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PL - 08 Plenary Lecture

UNOCCUPIED AERIAL SYSTEMS TEMPORAL PHENOTYPING AND PHENOMIC SELECTION FOR MAIZE BREEDING AND GENETICS

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Emerging tools in plant phenomics and high throughput field phenotyping are redefining possibilities for objective decision support in plant breeding and agronomy as well as discoveries in plant biology and the plant sciences. Unoccupied aerial systems (UAS, i.e. drones) have allowed inexpensive and rapid remote sensing for many genotypes throughout time in relevant field settings. UAS phenomics approaches have iterated rapidly, mimicking genomics progression over the last 30 years; the progression of UAS equipment parallels that of DNA-markers; while UAS analytics parallels progression from single marker linkage mapping to genomic selection. The TAMU maize breeding program first focused on using UAS to automate routine traits (plant height, plant population, etc.) comparing these to ground reference measurements. Finding success, we next focused on developing novel measurements impractical or impossible with manual collection such as plant growth and vegetation index curves. UAS plant growth curves measured in a genetic mapping populations has allowed discovery of temporal variation in quantitative trait loci (QTL). Now, phenomic selection approaches are being tested using temporal UAS, as first described using near infrared reflectance spectroscopy (NIRS) of grain. Phenomic selection is similar to genomic selection but uses a multitude of plant phenotypic measurements to identify relatedness and predict germplasm performance.

Phenotypic measurements are thus treated as random markers with the underlying genetic or physiological cause remaining unknown. Using multiple extracted image features from multiple time points, genotype rankings have been successfully predicted for grain yield. Among the most exciting aspects have been identifying novel segregating physiological phenotypes important in prediction, which occur in growth stages earlier than previously evaluated. Similarly, UAS have allowed investigating plant responses to biotic and abiotic stress over time. UAS findings and approaches permit new fundamental plant biology and physiology research, which is catalyzing a new era in the plant sciences.

Key words: *maize breeding, UAS, phenomic selection*.

02 - 03 Invited Lecture

OPTIMIZATION OF THE DOUBLED HAPLOID TECHNOLOGY FOR TEMPERATE MAIZE BREEDING PROGRAMS: A CASE STUDY FROM MAIZE RESEARCH INSTITUTE ZEMUN POLJE

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Doubled haploid (DH) technology is one of the several technological advances greatly impacting modern maize breeding. The main benefit for breeders is the development of parental inbred lines in one year comparing to four using conventional breeding. Maize Research Institute, Zemun Polje (MRIZP) initiated doubled haploid program in maize in 2014. In six years, up to 8,000 DH lines have been developed from close to 160 donor germplasm sources of different genetic backgrounds. During this period, the research group engaged in the DH program identified several issues that need to be addressed in order to optimize the method for use in temperate regions including poor agronomic performance of haploid inducing lines, donor germplasm effect on the overall efficiency of DH method in maize breeding and selection strategies for improving test-cross performance of DH lines. To meet the challenges, MRIZP DH research group started a breeding program aiming at developing inducers with high and stable HIR adapted to temperate climate conditions. Two main goals were defined: development of haploid inducers with HIR up to 20% in a completely inducer genetic background, and second, to develop haploid inducers in 75 and 50% inducer genetic background with moderate HIR but better agronomic performance. Also, nine populations were used to assess the suitability of our most elite breeding materials for use as donors with respect to genetic background, specifically heterotic group origin, and give guidance to breeders on donor germplasm selection. Furthermore, we are studying different selection strategies for DH line breeding with respect to donor size and prior cycles of selection, i.e. recombination (none (F1), one (F2), or two selection cycles (F3)). We hope that our, still ongoing research will contribute to already extensive knowledge on doubled haploid methodology.

Key words: *doubled haploid method, doubled haploid lines, haploid inducers, maize*.