Soybean Research for Sustainable Development

Abstracts
World Soybean Research Conference 11
18-23 June 2023, Vienna, Austria

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Soybean Research for Sustainable Development

Abstracts of the World Soybean Research Conference 11 (WSRC 11)
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University of Natural Resources and Life Sciences, Vienna, Austria

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Foreword

At present, the world community is facing substantial changes of different nature which have a considerable impact on the global food and nutrition situation: Man-made climate change is becoming clearly visible and is negatively affecting food security, while disruptions and changes in global supply chains also contribute to increased food insecurity as well as economic instability. The soybean stands in the middle of these processes, as it is and continues to be the most important protein and oilseed crop of the world, which is utilized for the production of livestock feeds, numerous human food components, and non-food products. Due to a global rise in the consumption of meat and dairy products during previous decades, the massive expansion of soybean production was partly associated with increased greenhouse gas emission, deforestation, and loss of biodiversity. Because of this, present soybean production is experiencing harsh criticism from science and civil society.

Therefore, the timely motto of the World Soybean Research Conference 11 is "*Soybean research for sustainable development*". As research and development are the major engine behind any progress in crop production, agricultural research is urgently needed to mitigate the negative effects of climate change and to minimize the impact of soybean on the environment towards a fully sustainable soybean production in the near future. This includes a reduction of production inputs through improvement of agronomic and genetic input efficiency, new pathways in livestock feed uses, and finally an enhanced direct utilization of soybeans in human foods. The five major themes of the conference are (i.) breeding-genetics-genomics-biotechnology, (ii.) food-feed-nutrition, (iii.) agronomy-physiology-agrotechnology, (iv.) weeds-diseases-pests, and (v.) business-policy-market issues, which will be elaborated in over 30 scientific parallel sessions, 4 plenaries and 2 poster sessions. The versatility of approaches to sustainable soybean production is well reflected by miscellaneous contributions from fields such as genetic diversity, genomics-assisted soybean breeding, genome editing, stress and climate change mitigation, novel developments in soy-foods and feeds including chemistry, nutrition and health, agro-technology and data-driven crop and soil management, organic soybean production, seed science, the soybean rhizosphere, progress in the management of weeds, diseases and pests, as well as policy and environmental sciences.

The WSRC 11 organizers have received over 500 scientific contributions, and the most outstanding scientists from all major soybean producing countries including China, the United States, Argentina, Canada, Brazil, India, Ukraine, France, Serbia, Japan and South Korea will share and discuss their latest results. In addition, reports from all world regions with significant soybean production will provide unique insights into specific issues of soybean cropping and utilization. Dedicated workshops have been organized to address specific needs such as soybeans for Africa, or soybean breeding for organic farming. In the time since the last World Soybean Research Conference, huge progress has been achieved in the utilization of genomic information, in data-driven agronomic decision-making as well as in various other aspects of soybean biology including the interaction with stress factors. Thus, the conference aims at

fostering the exchange of new knowledge and stimulating collaborative research among the world scientific community. Apart from oral presentations, poster sessions and an industry exhibition provide unique opportunities for personal interaction between the conference participants. Posters in particular are covering a very wide range of specific topics and research questions, and therefore poster sessions are a major source of exchange and scientific inspiration.

I am grateful to all conference chairpersons, members of the international scientific committee, members of the WSRC continuing committee and to all scientific contributors for their excellent inputs to compile an outstanding program, which delivers both a comprehensive overview as well as numerous specific highlights and new landmarks of soybean research. I also thank all sponsors, industry representatives and exhibitors for their valuable support of this conference. And most particularly, I acknowledge the help of the two WSRC organizing teams of the earlier conferences to be held in Savannah, GA, United States and Novi Sad, Serbia which had to be cancelled due to natural disasters; both teams were generously sharing their experience and preparation work they had carried out before.

During the historical Vienna World Exposition of 1873, soybean made its first legendary appearance on the international stage. In 2023 - 150 years later - the soybean community is back in Vienna. I wish all participants of the World Soybean Research Conference 11 many inspiring encounters and helpful insights for meeting the challenges ahead of us.

Johann Vollmann
Chair, International Scientific Committee, WSRC 11

Vienna, June 18, 2023

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Phenomic selection in soybean breeding

Vuk Djordjevic[1], Marina Ćeran[1], Simona Jaćimović[1], Jegor Miladinović[1], Marjana Vasiljević[1], Predrag Ranđelović[1], Jelena Marinković[1]

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Phenomic selection is a promising complement and alternative to genomic selection for improving breeding efficiency. The major advantage of using near-infrared spectroscopy (NIRS) to indirectly capture phenotypic variants and predict complex traits is its high-throughput and low cost. Using NIR spectra to predict individual performances in the context of breeding for yield remains relatively novel. Certain wavelengths of NIR light are absorbed by specific chemical bonds that constitute the components of tissues. The relative proportion of each of these bonds within the tissue quantitatively influence the nature of the absorbance or reflection of light at different wavenumbers. Phenomic selection was tested on 206 soybean genotypes, collecting yield and NIRS data. Spectra were obtained from different tissues, grains and dried, milled leaves, measuring absorbance in range 4000 – 10000 cm−1. RR-BLUP model was used for phenomic predictions, considering NIRS data instead of molecular. Differences between collected plant and seed NIR spectra were observed, causing variation in prediction ability of RR-BLUP models, ranging between 0,6 and 0,7 that was at the level of previously determined genomic prediction. For selection of optimal phenomic prediction model, it was important to elucidate contribution of chemical bonds i.e. macromolecules to the model's prediction power, in order to avoid that the model itself and not selection for yield, affects other traits. In the seed, spectra with the highest prediction values were mostly located at the positions of protein and oil peaks. Therefore, developed prediction model basically predicts protein and oil content in seeds. Due to existing genetic correlations between protein and oil content with the yield, by employing this model one may take the risk of selecting genotypes based on altered chemical composition rather than yield. In terms of specific breeding goals, it is necessary to focus carefully on selection of optimal phenomic prediction model.

Keywords: NIR spectroscopy, phenomic selection, yield, macromolecules

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