



2023年第29期总277期

小麦遗传育种专题

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➤ 前沿资讯

1 . Image-based phenomic prediction can provide valuable decision support in wheat breeding (基于图像的表型预测可以为小麦育种提供有价值的决策支持)

简介: Traditionally, breeders' selection decisions in early generations are largely based on visual observations in the field. With the advent of affordable genome sequencing and high-throughput phenotyping technologies, enhancing breeders' ratings with such information became attractive. In this research, it is hypothesized that G×E interactions of secondary traits (i.e., growth dynamics' traits) are less complex than those of related target traits (e.g., yield). Thus, phenomic selection (PS) may allow selecting for genotypes with beneficial response-pattern in a defined population of environments. A set of 45 winter wheat varieties was grown at 5 year-sites and analyzed with linear and factor-analytic (FA) mixed models to estimate G×E interactions of secondary and target traits. The dynamic development of drone-derived plant height, leaf area and tiller density estimations was used to estimate the timing of key stages, quantities at defined time points and temperature doseresponse curve parameters. Most of these secondary traits and grain protein content showed little G×E interactions. In contrast, the modeling of G×E for yield required a FA model with two factors. A trained PS model predicted overall yield performance, yield stability and grain protein content with correlations of 0.43, 0.30 and 0.34. While these accuracies are modest and do not outperform well-trained GS models, PS additionally provided insights into the physiological basis of target traits. An ideotype was identified that potentially avoids the negative pleiotropic effects between yield and protein content.

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2 . Male sterility systems and their applications in hybrid wheat breeding (雄性不育系统及其在杂交小麦育种中的应用)

简介: To ensure food security for~10 billion human population in 2050 a sustainable increase in food production is indispensable. Wheat is the third most consumed cereal crop worldwide after rice and maize. It is estimated that the current wheat yield will be insufficient to cope with future needs. In the past hybrid seed production has revolutionized rice and maize production; however, wheat is still lagging behind other crops, such as rice, corn, soybeans, and canola in terms of variety/hybrid development and trait development. The potential of hybrid wheat is undeniable but these challenges need to be overcome if we want to commercialize it. Despite a century of efforts we still do not have a reliable hybrid breeding system to attempt large-scale production due to certain issues like self-pollination, polyploid nature, low variability in germplasm (less than 1% cross-pollination), and higher seed rates. Moreover, a limited number of GMS genes and their regulatory pathways has

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narrowed our selection; further research is required to identify and understand the genetic and molecular mechanisms involved. There are few successful examples of hybrid wheat, only 1% of its total wheat growing area is hybrid wheat. There is no simple way to produce a stable wheat hybrid, until this point no one knows how to commercialize wheat on a larger scale. The use of comparative functional genomics and biotechnological tools combined with conventional breeding is likely the possible key to guarantee a stable hybrid wheat breeding and to help overcome global food security issues. This paper would provide an overview of techniques to induce male sterility in wheat and their use in commercialized hybrid seed production systems.

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➤ 学术文献

1 . Phenomic selection in wheat breeding: prediction of the genotype-by-environment interaction in multi-environment breeding trials (小麦育种中的表型选择: 多环境育种试验中基因型与环境相互作用的预测)

简介: The performance of wheat cultivars in multi-environmental trials (MET) is difficult to predict because of the genotype-by-environment interactions (G×E). Phenomic selection is supposed to be efficient for modelling the G×E effect because it accounts for non-additive effects. Here, phenomic data are near-infrared (NIR) spectra obtained from plant material. While phenomic selection has recently been shown to accurately predict wheat grain yield in single environments, its accuracy needs to be investigated for MET. We used four datasets from two winter wheat breeding programs to test and compare the predictive abilities of phenomic and genomic models for grain yield and heading date in different MET scenarios. We also compared different methods to model the G×E using different covariance matrices based on spectra. On average, phenomic and genomic prediction abilities are similar in all different MET scenarios. Better predictive abilities were obtained when G×E effects were modelled with NIR spectra than without them, and it was better to use all the spectra of all genotypes in all environments for modelling the G×E. To facilitate the implementation of phenomic prediction, we tested MET designs where the NIR spectra were measured only on the genotype-environment combinations phenotyped for the target trait. Missing spectra were predicted with a weighted multivariate ridge regression. Intermediate predictive abilities for grain yield were obtained in a sparse testing scenario and for new genotypes, which shows that phenomic selection is an efficient and practicable prediction method for dealing with G×E.

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➤ 相关专利

1. 一种小麦育种专用人工授粉器

简介：本发明涉及一种小麦育种专用人工授粉器，包括授粉箱，所述授粉箱上设置有授粉机构，所述授粉箱上设置有调节支撑机构，所述授粉机构包括与授粉箱的内部转动连接有第一齿轮，所述第一齿轮的背面固定连接有机，所述授粉箱的内部转动连接有与第一齿轮相啮合的第二齿轮，所述授粉箱的内顶壁固定连接有机震动块，所述授粉箱的底部固定连接有机安装架，所述安装架的左侧固定连接有机马达，所述马达的输出端固定连接有机转杆。该小麦育种专用人工授粉器，通过设置的授粉机构，方便在使用时采用机械震动的方式进行出粉，然后采用双面刷进行涂刷授粉，能够有效的提高授粉器授粉的效果，有助于减少喷粉气管堵塞的情况。

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<http://agri.ckcest.cn/file1/M00/03/5B/Csgk0Yj8CvaAQbxuAAceWeugdQ773.pdf>

2. 一种小麦育种用多级筛选装置

简介：本实用新型涉及小麦育种筛选技术领域，尤其是一种小麦育种用多级筛选装置，包括筛选箱和拉门，所述筛选箱的前端面上下方均通过多个合页转动连接有拉门，所述筛选箱的上方中间固接有机进料斗，所述筛选箱的左侧下方内壁固接有机下料板，且下料板的右侧外壁与筛选箱的开口处内壁相固接，所述筛选箱的上方内部安装有机下料装置，所述筛选箱的内壁中间安装有机小麦育种筛选装置。可以将小麦种子倒入进料斗，之后接使第一电机的输出轴带动齿轮进行往复转动，齿轮通过齿条可以带动挡料板往复移动，这样通过挡料板便可以使小麦种子间歇下落，从而便可以提高对小麦种子的筛选效果。

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