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ASSESSMENT OF GENETIC VARIABILITY AND DEVELOPMENT OF HIGH PHYTASE AND LOW PHYTIC ACID GENOTYPES IN WHEAT

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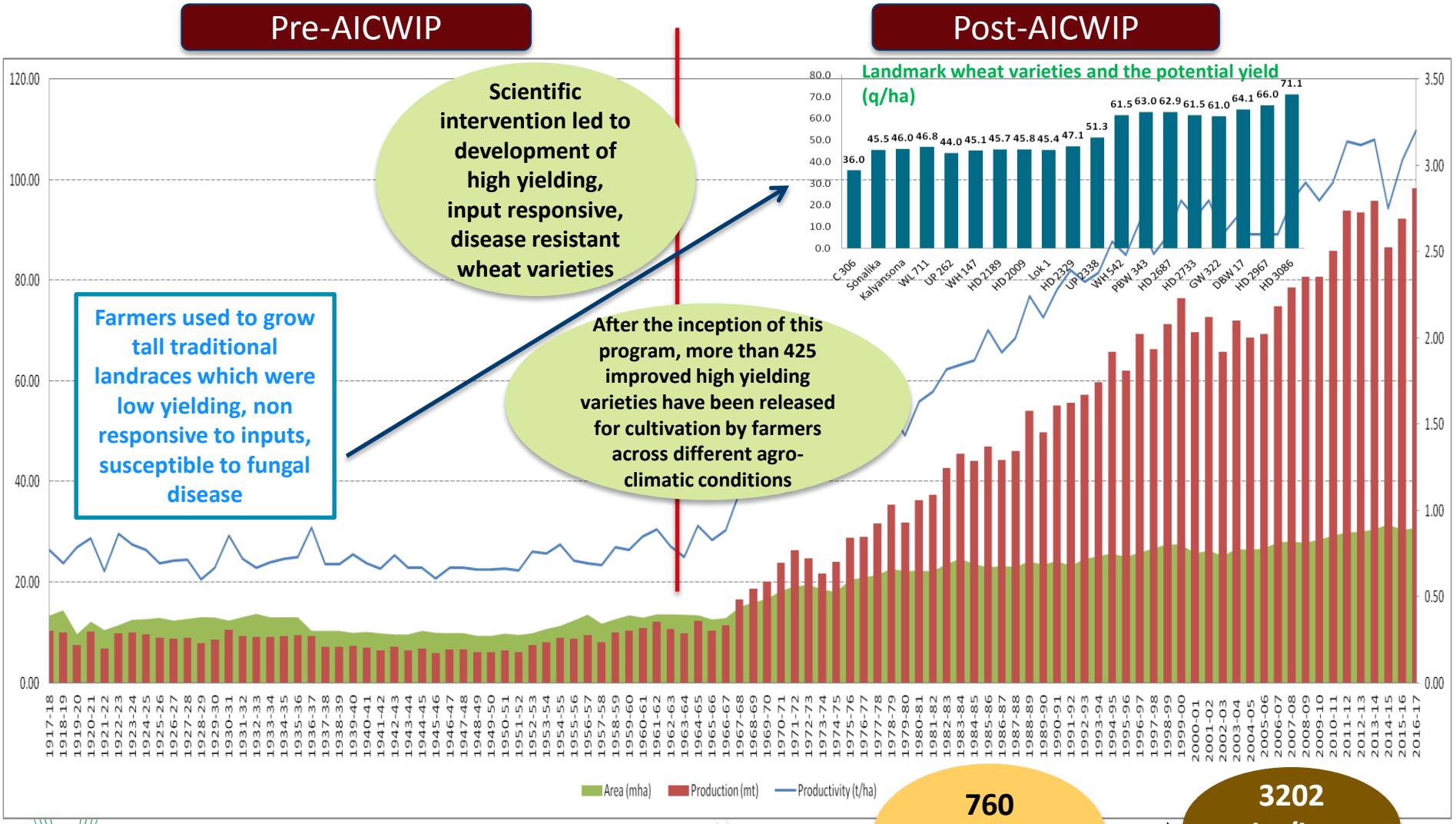
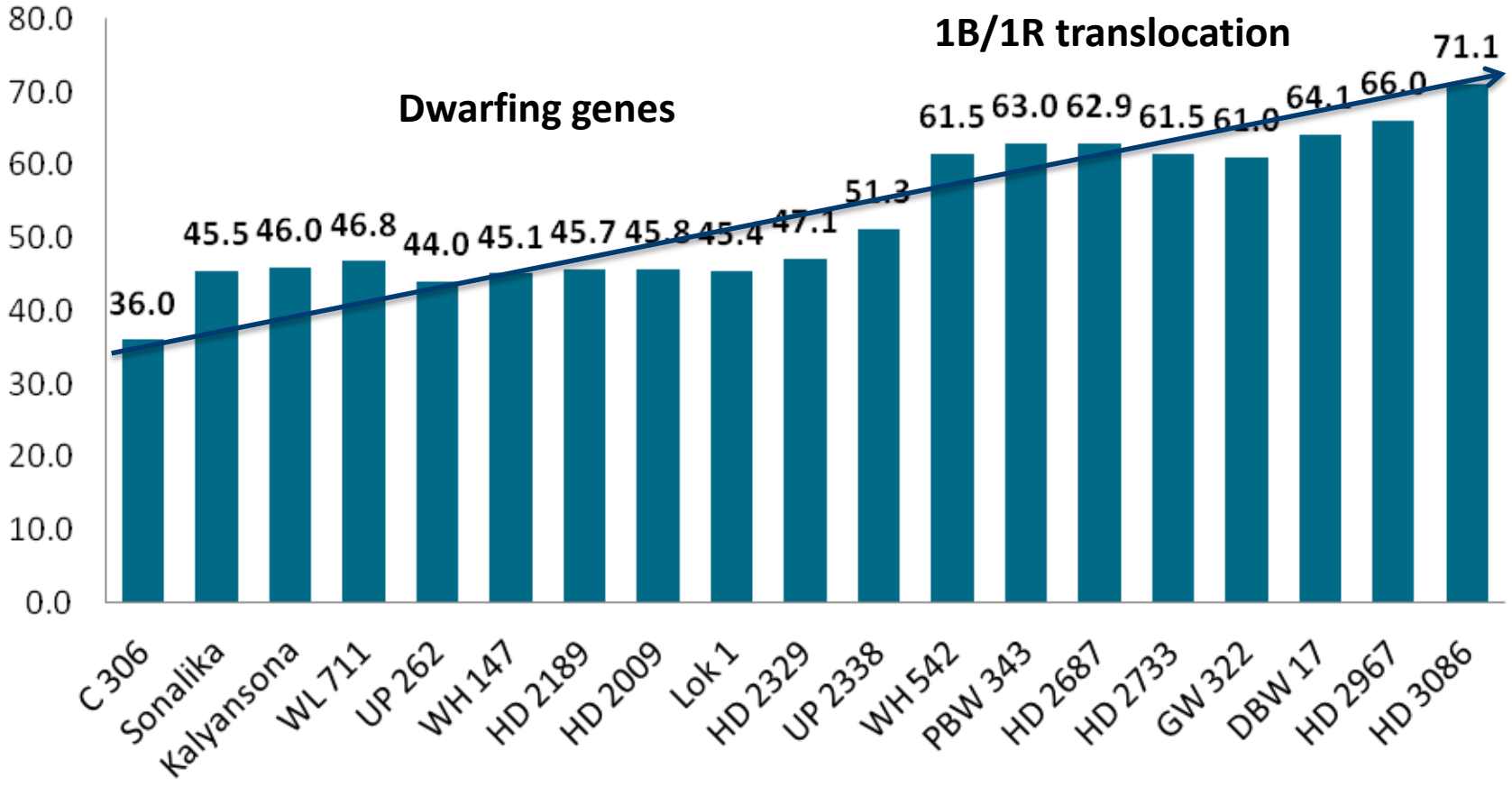
Enhancing production and productivity of Wheat through development of improved varieties

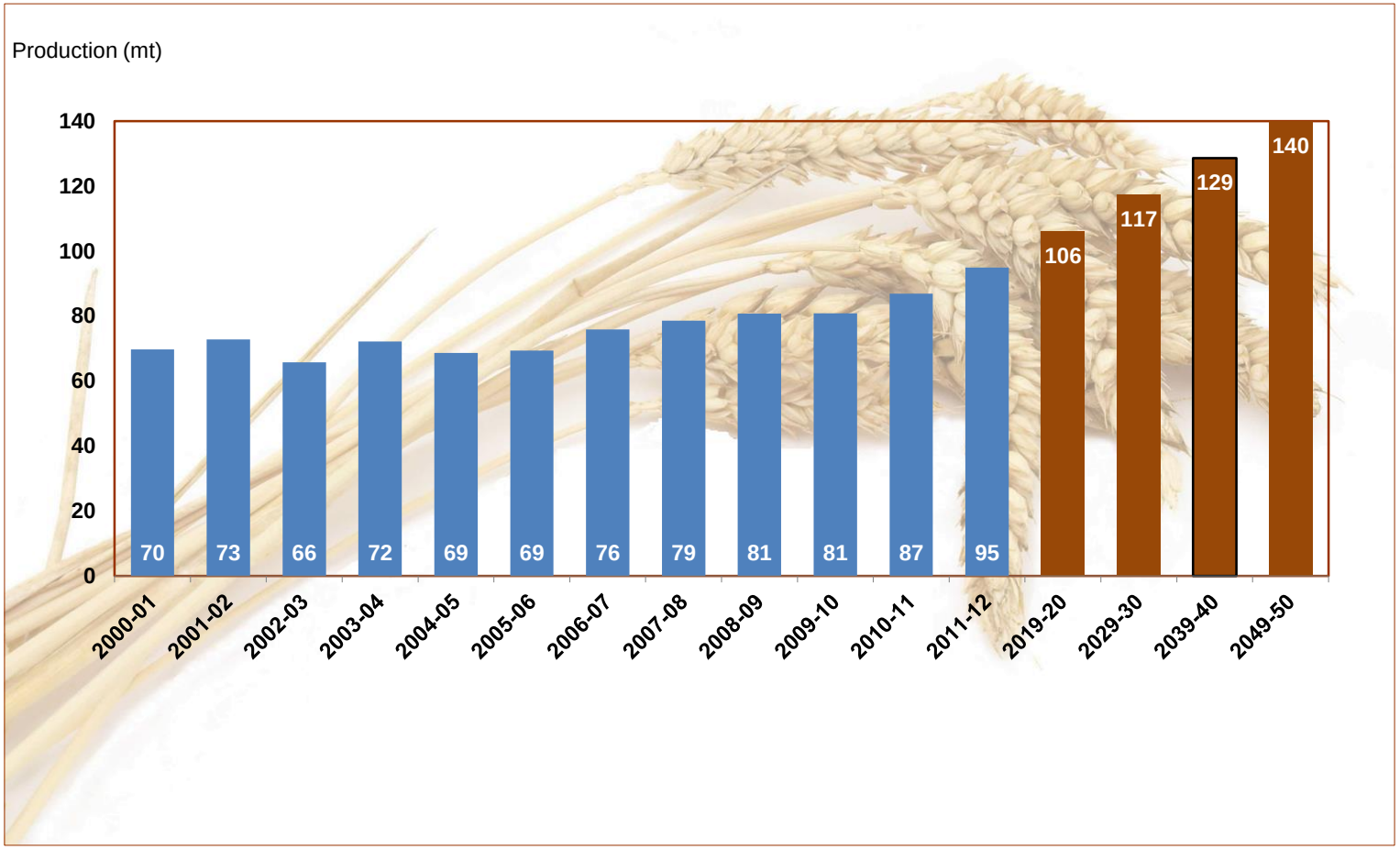
IIWBR has been instrumental in enhancing the national wheat production from a meagre 6.50 mt during 1950s to 98.38 mt during 2016-17 (15 fold increase)



Yield potential of wheat varieties released during last 6 decades



Time line of wheat production upto 2050

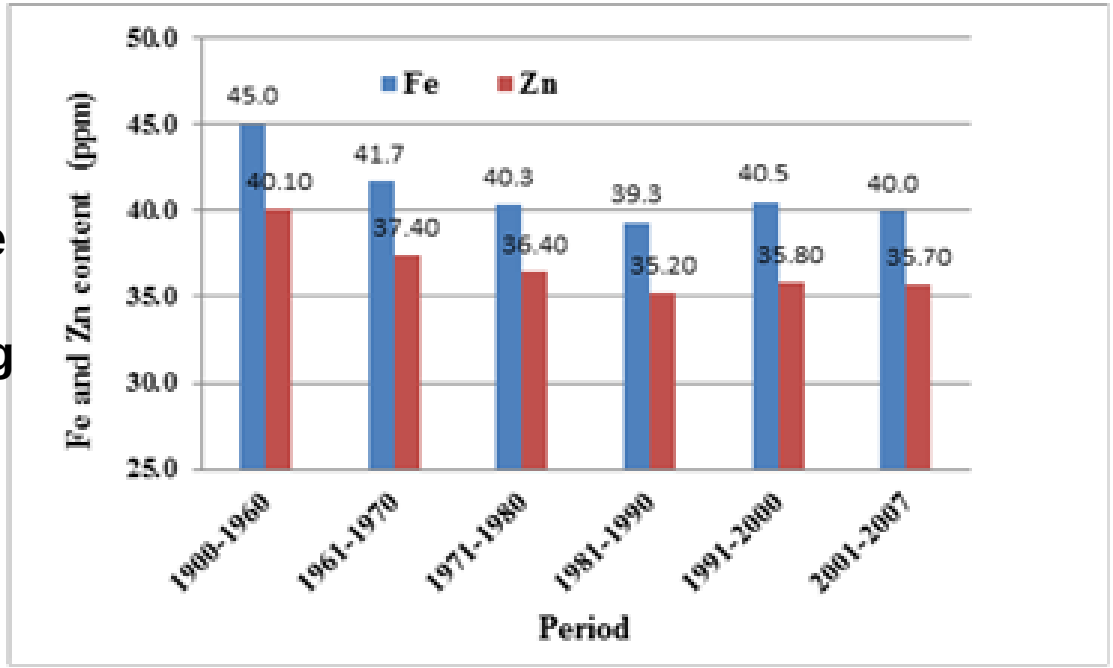


Major Challenges of wheat production

140 million tonnes by 2050

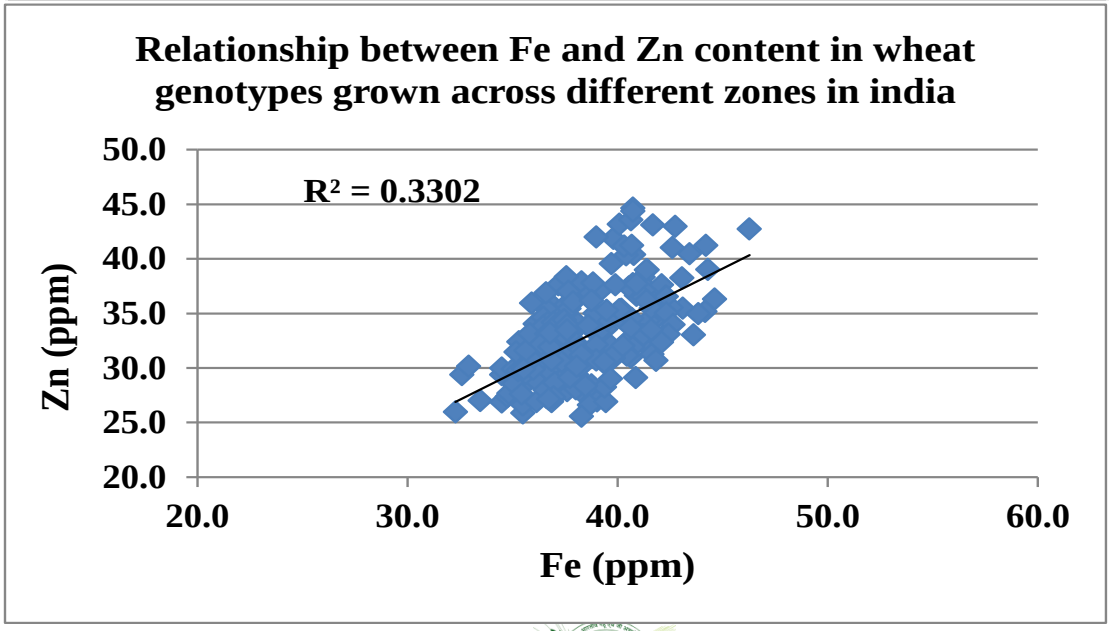
- **More productivity and production under changing climatic scenario of global warming, dwindling natural resources such as nutrients in the soil and water scarcity**
- **Bridging yield gap in different zones to achieve maximum potential of the technology**
- **To enhance yield potential across the environments in the country to keep pace with growing population. Our targets are to achieve 7.0 t/ha yield potential of wheat in NWPZ, 5.0 t/ha in CZ and NEPZ and 4.0 t/ha in PZ.**
- **To improve nutritional quality of wheat and barley to mitigate micronutrient deficiency and hidden hunger prevalent in India**

Variation in Fe and Zn content during different periods



Dilution effect

Significant correlation between Fe and Zn



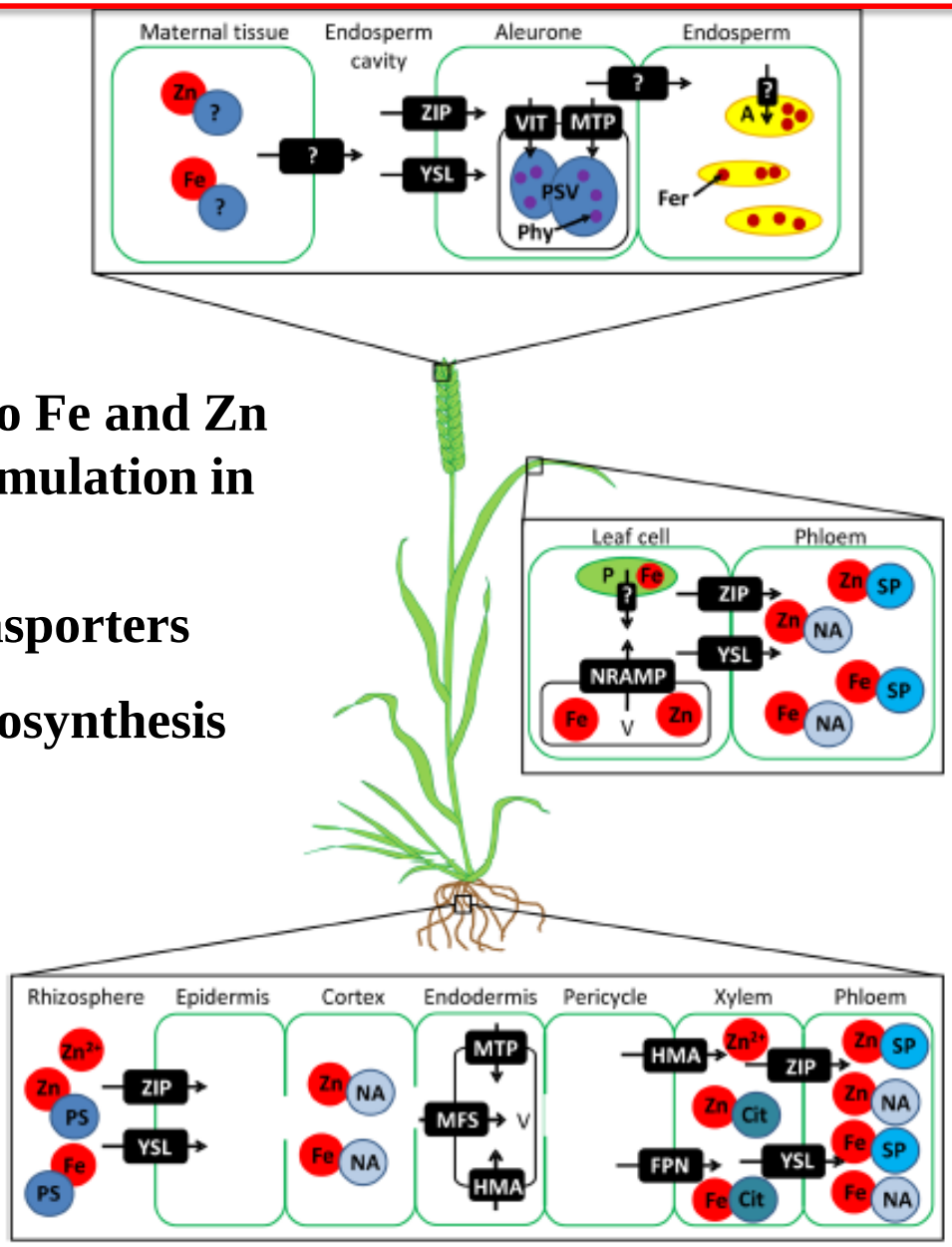
Synthetic hexaploids with more Zn content

Efforts in increasing Fe, Zn and grain protein content

1. Utilization of Gpc-B1
2. Agronomic management
3. Understanding genetics of micronutrient absorption, translocation and storage in grains
4. Association Mapping
5. Transcriptomics
6. Utilization of diploid progenitors

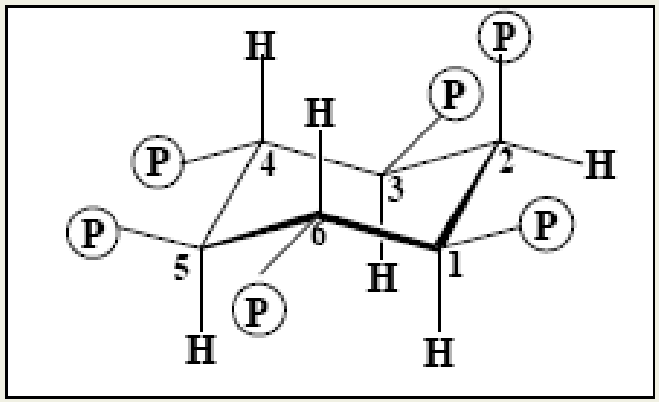
Study on the genes related to Fe/Zn transport and accumulation

- **Identification of genes related to Fe and Zn absorption, transport and accumulation in grain**
- **Analysis of Iron and Zinc transporters**
- **Genes for Phytosiderophore biosynthesis**
- **Vacuolar transporters**



Phytic Acid

(Inositol 6 phosphate)



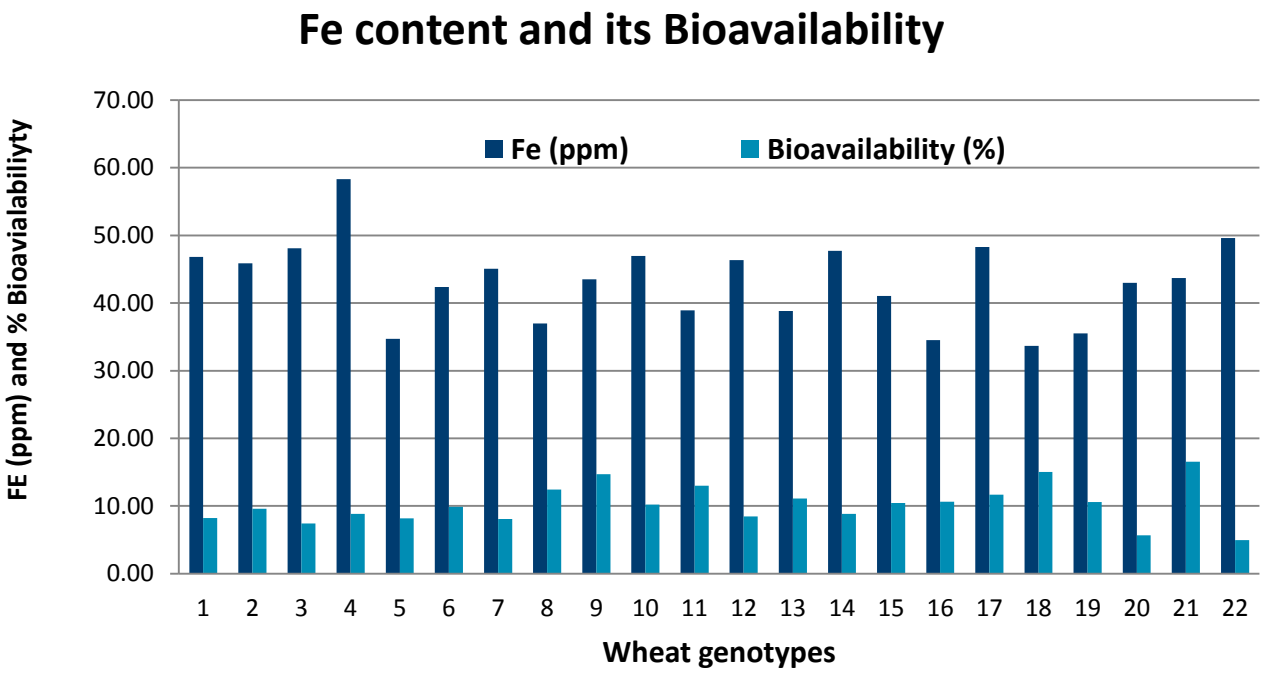
Some health benefits also

Chelates important minerals making them unavailable (Ca, Mg, Fe & Zn) to humans

Not utilized by non-ruminant animals and poorly utilized by ruminants – Phosphorus pollution

2 fold variation in phytic acid content

Bioavailability studies



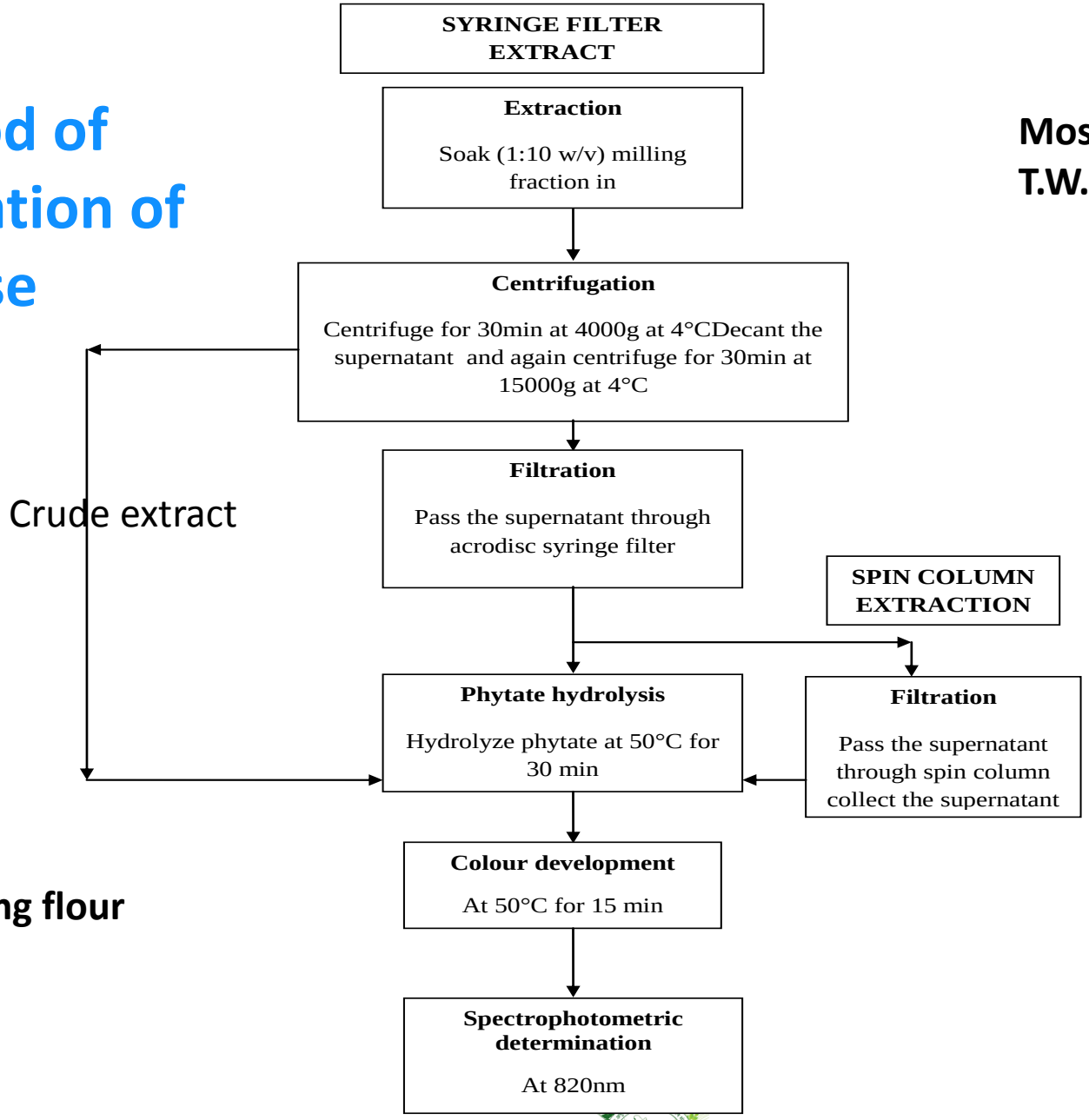
Fe 33.3 -58.6 ppm

Bioavailability 5.67-16.52%

Caco 2 Cell

National institute of immunology, Hyderabad, INDIA

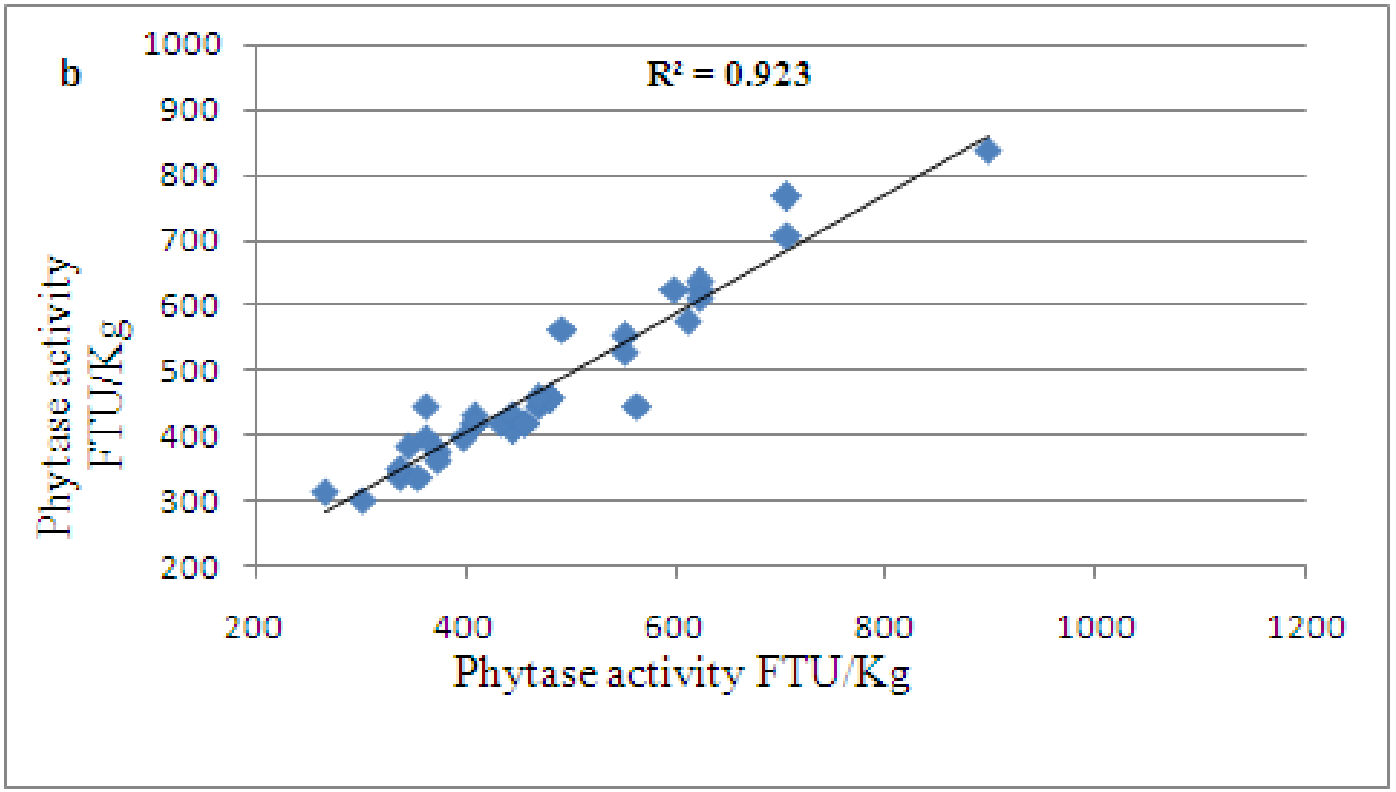
Direct method of estimation of phytase



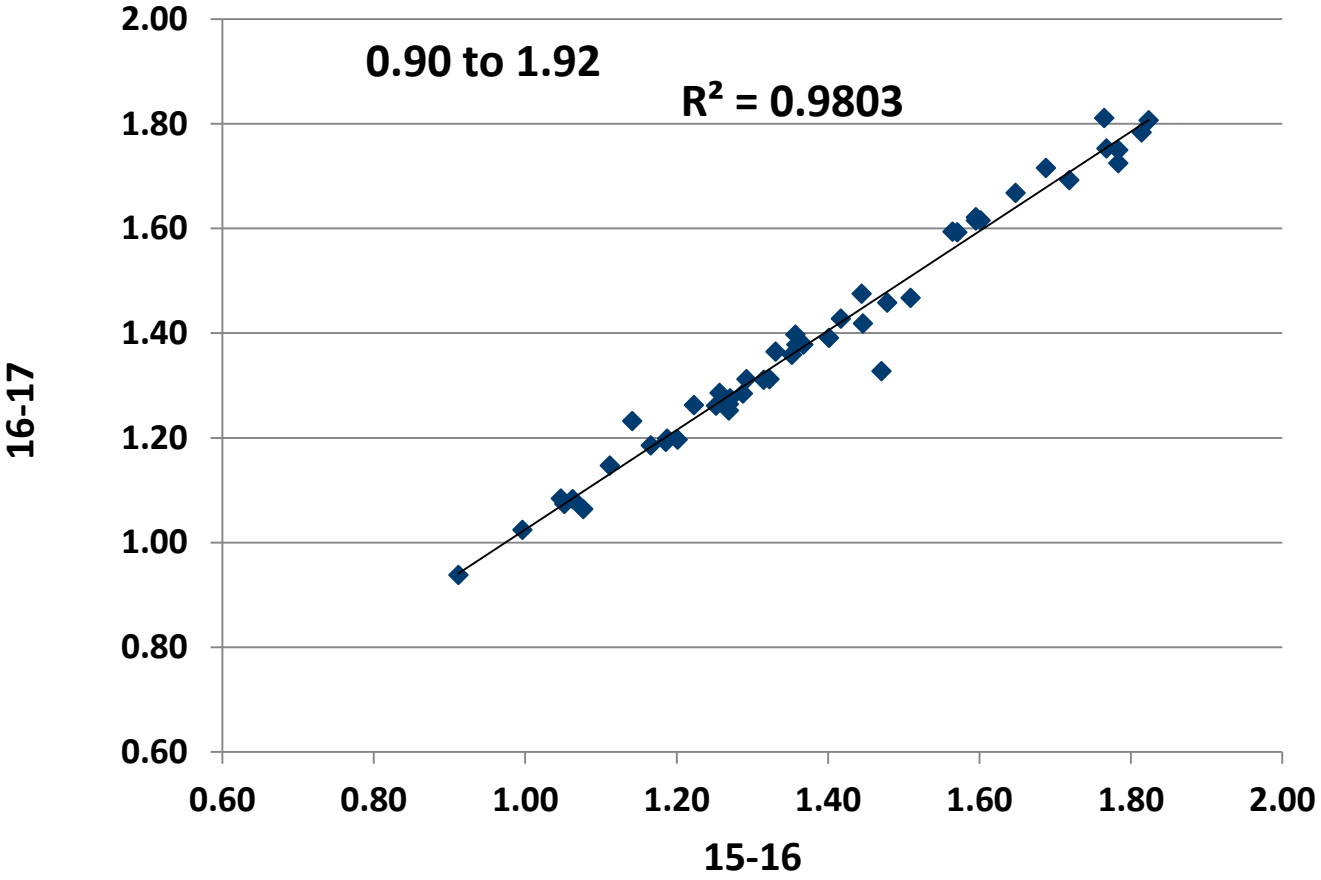
Moses 2003, T.W.Kim 2005

100 mg flour

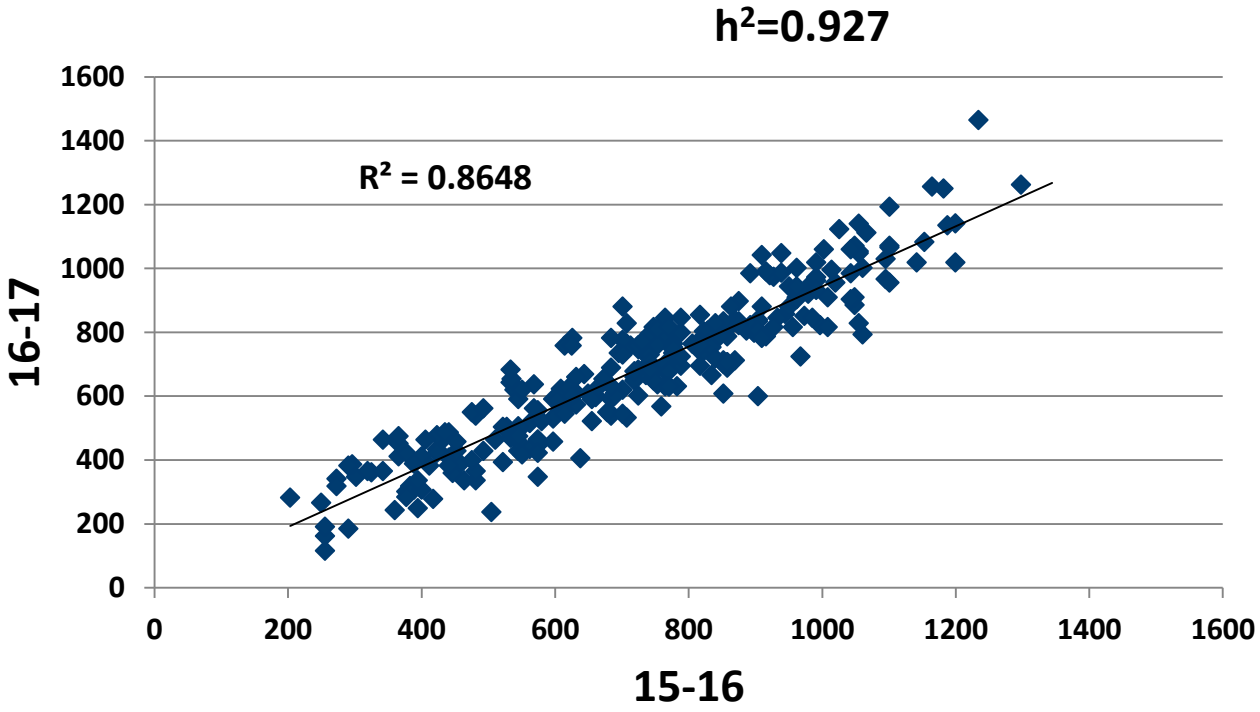
Repeatability of experiment (Crude extract method)



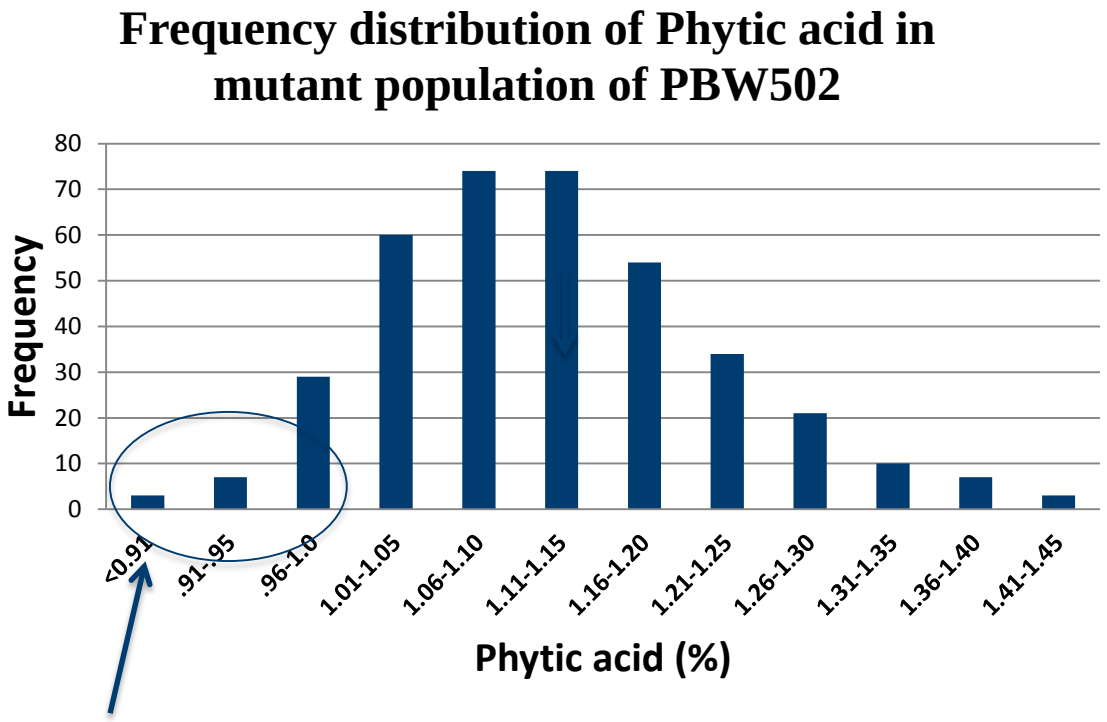
Phytic acid in released varieties of wheat in India



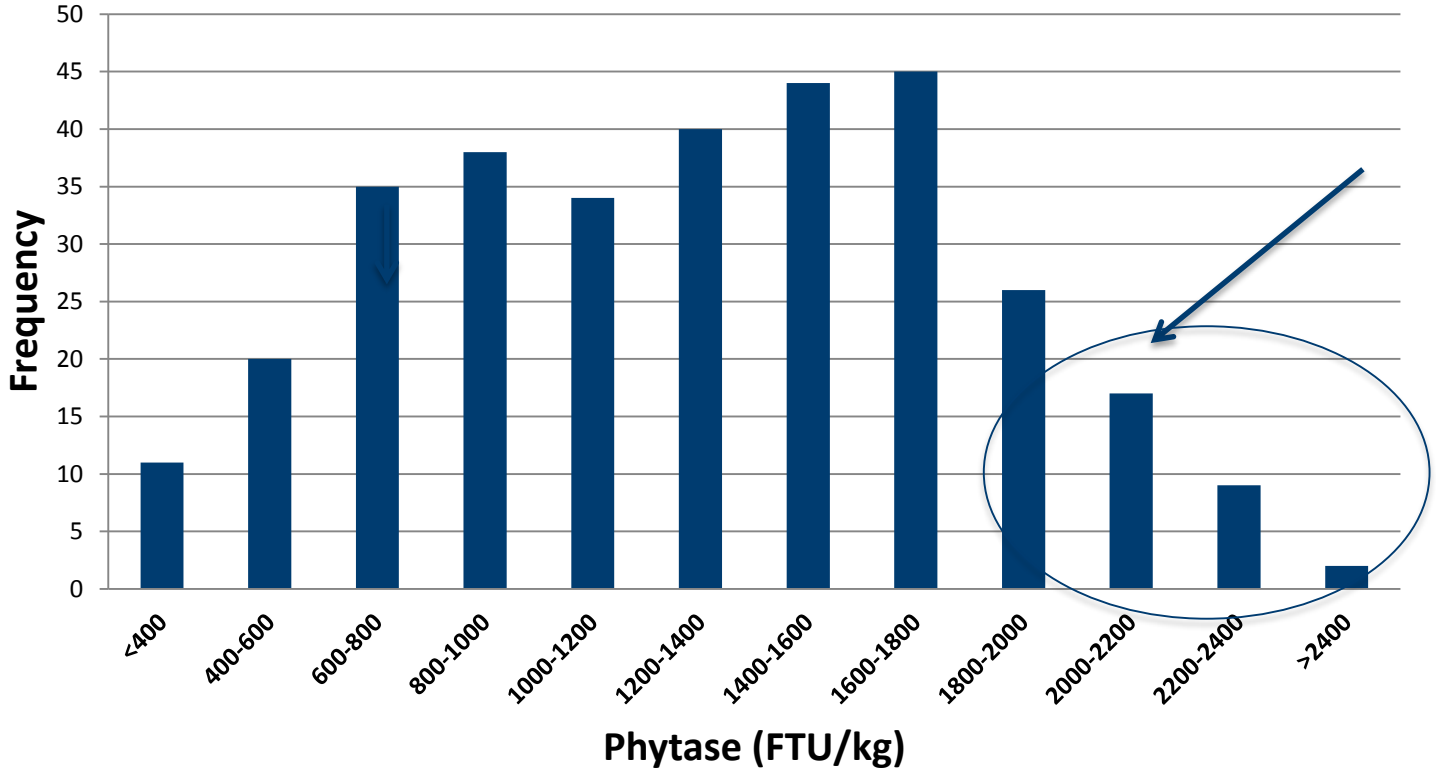
Variations in phytase levels (FTU/kg) in Indian wheat varieties



Identification of low phytic acid and high phytase lines in mutant population of PBW502



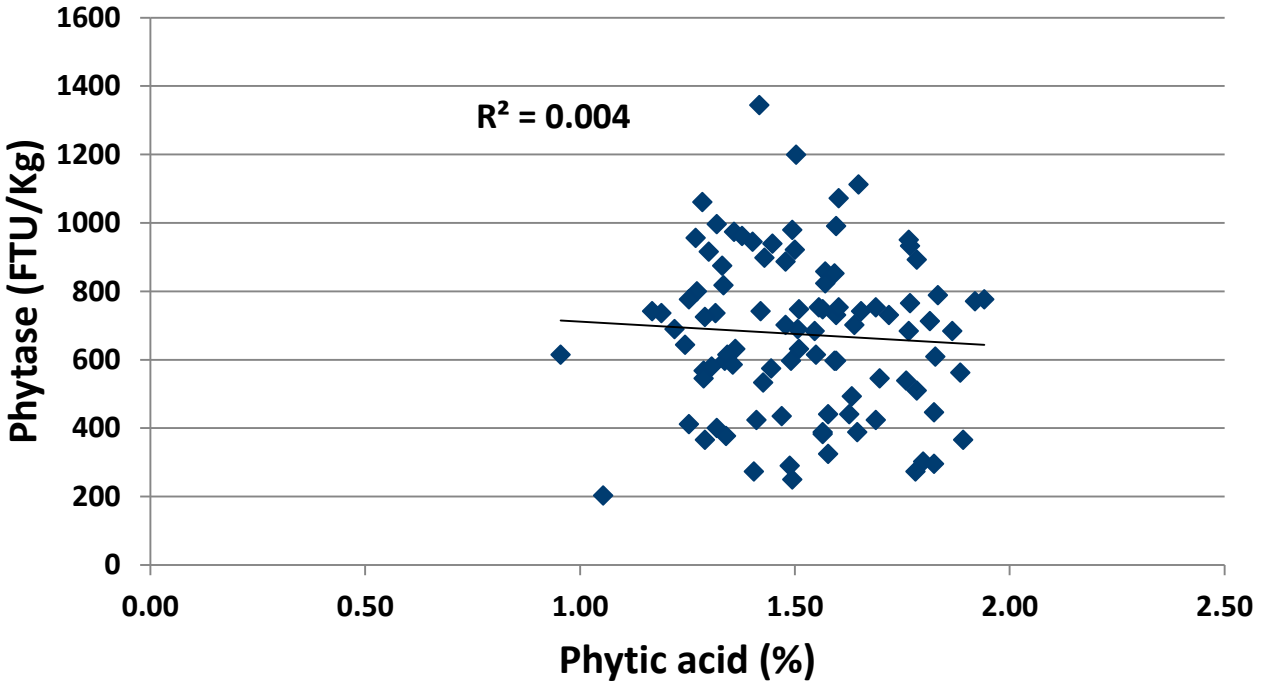
Frequency distribution of Phytase in mutant population of PBW502



High phytase and low phytic acid mutants are being utilized in making crosses with high yielding varieties

Molecular studies will also be conducted to identify mutation and develop molecular marker

Relationship between Phytase levels and phytic acid content



Conclusions

1. Very low bioavailability of Fe and Zn in human beings
2. Limited chances of increasing Fe and Zn content through genetic manipulations
3. Large variability in phytase levels and phytic acid among germplasm lines
4. Variability further extended in phytase levels through mutation
5. There is no relationship between phytase and phytic acid
6. Very high heritability of both phytase and phytic acid levels and easy and fast estimation of both the traits using microlevel test and thus great chance of manipulation through breeding
7. Great possibility of increasing bioavailability of Fe and Zn through increasing phytase levels and lowering phytic acid content

Thank you