2023年第21期总269期

# 小麦遗传育种专题

## 本期导读

### 前沿资讯

1．硬粒小麦产量及品质性状的田间评价

2．不同管理措施对面包小麦品质的农场影响:以雅基谷为例

3．四倍体硬粒小麦高、低分子量谷蛋白亚基与谷蛋白强度的关系

4．四倍体小麦基因型中硫酸盐和硒酸盐的相互作用

### 学术文献

1.谷蛋白和嘌呤蛋白在改善小麦籽粒品质中的作用研究进展

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## 前沿资讯

### 1 .On-farm assessment of yield and quality traits in durum wheat(硬粒小麦产量及品质性状的田间评价)

简介：Background:  Durum wheat is key source of calories and nutrients for many regions of the world. Demand for it is predicted to increase. Further efforts are therefore needed to develop new cultivars adapted to different future scenarios. Developing a novel cultivar takes, on average, 10 years and advanced lines are tested during the process, in general, under standardized conditions. Although evaluating candidate genotypes for commercial release under different on-farm conditions is a strategy that is strongly recommended, its application for durum wheat and particularly for quality traits has been limited. This study evaluated the grain yield and quality performance of eight different genotypes across five contrasting farmers' fields over two seasons. Combining different analysis strategies, the most outstanding and stable genotypes were identified. Results:  The analyses revealed that some traits were mainly explained by the genotype effect (thousand kernel weight, flour sodium dodecyl sulfate sedimentation volume, and flour yellowness), others by the management practices (yield and grain protein content), and others (test weight) by the year effect. In general, yield showed the highest range of variation across genotypes, management practices, and years and test weight the narrowest range. Flour yellowness was the most stable trait across management conditions, while yield-related traits were the most unstable. We also determined the most representative and discriminative field conditions, which is a beneficial strategy when breeders are constrained in their ability to develop multi-environment experiments. Conclusions:  We concluded that assessing genotypes in different farming systems is a valid and complementary strategy for on-station trials for determining the performance of future commercial cultivars in heterogeneous environments to improve the breeding process and resources.

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http://agri.ckcest.cn/file1/M00/03/59/CsgkOYi4xjKAKtaEABfhtCgJCOA920.pdf

### 2 . On-farm impact on bread wheat quality under different management practices: a case study in the Yaqui Valley(不同管理措施对面包小麦品质的农场影响:以雅基谷为例)

简介：Background:  Continuous development of new wheat varieties is necessary to satisfy the demands of farmers, industry, and consumers. The evaluation of candidate genotypes for commercial release under different on-farm conditions is a strategy that has been strongly recommended to assess the performance and stability of new cultivars in heterogeneous environments and under different farming systems. The main objectives of this study were to evaluate the grain yield and quality performance of ten different genotypes across six contrasting farmers' field conditions with different irrigation and nitrogen fertilization levels, and to develop suggestions to aid breeding programs and

farmers to use resources more efficiently. Genotype and genotype by environment (GGE) interaction biplot analyses were used to identify the genotypes with the strongest performance and greatest stability in the Yaqui Valley. Results: Analyses showed that some traits were mainly explained by the genotype effect, others by the field management conditions, and the rest by combined effects. The most representative and diverse field conditions in the Yaqui Valley were also identified, a useful strategy when breeders have limited resources. The independent effects of irrigation and nitrogen levels and their interaction were analyzed for each trait. The results showed that full irrigation was not always necessary to maximize grain yield in the Yaqui Valley. Other suggestions for more efficient use of resources are proposed. Conclusions: The combination of on-farm trials with GGE interaction analyses is an effective strategy to include in breeding programs to improve processes and resources. Identifying the most outstanding and stable genotypes under real on-farm systems is key to the development of novel cultivars adapted to different management and environmental conditions.

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## 3．Association of High and Low Molecular Weight Glutenin Subunits with Gluten Strength in Tetraploid Durum Wheat ( Triticum turgidum spp. Durum L.)（四倍体硬粒小麦高、低分子量谷蛋白亚基与谷蛋白强度的关系）

**简介：**The gluten strength and the composition of high- and low-molecular-weight glutenin subunits (HMWGSs and LMWGSs) of fifty-one durum wheat genotypes were evaluated using sodium dodecyl sulfate (SDS) sedimentation testing and SDS polyacrylamide gel electrophoresis (SDS-PAGE). This study examined the allelic variability and the composition of HMWGSs and LMWGSs in T. durum wheat genotypes. SDS-PAGE was proven to be a successful method for identifying HMWGS and LMWGS alleles and their importance in determining the dough quality. The evaluated durum wheat genotypes with HMWGS alleles 7+8, 7+9, 13+16, and 17+18 were highly correlated with improved dough strength. The genotypes containing the LMW-2 allele displayed stronger gluten than those with the LMW-1 allele. The comparative in silico analysis indicated that Glu-A1, Glu-B1, and Glu-B3 possessed a typical primary structure. The study also revealed that the lower content of glutamine, proline, glycine, and tyrosineand the higher content of serine and valine in the Glu-A1 and Glu-B1 glutenin subunits, and the higher cysteine residues in Glu-B1 and lower arginine, isoleucine, and leucine in the Glu-B3 glutenin, are associated with the suitability of durum wheat for pasta making and the suitability of bread wheat with good bread-making quality. The phylogeny analysis reported that both Glu-B1 and Glu-B3 had a closer evolutionary relationship in bread and durum wheat, while the Glu-A1 was highly distinct. The results of the current research may help breeders to manage the quality of durum wheat genotypes by exploiting the allelic variation in glutenin. Computational analysis

showed the presence of higher proportions of glutamine, glycine, proline, serine, and tyrosine than the other residues in both HMWGSs and LMWGSs. Thus, durum wheat genotype selection according to the presence of a few protein components effectively distinguishes the strongest from the weakest types of gluten.

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### 4．Interaction between Sulfate and Selenate in Tetraploid Wheat (Triticum turgidum L.) Genotypes（四倍体小麦基因型中硫酸盐和硒酸盐的相互作用）

**简介：**Selenium (Se) is an essential micronutrient of fundamental importance to human health and the main Se source is from plant-derived foods. Plants mainly take up Se as selenate ($SeO_4^{2-}$), through the root sulfate transport system, because of their chemical similarity. The aims of this study were (1) to characterize the interaction between Se and S during the root uptake process, by measuring the expression of genes coding for high-affinity sulfate transporters and (2) to explore the possibility of increasing plant capability to take up Se by modulating S availability in the growth medium. We selected different tetraploid wheat genotypes as model plants, including a modern genotype, Svevo (Triticum turgidum ssp. durum), and three ancient Khorasan wheats, Kamut, Turanicum 21, and Etrusco (Triticum turgidum ssp. turanicum). The plants were cultivated hydroponically for 20 days in the presence of two sulfate levels, adequate (S = 1.2 mM) and limiting (L = 0.06 mM), and three selenate levels (0, 10, 50 μM). Our findings clearly showed the differential expression of genes encoding the two high-affinity transporters (TdSultr1.1 and TdSultr1.3), which are involved in the primary uptake of sulfate from the rhizosphere. Interestingly, Se accumulation in shoots was higher when S was limited in the nutrient solution.

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## 学术文献

### 1．Recent developments on the contribution of glutenin and puroindoline proteins to improve wheat grain quality（谷蛋白和嘌呤蛋白在改善小麦籽粒品质中的作用研究进展）

**简介：**Background and Objectives: Wheat is most staple food crop for making different end products. The major factors determining the wheat flour end-use are glutenins and puroindolines. It is very important to identify the composition, variation, and functional

characteristics of these key factors. Findings: The glutenin subunits comprise two subgroups—high molecular weight glutenin subunits (HMW-GS), and low molecular weight glutenin subunits (LMW-GS). Puroindolines genes depict a wide diversity of both PINA and PINB allelic forms. The prevalence and relative proportions of these types may vary depending on several genetic and environmental factors. Conclusion: Current review summarizes recently published research on the impact of glutenin genes governing gluten strength and puroindolines genes related to grain softness. It encompasses recent reports on the development of DNA-based molecular markers utilized to identify novel alleles associated with HMW-GS, LMW-GS, and puroindoline genes in diverse wheat genotypes. Significance and Novelty: Substantial advancements have been made to identify associations between gene expression and grain quality and to develop improved wheat grain quality lines. Nevertheless, a novel marker system such as multiplex polymerase chain reaction and high throughput analysis is needed to screen large numbers of markers at low cost for rapid and precise analysis of germplasm, mapping, and marker-assisted selection.
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