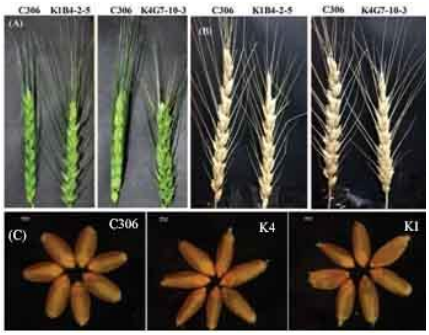

TaABCC13 silencing *affects grain filling and spike characteristics.(A) Spike at 14 days after anthesis; (B) mature spike; (C) representative seeds (K1 and K4 are two transgenic lines).*

Name of the Institute: National Agri-Food Biotechnology Institute, Mohali

Stage of Development: The gene construct was validated for its role in lowering of phytic acid in mature wheat grains. We are currently employing genome editing for this gene so as to use as a donor for elite Indian wheat varieties.

Scientific Experts: Dr. A K Pandey, Scientist-D

Contact person: Dr. A K Pandey
Address: National Agri-Food Biotechnology Institute, Mohali, Punjab
Phone: 011-4990300
email: pandeyak@nabi.res.in

Country context: The current work addresses the issue of iron bioavailability through cereal based diets.

Scalability: Genome editing tools for PA pathway genes are now being employed.

Name of Technology: Gene silencing of wheat phytic acid transporter gene to achieve low phytate content in wheat grains

Technology description: Low phytic acid is considered to be a trait in cereal crops that could be achieved by either manipulating the genes involved in the biosynthesis pathway or its transport in the vacuoles. Previously, we demonstrated that wheat ABCC13 is a functional transporter, primarily involved in heavy metal tolerance and probable candidate gene to achieve low phytate wheat. In the current study, RNAi mediated gene silencing was also performed for *ABCC13* to evaluate its functional importance in wheat. Transgenic plants with a significantly lowered transcript of *TaABCC13* in either seeds or roots were selected for further studies. Homozygous RNAi lines (K1B4 and K4G7 at T_4 seeds) exhibited 34%-22% reduction of the phytic acid content in the mature grains. These transgenic lines were defective for spike development, reduction in the number of spikelets and grain filling. Seeds of transgenic wheat showed relatively delayed germination but did not affect the survival of the plant. Interestingly, the early emergence of lateral roots was observed in *TaABCC13* silenced lines as compared to the non-transgenic.

Background: Efforts have been made to reduce phytate content in soy-bean, maize, phaseolus, barley and rice, but not in wheat. Understanding the genes involved in phytic acid (PA) biosynthesis, their functional characterization and targeting these genes for suppression could be one of the best strategies for reducing phytate. In order to achieve the above goal in wheat, it is therefore necessary to identify the genes those contribute in PA accumulation in during early stages of grain development. In an attempt to design approaches to enhance micronutrient bioavailability of wheat grains, seven wheat genes that might be involved in either biosynthesis or transport of PA were identified. RNAi mediated gene silencing was performed for *TaABCC13,* a putative PA transporter to evaluate its functional importance in wheat. Transgenic plants with a significantly lowered transcript of *TaABCC13* in either seeds or roots were selected for further studies. Based on our results we validated that *TaABCC13* is a functional transporter of PA and an important candidate gene to achieve lowering of seed PA.

Benefits and Utility: Enhanced micronutrient bioavailability from cereal grains is considered as an important trait. Unfortunately, these cereal based diets are poor in micronutrient bioavailability due to the presence of certain antinutrients like phytic acid. Therefore, attempts are being made across the world to decrease the total PA in cereal crops including wheat. In the present work, we have devised RNAi based strategy to address the lowering of grain PA in wheat. Multiple transgenic lines with lowered PA content were generated. The overall, goal of the project is to employ the strategies to enhance the bioavailability of important micronutrients like Fe, Zn, Ca etc. In the long run, this strategy combined with other novel approaches including marker free transgenic could address the burning issue of the malnutrition for Indian population.

Business and Commercial Potential: Considering the malnutrition scenario from the Indian population perspective, generation of marker free wheat with lowered PA and enhanced iron bioavailability would be of prime importance to the nation and of great commercial value.

Potential Investors to this technical innovation: Multiple seed companies and research labs are already working in the areas of developing high iron or low phytate wheat varieties.