶ 加入我的书架
- ▶ 加入引用管理器
- ▶ Email Alert
- ▶ RSS

作者相关文章

- ▶ 谭小梅
- ▶ 周志春
- ▶ 金国庆
- ▶ 张一

引用本文:

谭小梅, 周志春, 金国庆, 张一. 马尾松二代无性系种子园子代父本分析及花粉散布. 植物生态学报, 2011,35(9): 937-945.

TAN Xiao-Mei, ZHOU Zhi-Chun, JIN Guo-Qing, ZHANG Yi. Paternity analysis and pollen dispersal for the second generation clonal seed orchard of *Pinus massoniana*. Chinese Journal of Plant Ecology, 2011,35(9): 937-945.

链接本文:

<http://www.plant-ecology.com/CN/10.3724/SP.J.1258.2011.00937> 或 <http://www.plant-ecology.com/CN/Y2011/V35/I9/937>

[1]

[2] Ai C (艾畅), Xu LA (徐立安), Lai HL (赖焕林), Huang MR (黄敏仁), Wang ZR (王章荣).2006.Genetic diversity and paternity analysis of a seed orchard in *Pinus massoniana*.Scientia Silvae Sinicae (林业科学,42: 146-150.

[3] Botstein D, White RL, Skolnick M, Davis RW.1980.Construction of a genetic linkage map in man using restriction fragment length polymorphisms.American Journal of Human Genetics,32: 314-331.


[4] Chaix G, Gerber S, Razafimaharo V, Vigneron P, Verhaegen D, Hamon S (2003).Gene flow estimating with microsatellites in a Malagasy seed orchard of *Eucalyptus grandis*. Theoretical and applied genetics, 107, 705-712.

[5] Chen XY (陈小勇), Song YC (宋永昌).1999.Individual reproductive contributions in a population of *Cyclobalanopsis glauca* in Huangshan.Acta ecologica sinica (生态学报,19: 677-682.

[6] Chen XY (陈小勇), Song YC (宋永昌).2001.Analysis of parentage for naturally established seedlings of *Cyclobalanopsis glauca*.Journal of wuhan botanical research (武汉植物学研究,18: 174-180.

[7] Chen XY (陈晓阳), Shen XH (沈熙环), Yang P (杨萍), Pan QM (潘奇敏), Li WG (李文刚).1995.A Study on Characteristics of Reproductive Phenology of Chinese Fir Seed Orchard.Journal of Beijing Forestry University (北京林业大学学报,17: 10-18.

[8] Clark MS, Gu HY (顾红雅), Qu LJ (瞿礼嘉) (1998).Plant Molecular Biology - A Laboratory Manual. CHEP & Springer press, 3-11.(in Chinese)

[9] Feng FJ, Sui X, Chen MM, Zhao D, Han SJ, Li MH.2010.Mode of pollen spread in clonal seed orchard of *Pinus koraiensis*.Journal of Biophysical Chemistry,1: 33-39. 

[10] Gerber S, Chabrier P, Kremer A (2002).Program note - famoz: a software for parentage analysis using dominant, codominant and uniparentally inherited markers. Mol.Ecol.Notes., 3, 470-481.

[11] Goto S, Miyahara F, Ide Y (2002).Identification of the male parents of half-sib progeny from Japanese black pine (*Pinus thunbergii* Parl.) clonal seed orchard using RAPD markers. Breeding Science, 52, 71-77.

[12] Hansen OK, Kj?r ED.2006.Paternity analysis with microsatellites in a Danish *Abies nordmanniana* clonal seed orchard reveals dysfunctions.Can. J. For. Res,36: 1054-1058. 

[13] He TH (何田华), Ge S (葛颂).2001.Mating system, paternity analysis and gene flow in plant populations.Acta Phytoecologica Sinica (植物生态学报,25: 144-154.

[14] Huang SQ (黄双全), Guo YH (郭友好).2000.Advances in the study of pollination biology.Chinese Science Bulletin (科学通报,45:225-237.

[15] Kalinowski ST.1099..Taper ML, Marshall TC (2007). Revising how the computer program CERVUS accommodates genotyping error increases success in paternity assignment. Mol. Ecol.,16:-.

[16] Lai HL (赖焕林), Wang ZR (王章荣).1997.A study on gene flow between a masson pine seed orchard and a plantation near the orchard.Journal of Nanjing Forest University (南京林业大学学报,21: 37-41.

[17] Marshall TC, Slate J, Kruuk LEB, Pemberton JM (1998).Statistical confidence for likelihood-based paternity inference in natural populations. Molecular Ecology, 7, 639-655.

[18] Shen XH (沈熙环) (1994).Creating Conditions for the Development of Advanced Generation Breeding: High-yield Technology of Seed Orchard. Beijing: Forestry Press of China, 15.(in Chinese)

[19] Snow AA, Lewis PO (1993).Reproductive traits and male fertility in plants: empirical approaches. Annu. Rev. Ecol. Syst, 24, 331-351.

[20] Sun YG (孙亚光), Li HG (李火根), Zhang HL (张红莲).2010.A case study of gamete selection and male reproduction fitness in *Liriodendron*.Chinese Bulletin of Botany (植物学报,45:52-58.

[21] Sun YG (孙亚光), Li HG (李火根).2007.The paternity analysis for open-pollination progenies of *Liriodendron* L.using SSR markers. Chinese Bulletin of Botany (植物学通报,24: 590-596.

[22] Sun YG (孙亚光), Li HG (李火根).2008.Variations of male reproductive success and sexual selection among individuals of the experimental population of *Liriodendron* revealed by SSR Markers.Molecular Plant Breeding (分子植物育种,6: 79-84.

[23] Whitehead DR (1983).Wind pollination: some ecological and evolutionary perspectives. In: L Real, ed. Pollination biology. Academic Press, Orlando, FL. 97-108.

- [24] Moriguchi Y, Tani N, Ito S, Kanehira F, Tanaka K, Yomogida H, Taira H, Tsumura Y. 2005. Gene flow and mating system in five *Cryptomeria japonica* D. Don seed orchards as revealed by analysis of microsatellite markers. *Tree Genetics & Genomes*, 1: 174-183.
- [25] Zhang DM (张冬梅), Shen XH (沈熙环), He TH (何田华). 2001. A paternity analysis of seeds from different clones in a *Pinus tabulaeformis* Carr seed orchard. *Acta Phytocologica Sinica* (植物生态学报), 25: 166-174.
- [26] Zhang DM (张冬梅), Sun PG (孙佩光), He TH (沈熙环), Ru GX (茹广欣). 2009. Paternity analysis of open- and control-pollinated seeds collected from a seed orchard of *Pinus tabulaeformis*. *Acta Phytocologica Sinica* (植物生态学报), 33: 302-310.
- [27] Zhang HX (张华新), Shen XH (沈熙环). 2002. Progress on reproductive system of forest seed orchards. *Scientia Silvae Sinicae* (林业科学), 38: 129-134.
- [28] Zhang W (张薇), Gong J (龚佳), Ji KS (季孔庶). 2009. Analyses on the mating system in seedling seed orchard of *Pinus massoniana*. *Scientia Silvae Sinicae* (林业科学), 45: 22-26.
- [29] Zhang ZW, Sui JJ, Mei L, Shu CQ. 2008. Pollen dispersal and its spatial distribution in a seed orchard of *Larix kaempferi* (Lamb.) Carr. *Silvae Genetica*, 57: 256-261.
- [30] Zhou Y, Bui T, Auckland LD (2002). Undermethylated DNA as a source of microsatellites from a conifer genome. *Genome*, 45, 91-99.
- [1] 张利锐, 彭艳玲, 任广朋, 周永锋, 李忠虎, 刘建全. 马尾松和黄山松两个核基因位点的群体遗传多样性和种间分化[J]. 植物生态学报, 2011, 35(5): 531-538
- [2] 张雷, 刘世荣, 孙鹏森, wang tongli. 气候变化对马尾松潜在分布影响预估的多模型比较[J]. 植物生态学报, 2011, 35(11): 0-0
- [3] 刘佳, 项文化, 徐晓, 陈瑞, 田大伦, 彭长辉, 方晰. 湖南会同5个亚热带树种的细根构型及功能特征分析[J]. 植物生态学报, 2010, 34(8): 938-945
- [4] 李志勇, 王彦辉, 于澎涛, 张治军, 杜士才, 何萍, 王祥, 段健, 李振华. 重庆酸雨区马尾松香樟混交林的土壤化学性质和林木生长特征[J]. 植物生态学报, 2010, 34(4): 387-395
- [5] 张冬梅, 孙佩光, 沈熙环, 茹广欣. 油松种子园自由授粉与控制授粉种子父本分析[J]. 植物生态学报, 2009, 33(2): 302-310
- [6] 马雪红, 周志春, 金国庆, 张一. 竞争对马尾松和木荷觅取异质分布养分行为的影响[J]. 植物生态学报, 2009, 33(1): 81-88
- [7] 李志勇, 陈建军, 王彦辉, 于澎涛, 杜士才, 何萍, 段健. 重庆酸雨区人工木荷林对土壤化学性质的影响[J]. 植物生态学报, 2008, 32(3): 632-638
- [8] 马雪红, 周志春, 张一, 金国庆. 杉木不同家系对异质养分环境的适应性反应差异[J]. 植物生态学报, 2008, 32(1): 189-196
- [9] 李轩然, 刘琪璟, 蔡哲, 马泽清. 千烟洲针叶林的比叶面积及叶面积指数[J]. 植物生态学报, 2007, 31(1): 93-101
- [10] 旷远文, 温达志, 周国逸, 张德强. 鼎湖山异龄马尾松针叶长度序列元素分布[J]. 植物生态学报, 2006, 30(1): 33-39
- [11] 莫江明, 彭少麟, Sandra BROWN, 方运霆, 孔国辉. 鼎湖山马尾松林植物养分积累动态及其对人为干扰的响应[J]. 植物生态学报, 2004, 28(6): 810-822
- [12] 项文化, 田大伦. 不同年龄阶段马尾松人工林养分循环的研究[J]. 植物生态学报, 2002, 26(1): 89-0
- [13] 陈劲松, 苏智先. 缙云山马尾松种群生物量生殖配置研究[J]. 植物生态学报, 2001, 25(6): 704-708
- [14] 莫江明, 孔国辉, Sandra BROWN, 方运霆, 张佑昌. 鼎湖山马尾松林凋落物及其对人类干扰的响应研究[J]. 植物生态学报, 2001, 25(6): 656-664
- [15] 张冬梅, 沈熙环, 何田华. 利用等位酶对油松无性系种子进行父本分析[J]. 植物生态学报, 2001, 25(2): 166-175