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前沿资讯

1．专家团队揭示水稻株型调控新机制

简介：近日，华南农业大学国家植物航天育种工程技术研究中心陈志强教授团队在国际著名学术期刊New Phytologist（影响因子10.323）在线发表了题为“The DnaJ Domain-containing Heat Shock Protein NAL11 Determines Plant Architecture by Mediating GA homeostasis in Rice (Oryza sativa L.)”的学术论文。解析了热激蛋白NAL11通过调控赤霉素（GA）稳态影响水稻株型建成的机制，并揭示了水稻株型调控中存在的微调与平衡机制。株型是水稻产量的关键因素。团队前期鉴定了调控水稻株型的热激蛋白基因NAL11（NARROW LEAF 11），在此基础上，本研究挖掘了其具备育种潜力的稀有等位型NAL11-923del-1552，其相对较高的表达水平，促进了“少蘖、大穗、壮杆”的理想株型建成。进一步的功能解析，明确了NAL11参与赤霉素的稳态调节，影响细胞周期和细胞增殖，从而介导水稻株型的调控。有趣的是，通过分子与遗传研究发现，重要的理想株型基因IPA1，作为转录因子可直接结合至NAL11-923del-1552所缺失的片段中并下调NAL11的表达。而NAL11-923del-1552因缺失了IPA1的3个结合元件，部分避开了IPA1对其的负调节作用，从而保障了水稻相对较高的赤霉素活性与生物量。该研究揭示了一种水稻株型调控的微调与平衡机制，且为缓解伴随IPA1的育种利用带来的赤霉素缺陷提供了一种积极策略。本研究揭示了水稻株型调控中存在的一种微调与平衡机制，即在含IPA1优势等位的材料中，负调控NAL11表达保障了一定的分蘖数和产量，而在不含IPA1优势等位的材料中，NAL11的增强表达促进了理想株型建成，两者协同调控水稻株型。此外，本研究还发掘了NAL11的稀有优异等位型，在籼稻和粳稻的现有品种中还少有渗入，在水稻育种中仍具备良好的应用前景。该研究的主要学术贡献：（1）揭示了热激蛋白调控水稻株型的作用机制，拓宽了对热激蛋白影响植物生长发育的认知。（2）发掘了优异等位型NAL11-923del-1552，丰富了水稻株型育种的遗传资源。（3）揭示了NAL11-923del-1552促进“少蘖、大穗、壮杆”理想株型建成与IPA1之间的调控关系，并从赤霉素途径阐述了二者的作用机制。（4）探讨了自然变异NAL11-923del-1552在水稻株型建成与育种利用中的生物学意义。

来源：华南农业大学

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全文链接:

http://agri.ckcest.cn/file1/M00/03/47/CsgkOYgDygGAWRY3AAL35qhsOHQ636.pdf

2．专家团队培育出“三抗”优质水稻品种

简介：11月30日，农业农村部发布第625号公告，中国科学院亚热带农业生态研究所申报的杂交稻新品种科贵优4302通过国家农作物品种审定委员会审定。科贵优4302（国审稻20220226）由亚热带生态所为主，联合广东省农业科学院水稻研究所和中国种子集团有限公司合作选育。科贵优4302在长江中下游稻区晚稻区试中表现为中抗稻瘟病、中抗白叶枯病、中抗褐飞虱，同时，品质达到部标优质三级，产量比对照增产1.9%，是我国目前通过审定的第一个抗这三种病虫害的优质水稻品种。亚热带生态所水稻分子育种团队致力于水稻多抗性状的分子设计育种研究，采用常规育种与分子育种技术紧密结合的育种方法，发挥分子育种技术在改良抗性等质量性状中的作用，在一个品种中聚集至少三种具有重要生产应用价值的抗性，为水稻育种树立了新的技术标杆。同时，中国种子

集团有限公司利用亚热带生态所培育的“三抗”恢复系R4312，选育出“双抗”、优质、高产杂交中稻新品种呈两优4312，并通过国审（国审稻20220111）。它在长江中下游稻区中稻区试中表现为中抗稻瘟病、中抗褐飞虱，同时，米质达到部标优质2级，产量比对照增产4.1%。该团队负责人肖国樱表示，要继续加强与全国各地研究院所和企业的交流合作，将培育的“三抗”亲本授权给相关单位配组，提高多抗、优质、高产杂交稻的育种技术水平。

来源：中国科学院

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全文链接:

http://agri.ckcest.cn/file1/M00/10/19/CsgkOGOs_9mATFnFAAQFce8ZsVo581.pdf

学术文献

1. Nitrogen Use Traits of Different Rice for Three Planting Modes in a Rice-Wheat Rotation System(稻麦轮作三种种植模式下不同水稻氮素利用特性)

简介：At present, there is a limited understanding of nitrogen (N) accumulation, translocation, and utilization in different types of rice grown using different planting methods in a ricewheat rotation system. Systematic experiments were conducted with six rice cultivars, including two japonica-indica hybrids (JIHR), two japonica conventional rice (JCR) cultivars, and two indica hybrid rice (IHR) cultivars, to study the effects on N use of plants in three transplanting modes: (1) the pothole seedling machine transplanting mode (PM), (2) the carpet seedling machine transplanting mode (CM), and (3) the mechanical direct seeding mode (DM). Results showed that at stem elongation stage, for N content and uptake, the planting methods were ranked in the order PM < CM < DM, and at heading and maturity the order was PM > CM > DM. After stem elongation the rankings for N accumulation, ratio of N accumulation to total N, and N uptake rate were PM > CM >DM. Thus, on the basis of a certain amount of N accumulation in the early growth phase, increasing the N uptake rate and N accumulation in the middle and late growth phases are ways to increase total N uptake for the PM and CM modes compared to DM. In addition, the PM/JIHR treatment had the highest N uptake at maturity. The N contents of leaves, stem-sheaths, and panicles at heading and maturity for the three planting modes were ranked PM > CM > DM. Moreover, the N translocation amount, apparent N translocation rate, and translocation conversion rate of leaves under PM were significantly higher than for CM and DM, which would increase N accumulation in the grain. The N uptake per 100 kg grain and the partial factor productivity of applied N under PM were larger than for CM and DM, but the N use efficiency of grain yield and biomass were smaller for PM than for CM and DM. In conclusion, rice grown using PM, especially JIHR, had higher total N uptake and N utilization compared to the CM and DM modes, and cultivation measures to improve the N use efficiency of grain yield and biomass could be appropriately applied to further improve N use in a ricewheat rotation system.

来源：Agriculture

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2. Optimized Management Practices Synergistically Improved Grain Yield and Nitrogen Use Efficiency by Enhancing Post-Heading Carbon and Nitrogen Metabolism in Super Hybrid Rice(优化管理实践通过提高超级杂交稻抽穗后碳氮代谢协同提高籽粒产量和氮素利用效率)

简介：The super hybrid rice breeding program in China has raised genetic yield ceilings through morphological improvements and inter-subspecific heterosis. Despite this, little information on the physiological basis underlying this yield transformation exists, and less so on the genotype x environment x management conditions enabling consistent yield gains. Here, we assess grain yield, photosynthetic physiology, and leaf carbon and nitrogen (N) metabolic properties of super rice (Y-liangyou900) under four management practices (i.e., zero-fertilizer control, CK; farmers' practice, FP; high-yield and high-efficiency management, OPT1; and super-high-yield management, OPT2) using a field experiment conducted over five years. Grain yield and agronomic N use efficiency (AEN) of OPT2 were 15% and 10% higher than OPT1, and 30% and 78% higher than FP, respectively. The superior yields of OPT2 were attributed to higher source production capacity, that is, higher leaf photosynthetic rate, carbon metabolic enzyme activity (i.e., AGP and SPS), nitrogen metabolic enzyme activity (i.e., NR, GS, and GOGAT), soluble protein and sugar content, and delayed leaf senescence (the latter due to elevated activity of protective enzyme systems) during grain filling. The higher AEN of OPT2 was associated with higher activity of leaf carbon metabolic enzyme (i.e., AGP and SPS), nitrogen metabolic enzyme (i.e., NR, GS, GDH, and GOGAT) and protective enzyme (POD) after heading, and lower C/N ratio in grains. We conclude that optimized management (optimized water and fertilizer management with appropriate dense planting) improved grain yield and N use efficiency simultaneously by enhancing post-heading leaf carbon and N metabolism and delayed leaf senescence.
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http://agri.ckcest.cn/file1/M00/10/19/CsgkOGOtLIuAVxGfAFeJQfs469s750.pdf

3. Genomic revolution of US weedy rice in response to 21st century agricultural technologies(应对21世纪农业技术的美国杂草稻基因组革命)

简介：Weedy rice is a close relative of cultivated rice that devastates rice productivity worldwide. In the southern United States, two distinct strains have been historically predominant, but the 21(st) century introduction of hybrid rice and herbicide resistant rice technologies has dramatically altered the weedy rice selective landscape. Here, we use

whole-genome sequences of 48 contemporary weedy rice accessions to investigate the genomic consequences of crop-weed hybridization and selection for herbicide resistance. We find that population dynamics have shifted such that most contemporary weeds are now crop-weed hybrid derivatives, and that their genomes have subsequently evolved to be more like their weedy ancestors. Haplotype analysis reveals extensive adaptive introgression of cultivated alleles at the resistance gene ALS, but also uncovers evidence for convergent molecular evolution in accessions with no signs of hybrid origin. The results of this study suggest a new era of weedy rice evolution in the United States.

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