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杂交水稻专题

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前沿资讯

1．专家在PPR蛋白调控水稻花粉发育的分子机制研究中取得新进展

简介：近日，华南农业大学生命科学学院、亚热带农业生物资源保护与利用国家重点实验室、岭南现代农业科学与技术广东省实验室庄楚雄研究员团队在国际知名学术期刊New Phytologist（IF2020=10.151，生物学1区）在线发表了题为“A cytosolic pentatricopeptide repeat protein is essential for tapetal plastid development by regulating OsGLK1 transcript levels in rice”的研究论文。该研究揭示了PPR蛋白可以调控核编码转录因子mRNA的降解，同时揭示绒毡层质体发育与绒毡层PCD和降解的关系。五肽重复序列蛋白(pentatricopeptide repeat protein, PPR)，主要定位于质体或线粒体中，在参与RNA代谢和转录后调控细胞器基因表达中发挥功能。然而，PPR蛋白是否调控细胞核编码基因的表达尚不清楚。我们的研究发现了水稻中的一个PPR蛋白，OsCPPR1在花粉发育中的功能。与大多数其它PPR蛋白相比，OsCPPR1定位于细胞质中。下调OsCPPR1的表达导致绒毡层细胞质体发育异常，细胞程序性死亡（PCD）过程延长，绒毡层降解过程延长，花粉育性显著降低。通过转录组学分析，在OsCPPR1表达下调的植株中，编码调控质体发育和维持的转录因子OsGLK1的表达显著高于野生型。此外，在RNA免疫共沉淀和RNA电泳凝胶阻滞实验的结果表明，OsCPPR1与OsGLK1 mRNA的单链区域结合。且RLM-5′ RACE和RNA稳定性实验进一步表明OsCPPR1能降解OsGLK1 mRNA。值得注意的是，敲除OsGLK1基因的表达能够部分恢复OsCPPR1基因敲除植株的花粉育性，而OsGLK1基因过表达植株也表现出与OsCPPR1基因敲除植株相似的质体发育异常和绒毡层降解延迟。综上，我们的研究表明OsCPPR1通过直接调节OsGLK1 mRNA的降解，从而控制水稻花药质体的发育和绒毡层的PCD与降解过程。

来源：华南农业大学

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2．专家组揭示脂质转运蛋白通过脂质传递接力调控水稻花粉壁发育的分子机制

简介：3月21日，Journal of Genetics and Genomics（IF5Y2020：5.223）在线发表了题为“OsLTP47 may function in a lipid transfer relay essential for pollen wall development in rice”（https://doi.org/10.1016/j.jgg.2022.03.003）的研究论文。该研究揭示了一个花粉壁发育必需的脂质转移蛋白OsLTP47通过脂质传递接力调控水稻花粉壁发育的分子机制，拓宽了我们对脂质转运蛋白在花粉壁形成过程协同作用的认知。植物花粉壁为花粉提供了物理和化学的保护屏障，使得雄配子免受于各种环境的胁迫。水稻花粉壁发育过程需要花粉壁组分的正常合成和运输。目前涉及花粉壁组分合成的调控网络相对完善，但涉及花粉壁组分运输过程的调控网络尚不完善。该研究通过筛选钴60γ射线随机诱变获得一个雄性不育的水稻突变体，然后利用图位克隆、功能敲除和功能互补等手段，证实一个假定脂质转运蛋白基因OsLTP47是控制该突变表型的目标基因。通过亚细胞定位和体外脂质结合实验，发现OsLTP47编码的蛋白是一个定位于质膜的脂质转运蛋白。进一步利用酵母双杂交技术和Pull-down技术，发现OsLTP47与另外一个定位于花药绒毡层细胞质和绒毡层与小孢子外壁间小腔内的脂质转

运蛋白OsC6能够互作。接着，该研究通过GC-FID和GC-MS技术测定花药脂质成分，发现突变体存在脂质代谢混乱。最后，细胞学分析，发现相较于野生型植株，osltp47突变体的花粉壁发育存在明显的缺陷。综上所述，该研究揭示了两个不同位置的脂质转运蛋白OsLTP47和OsC6可能以接力方式协同运输花粉壁组分到花粉外壁的分子机制，为完善花粉壁组分的运输网络提供了重要的线索。

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3．专家团队揭示水稻种子萌发与耐盐性调控新机制

简介：近日，中国农业科学院生物技术所作物耐逆性调控与改良创新团队发现新的AP2家族转录因子OsSAE1，并揭示了其调控水稻种子萌发和耐盐性的分子途径，为培育耐盐直播稻新品种提供了新的基因资源。相关研究成果发表于《植物生理学（Plant Physiology）》上。土壤盐渍化是影响作物产量的一种重要的非生物胁迫因子，是农作物减产的主要原因之一。盐胁迫抑制作物生长发育，降低其存活率、生物量和产量。粮食作物中，水稻对盐胁迫最为敏感，尤其在萌发期和幼苗期，高盐胁迫将直接导致萌发率和出苗率降低。已有研究表明，植物激素脱落酸（ABA）参与应答盐胁迫，通过其信号途径调控种子萌发与活力。因此，分离鉴定耐盐基因，研究水稻耐盐与内源激素间的分子调控机制，对培育高产与耐盐性协同改良的水稻新品种具有重要意义。本研究在水稻中鉴定了一个新的AP2家族转录因子OsSAE1，研究发现，OsSAE1基因敲除植株的种子萌发延迟，萌发期和幼苗生长早期对ABA的敏感性增强，幼苗的耐盐性降低，而OsSAE1过表达植株则表现为种子萌发率和耐盐性增加。体内和体外实验表明，OsSAE1能够直接与ABA信号途径关键基因OsABI5的启动子相结合并抑制该基因的表达，从而促进水稻种子萌发并提高水稻幼苗的耐盐性。该研究揭示了OsSAE1参与水稻种子萌发与耐盐性调控的新机制，有助于在水稻耐盐直播品种选育的应用。

来源：中国农业科学院生物技术所

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学术文献

1．Identification of Heterotic Groups and Patterns Based on Genotypic and Phenotypic Characteristics Among Rice Accessions of Diverse Origins(基于不同来源水稻材料基因型和表型特征的杂种优势群和模式识别)

简介：Identification of the right parental combinations to maximize heterosis is the major goal of hybrid breeding, which could be achieved through identification of heterotic groups. The main objective of this study was to identify promising heterotic groups for future rice breeding programs. A collection of 359 rice genotypes of diverse origins of China and abroad,

composed of inbreds, maintainers, restorers, and temperature-sensitive genic male sterile (TGMS) lines were genotyped using 10K SNP chips. The SNP data set was subjected to genomic analyses for estimation of genetic divergence and diversity. Significant variations were observed in the germplasm with the identification of six different genetic groups. These lines were assigned to the genetic groups independent of their origin. Taking an account of commercially used heterotic groups present in each cluster, three cytoplasmic male sterile (CMS) lines and 14 inbred and restorer lines with moderate to high genetic distances selected from five heterotic patterns were crossed and obtained 42 F-1 hybrids. A total of 14 hybrids were found with significant maximum mid- and better-parent heterosis, namely, TaifengA x Guang122, TaifengA x Wushansimiao, and TaifengA x Minghui63 for earliness; Guang8A x Huazhan for dwarf stature; and Guang8A x Huanghuzhan-1, TaifengA x Yuexiangzhan, Guang8A x Minhui3301, TianfengA x Guang122, Guang8A x Yahui2115, TianfengA x Huanghuazhan, TianfengA x Minghui63, TianfengA x Minhui3301, TaifengA x Gui99, and Guang8A x Yuenongsimiao for yield and yield-related traits. Mid-parent and better-parent heterotic F1 hybrids were in positive correlation with the genetic distances as that manifested by commercially used heterotic groups, encouraging the use of genotypic data for identification of heterotic groups. Our study provides an informative strategy for the development of early maturing, lodging resistant and high-yielding commercial hybrids and cultivars in future heterosis breeding programs.

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2. Solar radiation-use characteristics of indica_japonica hybrid rice (Oryza sativa L.) in the late season in southeast China（东南地区籼粳杂交稻（Oryza sativa L.）晚季太阳辐射利用特征）

简介：New indica and japonica hybrid rice cultivars, such as the Yongyou series, provide farmers with very high yield potential. However, information on their canopy light capture and solar radiation use efficiency in the late season is limited. Field experiments were performed to compare the radiation-use parameters of four rice types: indica rice (IR), inbred japonica rice (IJR), hybrid japonica rice (HJR), and hybrid indica/japonica rice (HIJR), from 2016 to 2018 during the late season in Hangzhou, China. The grain yield, aboveground biomass, intercepted solar radiation (SI), and radiation-use efficiency (RUE) of the HIJR were on average respectively 13.4%-53.4%, 14.3%-30.6%, 7.6%-21.4%, and 8.2%-14.9% higher than those of the HJR, IJR, and IR. The leaf area index (LAI) of the HIJR was 18.2%-57.0% greater than that of the IJR and HJR at four growth stages, resulting in respectively 17.8%-38.5% and 10.7%-42.8% greater canopy light interception rates (LIR) and amount of intercepted solar radiation during the vegetative stage. The prolonged grain-filling stage also led to respectively 33.9%-52.6% and 30.5%-51.4% increases in amounts of incident and intercepted radiation for the HIJR relative to the IR during grain filling. These results indicate that the SI superiority of the HIJR was caused by canopy

closure as rapid as that of the IR during the vegetative stage (greater LAI and canopy LIR during the growing season) and a grain-filling stage as long as that of the HJR. For grain-filling stage, differences in leaf P-n between HIJR, IR, and IJR were not significant, suggesting that the greater RUE of the HIJR (12.7%-52.8% higher) than that of the other rice types resulted from improved canopy architecture after flowering (FL). Principal components analysis (PCA) revealed that the superiority of the HIJR in terms of solar radiation use resulted from the greater canopy light capture capability of IR and the prolonged growth period (especially during grain filling) of japonica rice in the late growing season. (C) 2020 Crop Science Society of China and Institute of Crop Science, CAAS. Production and hosting by Elsevier B.V. on behalf of KeAi Communications Co., Ltd.

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