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小麦遗传育种专题

本期导读

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1. 一种面包面条兼用型红皮高硬度强筋小麦的育种方法

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学术文献

1 . Wheat DOF transcription factors TaSAD and WPBF regulate glutenin gene expression in cooperation with SPA (小麦DOF转录因子TaSAD和WPBF与SPA协同调控谷蛋白基因表达)

简介: Grain storage proteins (GSPs) quantity and composition determine the end-use value of wheat flour. GSPs consists of low-molecular-weight glutenins (LMW-GS), high-molecular-weight glutenins (HMW-GS) and gliadins. GSP gene expression is controlled by a complex network of DNA-protein and protein-protein interactions, which coordinate the tissue-specific protein expression during grain development. The regulatory network has been most extensively studied in barley, particularly the two transcription factors (TFs) of the DNA binding with One Finger (DOF) family, barley Prolamin-box Binding Factor (BPBF) and Scutellum and Aleurone-expressed DOF (SAD). They activate hordein synthesis by binding to the Prolamin box, a motif in the hordein promoter. The BPBF ortholog previously identified in wheat, WPBF, has a transcriptional activity in expression of some GSP genes. Here, the wheat ortholog of SAD, named TaSAD, was identified. The binding of TaSAD to GSP gene promoter sequences in vitro and its transcriptional activity in vivo were investigated. In electrophoretic mobility shift assays, recombinant TaSAD and WPBF proteins bound to cis-motifs like those located on HMW-GS and LMW-GS gene promoters known to bind DOF TFs. We showed by transient expression assays in wheat endosperms that TaSAD and WPBF activate GSP gene expression. Moreover, co-bombardment of Storage Protein Activator (SPA) with WPBF or TaSAD had an additive effect on the expression of GSP genes, possibly through conserved cooperative protein-protein interactions.

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<http://agri.nais.net.cn/file1/M00/03/6A/Csgk0WW7PuuAHa6eABjitxzgYkY651.pdf>

2 . Evaluating Total Phenolic Content, Antioxidant Activity, High Molecular Weight Glutenin Subunits (HMW-GS), and Grain Yield Parameters of Cultivated Wheat and Hybrids (栽培小麦和杂交品种总酚含量、抗氧化活性、高分子量谷蛋白亚基(HMW-GS)和产量参数的评价)

简介: This study was conducted to assess the high molecular weight glutenin subunits (HMW-GS), yield, total phenolic content (TPC), and antioxidant capacity using five assays: free radical scavenging (DPPH and ABTS), reducing power (CUPRAC and FRAP), and phosphomolybdenum. Wheat species, old cultivar, landrace, and hybrid wheat genotypes were compared with adaptive modern bread and durum wheat cultivars. Under rainfed conditions, high grain yield was particularly obtained from *T. turanicum*, *T. polonicum*, and *T. compactum* wheat species, as *T. spelta*, *T. compactum*, *T. turanicum*, *T. turgidum*, and *T. polonicum* were better performed to grain yield under irrigated conditions. In the study, the

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wheat genotypes, *T. petropavlovskyi*, *T. spelta*, *T. sphaerococcum*, *T. compactum*, Yektay 406, Ak 702, Köse 220/39, and wheat hybrids were found to have the HMW-GS 2+12inGlu-D1in relation to low quality. The Yellowstone wheat cultivar carried high-quality alleles together for 1 in Glu-A1 and 5+10 in Glu-D1. The study exhibited that *T. monococcum* (einkorn), *T. spelta* (spelt), *T. dicoccum* (emmer), and Yektay 406 (old cultivar) for better antioxidant capacity were displayed together in the same cluster of the dendrogram constructed by DPPH, ABTS, CUPRAC, FRAP, and phosphomolybdenum assay results. In addition, significant correlations were observed between TPC, ABTS, CUPRAC, FRAP, and phosphomolybdenum. The study suggested that ancient wheat species superior to the investigated characteristics had antioxidants beneficial for healthy nutrition and may also be used in the improvement of cultivars with high yield and quality.

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3 .The conformation of glutenin polymers in wheat grain: some genetic and environmental factors associated with this important characteristic (小麦中谷蛋白聚合物的构象: 与这一重要特征相关的一些遗传和环境因素)

简介: In a previous study we used asymmetric-flow field-flow fractionation to determine the polymer mass (M_w), gyration radius (R_w) and the polydispersity index of glutenin polymers (GPs) in wheat (*Triticum aestivum*). Here, using the same multi-location trials (4 years, 11 locations, and 192 cultivars), we report the factors that are associated with the conformation (Conf) of the polymers, which is the slope of $\text{Log}(R_w)$ versus a function of $\text{Log}(M_w)$. We found that Conf varied between 0.285 and 0.740, it had low broad-sense heritability ($H^2=16.8$), and it was significantly influenced by the temperature occurring over the last month of grain filling. Higher temperatures were found to increase R_w and the compactness and sphericity of GPs. Alleles for both high- and low-molecular-weight glutenin subunits had a significant influence on the Conf value. Assuming a Gaussian distribution for M_w , the number of polymers present in wheat grains was computed for different kernel weights and protein concentrations, and it was found to exceed 10^{12} GPs per grain. Using atomic force microscopy and cryo-TEM, images of GPs were obtained for the first time. Under higher average temperature, GPs became larger and more spherical and consequently less prone to rapid hydrolysis. We propose some orientations that could be aimed at potentially reducing the impact of numerous GPs on people suffering from non-celiac gluten sensitivity.

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4 . Purification and immunoglobulin E epitopes identification of low molecular weight glutenin: an allergen in Chinese wheat (中国小麦过敏原低分子量麦谷蛋白的纯化及免疫球蛋白E表位鉴定)

简介: As one of the most important cereals, wheat (*Triticum aestivum*) has high nutritional value and is widely cultivated in China. However, wheat can cause severe allergic reactions, and a growing number of people are developing allergies to Chinese wheat. Low molecular weight glutenin (LMW-GS), an important allergen in susceptible populations, is responsible for celiac disease and wheat contacts dermatitis. In this study, LMW-GS was highly purified from Chinese wheat (Xiaoyan 6) and further identified and characterized. In addition, 8 peptides were predicted efficiently by 5 immunological tools, among which five peptides showed significant immunoglobulin E binding abilities. Two specific epitopes were found to be in the non-conserved region of the amino acid sequence of LMW-GS, which was speculated to be the specific epitope of Chinese wheat. This systematic research of LMW-GS may provide new insights into the prevention of wheat allergy and development of hypoallergenic wheat products.

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➤ 相关专利

1. 一种面包面条兼用型红皮高硬度强筋小麦的育种方法

简介: 本发明公开了一种面包面条兼用型红皮高硬度强筋小麦育种方法,以携带高硬度基因(Pin)、优质高分子量谷蛋白亚基(HMW-GS)或Wx基因部分缺失材料为亲本,创制长江中下游麦区当前主栽红皮小麦品种背景的携不同优质基因材料,并进一步杂交、回交或复交;综合利用高通量分子标记检测,明确红皮强筋小麦品质评价指标和标准,高效全面品质跟踪测试,培育聚合高硬度基因(Pin),优质高分子量谷蛋白亚基(HMW-GS)和Wx基因部分缺失3个优质分子模块基因材料,定向设计改良红皮高硬度强筋小麦品质;同时加强产量性状和综合农艺鉴定,实现红皮强筋小麦产量和质量协同改良。本方法极大提高了面包面条兼用型红皮高硬度强筋小麦育种效率和精确性。

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