2023年第51期总299期

小麦遗传育种专题

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前沿资讯

1．Characterization of durum wheat resistance against leaf rust under climate change conditions of increasing temperature and [CO_2]（升温和[CO_2]气候变化条件下硬粒小麦抗叶锈病特性研究）

简介：Durum wheat cultivation in Mediterranean regions is threatened by abiotic factors, mainly related to the effects of climate change, and biotic factors such as the leaf rust disease. This situation requires an in-depth knowledge of how predicted elevated temperatures and [CO_2] will affect durum wheat-leaf rust interactions. Therefore, we have characterised the response of one susceptible and two resistant durum wheat accessions against leaf rust under different environments in greenhouse assays, simulating the predicted conditions of elevated temperature and [CO_2] in the far future period of 20702099 for the wheat growing region of Cordoba, Spain. Interestingly, high temperature alone or in combination with high [CO_2] did not alter the external appearance of the rust lesions. However, through macro and microscopic evaluation, we found some host physiological and molecular responses to infection that would quantitatively reduce not only pustule formation and subsequent infection cycles of this pathogen, but also the host photosynthetic area under these predicted weather conditions, mainly expressed in the susceptible accession. Moreover, our results suggest that durum wheat responses to infection are mainly driven by temperature, being considered the most hampering abiotic stress. In contrast, leaf rust infection was greatly reduced when these weather conditions were also conducted during the inoculation process, resembling the effects of possible heat waves not only in disease development, but also in fungal germination and penetration success. Considering this lack of knowledge in plant-pathogen interactions combined with abiotic stresses, the present study is, to the best of our knowledge, the first to include the effects of the expected diurnal variation of maximum temperature and continuous elevated [CO2] in the durum wheat-leaf rust pathosystem.

来源：Nature

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http://agri.nais.net.cn/file1/M00/10/35/CsgkOGV6ZNaAVDlpAB9VavC1RwI901.pdf

学术文献

1．A null allele of the polyphenol oxidase gene Ppo-A1 in hexaploid wheat originates from tetraploid wheat（来源于四倍体小麦的六倍体小麦多酚氧化酶基因Ppo-A1的一个空等位基因）

简介：Polyphenol oxidase (PPO) has a major effect on the time-dependent darkening of noodle products. Development of varieties with low PPO activity is one method to eliminate this problem and respond to the demands of consumers. Among the common wheat (Triticum aestivum L.) Ppo genes, Ppo-A1 has the highest effect on grain PPO activity, and

several Ppo-A1 alleles with low or no activity have been reported, with the recently identified Ppo-A1i allele being the most desirable allele. In this study, reverse-transcription polymerase chain reaction analysis confirmed that this allele was not expressed and was therefore functionally null. We also determined that Ppo-A1i has an approximately 3 kb insertion in the second intron. Taking advantage of the insertion sequence, we developed a new co-dominant marker, PPO18Plus, capable of distinguishing Ppo-A1a, Ppo-A1b, and Ppo-A1i. In addition, we determined that the Ppo-A1i allele is identical to and originates from the Ppo-A1g allele of tetraploid wheat. The durum wheat (Triticum turgidum ssp. durum (Desf.) Husn.) Ppo-A1g allele has been used to improve pasta color in durum wheat breeding programs. Thus, the PPO18Plus marker developed here will be very useful in both hexaploid and durum wheat breeding programs.

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http://agri.nais.net.cn/file1/M00/10/35/CsgkOGV6aXyAJ72eABNJwGwishY514.pdf

2．Genetics of a diverse soft winter wheat population for pre-harvest sprouting, agronomic, and flour quality traits(不同软质冬小麦群体收获前发芽、农艺和面粉品质性状的遗传)

简介： Soft winter wheat has been adapted to the north-central, north-western, and south-central United States over hundreds of years for optimal yield, height, heading date, and pathogen and pest resistance. Environmental factors like weather affect abiotic traits such as pre-harvest sprouting resistance. However, pre-harvest sprouting has rarely been a target for breeding. Due to changing weather patterns from climate change, pre-harvest sprouting resistance is needed to prevent significant crop losses not only in the United States, but world-wide. Twenty-two traits including age of breeding line as well as agronomic, flour quality, and pre-harvest sprouting traits were studied in a population of 188 lines representing genetic diversity over 200 years of soft winter wheat breeding. Some traits were correlated to one another by principal components analysis and Pearson's correlations. A genome-wide association study using 1978 markers uncovered a total of 102 regions encompassing 226 quantitative trait nucleotides. Twenty-six regions overlapped multiple traits with common significant markers. Many of these traits were also found to be correlated by Pearson's correlation and principal components analyses. Most pre-harvest sprouting regions were not co-located with agronomic traits and thus useful for crop improvement against climate change without affecting crop performance. Six different genome-wide association statistical models (GLM, MLM, MLMM, FarmCPU, BLINK, and SUPER) were utilized to search for reasonable models to analyze soft winter wheat populations with increased markers and/or breeding lines going forward. Some flower quality and agronomic traits seem to have been selected over time, but not pre-harvest sprouting. It appears possible to select for pre-harvest sprouting resistance without impacting flour quality or the agronomic value of soft winter wheat.

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http://agri.nais.net.cn/file1/M00/03/62/CsgkOWV6aiqAAfU6ADIMJAV6bvs079.pdf

3．Genetic variation for terminal heat stress tolerance in winter wheat(冬小麦末端耐热性的遗传变异)

简介：In many regions worldwide wheat (Triticum aestivum L.) plants experience terminal high temperature stress in the grain filling stage, which is a leading cause for single seed weight decrease and consequently for grain yield reduction. An essential approach to mitigate high temperature damage is to develop tolerant cultivars using the conventional breeding approach which involves identifying tolerant lines and then incorporating the tolerant traits in commercial varieties. In this study, we evaluated the terminal heat stress tolerance of 304 diverse elite winter wheat lines from wheat breeding programs from the US, Australia, and Serbia in controlled environmental conditions. Chlorophyll content and yield traits were measured and calculated as the percentage of non-stress control. The results showed that there was significant genetic variation for chlorophyll retention and grain weight under heat stress conditions. The positive correlation between the percent of chlorophyll content and the percent of single seed weight was significant. Two possible mechanisms of heat tolerance during grain filling were proposed. One represented by wheat line OK05723W might be mainly through the current photosynthesis since the high percentage of single seed weight was accompanied with high percentages of chlorophyll content and high shoot dry weight, and the other represented by wheat Line TX04M41164 might be mainly through the relocation of reserves since the high percentage of single seed weight was accompanied with low percentages of chlorophyll content and low shoot dry weight under heat stress. The tolerant genotypes identified in this study should be useful for breeding programs to combine different tolerance mechanisms into the same variety for mitigating heat-caused grain yield loss.
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4．Evaluation of ethyl methanesulfonate-induced in vitro mutagenesis, polymorphism and genomic instability in wheat (Triticum aestivum L.)(甲磺酸乙酯诱导小麦体外诱变、多态性和基因组不稳定性的评价)

简介：Wheat (Triticum aestivum L.) is highly rich in nutrients and is an important staple food for humankind. Mutation breeding offers a relatively quick method for crop improvement and it provides variation for selective breeding programs and functional gene studies. In vitro mutagenesis, coupled with in vitro regeneration procedure, can offer a wide variety of plant materials for mutagenesis; enable generation of large mutant populations in a relatively short period. Present experiments were conducted to investigate potential use of conventional chemical mutagenesis technique through ethyl methanesulfonate (EMS) for

mature embryo culture in wheat. EMS mutagenesis was experimented with 4 treatment durations (2, 4, 6, and 8 h) and 5 treatment concentrations (0, 0.1, 0.2, 0.3, and 0.4%). Mature embryos were treated to detect optimum doses of mutagenesis and to estimate polymorphism and genomic instability. First of all, 50% reduction in number of regenerated plants as compared to the control (LD50) was adopted as the optimum dose. Treated and untreated mature embryos were transferred to callus induction media. EMS mutagens at different duration and concentration had significant effects on callus formation rate (%), embryogenic callus formation rate (%), responded embryogenic callus rate (%), regeneration efficiency and number of plants parameters. Based on LD50 criterion, the optimum value was achieved at 8 h duration of 0.1% EMS concentration. Secondly, inter-primer binding site (iPBS) markers was applied to investigate insertion polymorphism and genomic instability in the regenerated plants. EMS mutagenic treatments had significant effects on different effects on polymorphism and genomic instability of regenerated plants. Present findings revealed that in vitro mutagenesis might be a useful approach for accelerating breeding strategies to create enough genetic variation in wheat populations. Besides, an integrated approach can be used to carry out mutation-assisted breeding and subsequent selection of desired mutants using molecular markers in wheat.

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