Iron biofortification of chickpea (*Cicer arietinum* L.): A tale of addressing Fe deficiency problem in less Fe fed population

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Soil & Crops
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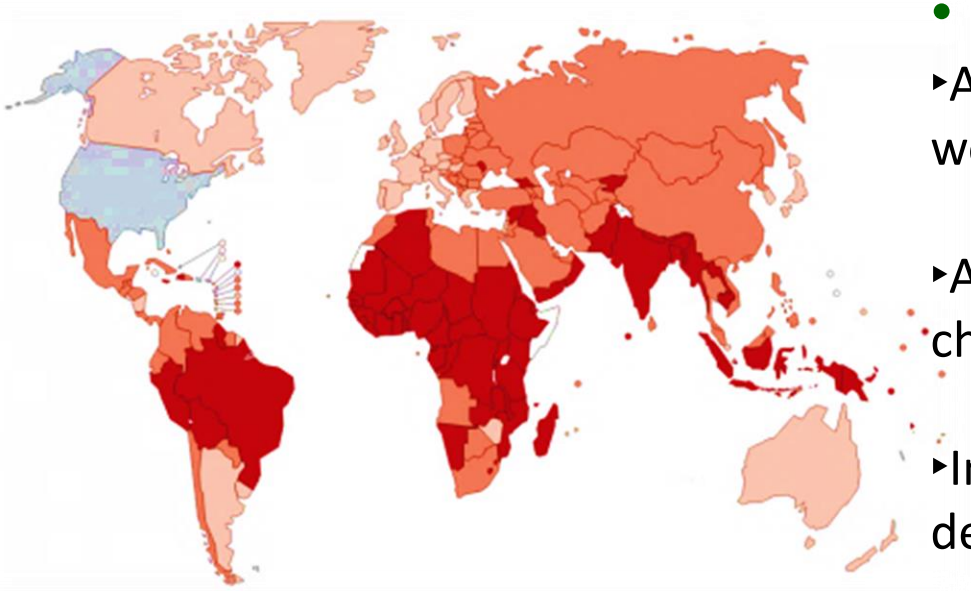
Background



- **Iron Deficiency-The Problem**
  - Affects two billion people- over 30% of world's population[1]
  - Around 20% women's death during childbirth[1]
  - Impaired physical and mental development in children and adoloscence[1]
- **Major Reason:**
  - Low iron bioavailability due to low iron conc.in dietary iron[2]

[1]Pfeiffer and McClafferty, 2007; [2]Monsen et al, 1978

Image courtesy:http://medcaretips.com/anemia-causes-symptoms-and-treatment/

Strategies

Biofortification

Fe Fertilization

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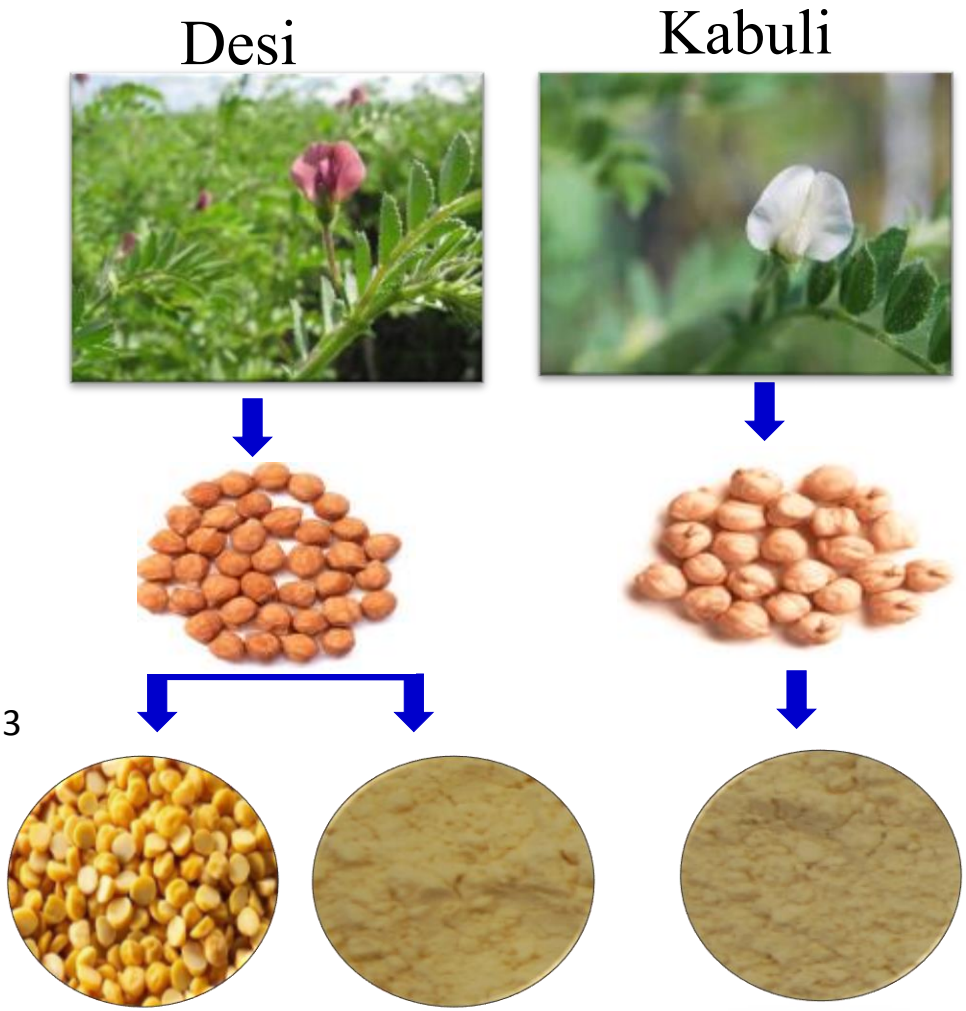
Chickpea:
A Potential Vehicle for Fe Biofortification

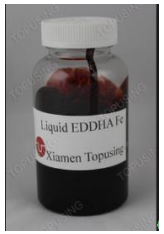
- Second most important pulse[1]
- Good source of protein and iron : 3.0-14.3 mg iron/100g of seed[2]
- Daily staple in the developing countries[2]
- Canada is one of the major producer and exporter of chickpea[3]
- Types: Kabuli and Desi[4]



[1]FAOSTAT,2012; [2]Diapari et al. 2014; [3]Pulse Canada,2016; [4]Ibrikci et al., 2003.

Research question?

Is it possible to biofortify chickpea seeds with iron (Fe) fertilizer as a rapid way to achieve increased level of iron (Fe) concentration in chickpea to address iron deficiency?

Biofortification → **Fertilization (Agronomy)** → 

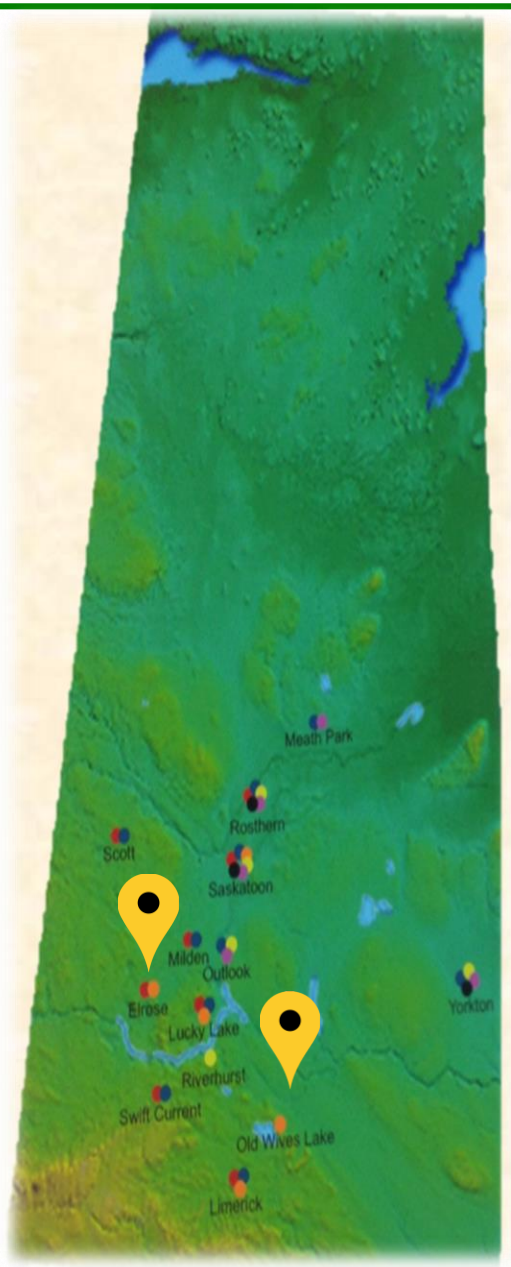
→ **Increase Mineral Content**

Objectives

I. To evaluate the fate of iron fertilizer through soil application and its accumulation in the seeds.

II. To find out correlation between the iron concentration and other seed compositions.

Experimental Design, Materials and Methods



Experimental Design and Materials

- Factorial Randomized Complete Block Design
- Fe molecule: Fe-EDDHA[1]

Fe fertilizer	Stability	Fe deficiency
FeEDTA, FeDTPA and FeHEDTA	Low	Limited/no results
FeEDDHA	High	Effective

- Levels of Fe doses: S0: Control(-Fe), S1 (low dose), S2 (high dose)
- Treatment combination: 54
- Cultivars: 18
- Replications: 4
- Year: Summer 2015 and 2016
- Locations: Moose Jaw and Elrose

[1]Lucena, 2006

Results

Summary of soil properties prior to fertilization and after fertilization in 2015 &2016

Before fertilization

Soil properties	Location			
	Elrose		Moose Jaw	
	Depth (inches)		Depth (inches)	
	0-6	6-12	0-6	6-12
pH	**7.7**	**8.0**	**7.7**	**8.2**
N (mg/kg)	10.8	9.1	9.5	5.6
P (mg/kg)	8.3	2.8	9.5	3.0
K (mg/kg)	484.5	378.0	513.0	434.5
Fe (mg/kg)	**20.2**	**15.6**	**15.8**	**13.2**

After fertilization

Soil properties	Location			
	Elrose		Moose Jaw	
	Depth (inches)		Depth (inches)	
	0-6	6-12	0-6	6-12
pH	**7.3**	**7.9**	**7.9**	**8.2**
N (mg/kg)	6.6	3.3	7.4	3.2
P (mg/kg)	15.6	4.8	12.0	2.1
K (mg/kg)	1026.0	719.0	867.0	463.5
Fe (mg/kg)	**21.4**	**21.3**	**16.7**	**16.8**

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Results

Fe conc.(ppm)

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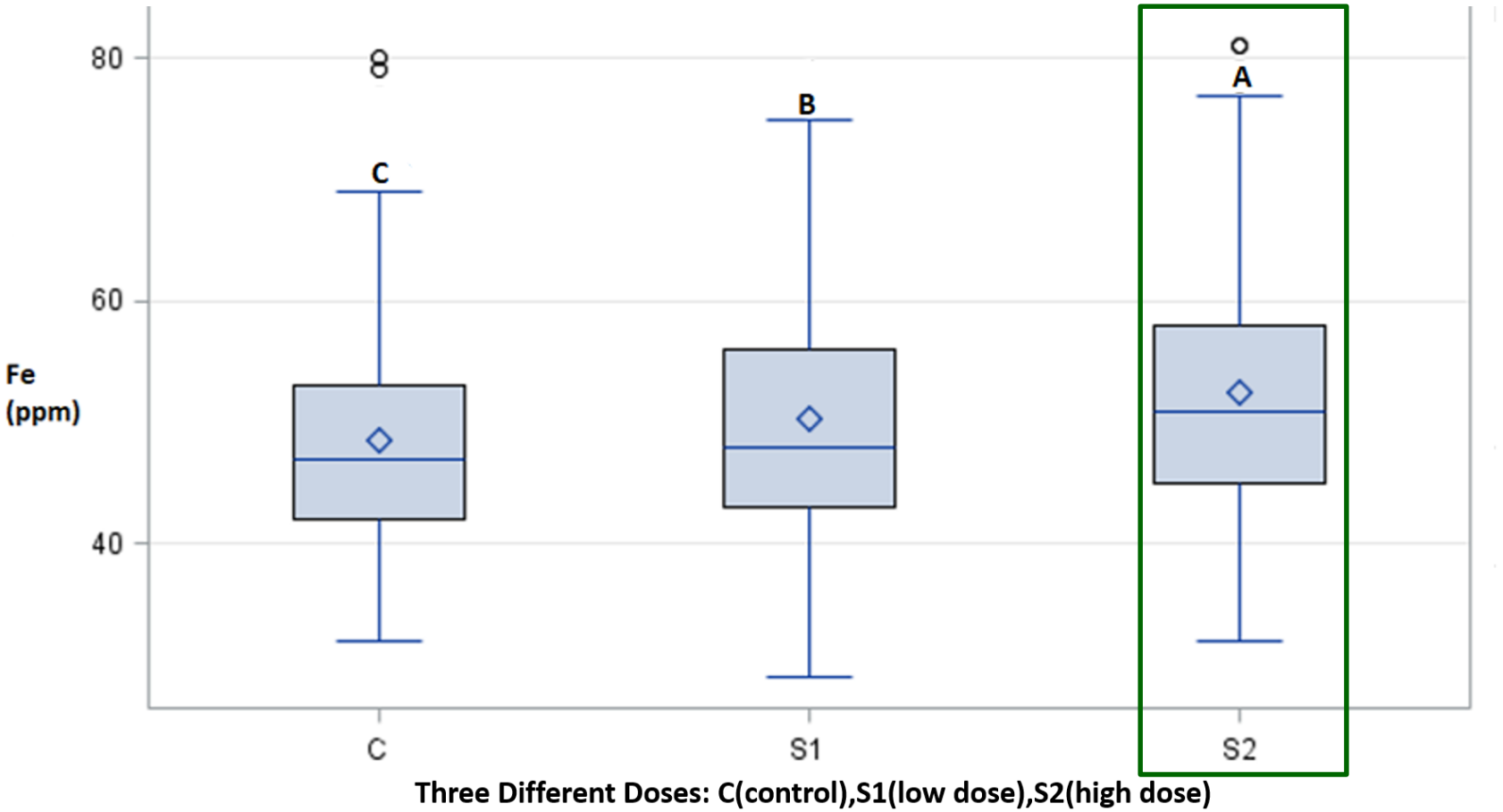
Effect of three different doses of FeEDDHA on Fe conc.(ppm) of seeds at Elrose and Moose Jaw, 2015 & 2016

F-Value
30.4*



*Significance p<0.05

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Results

Fe conc.(ppm)(cond.)

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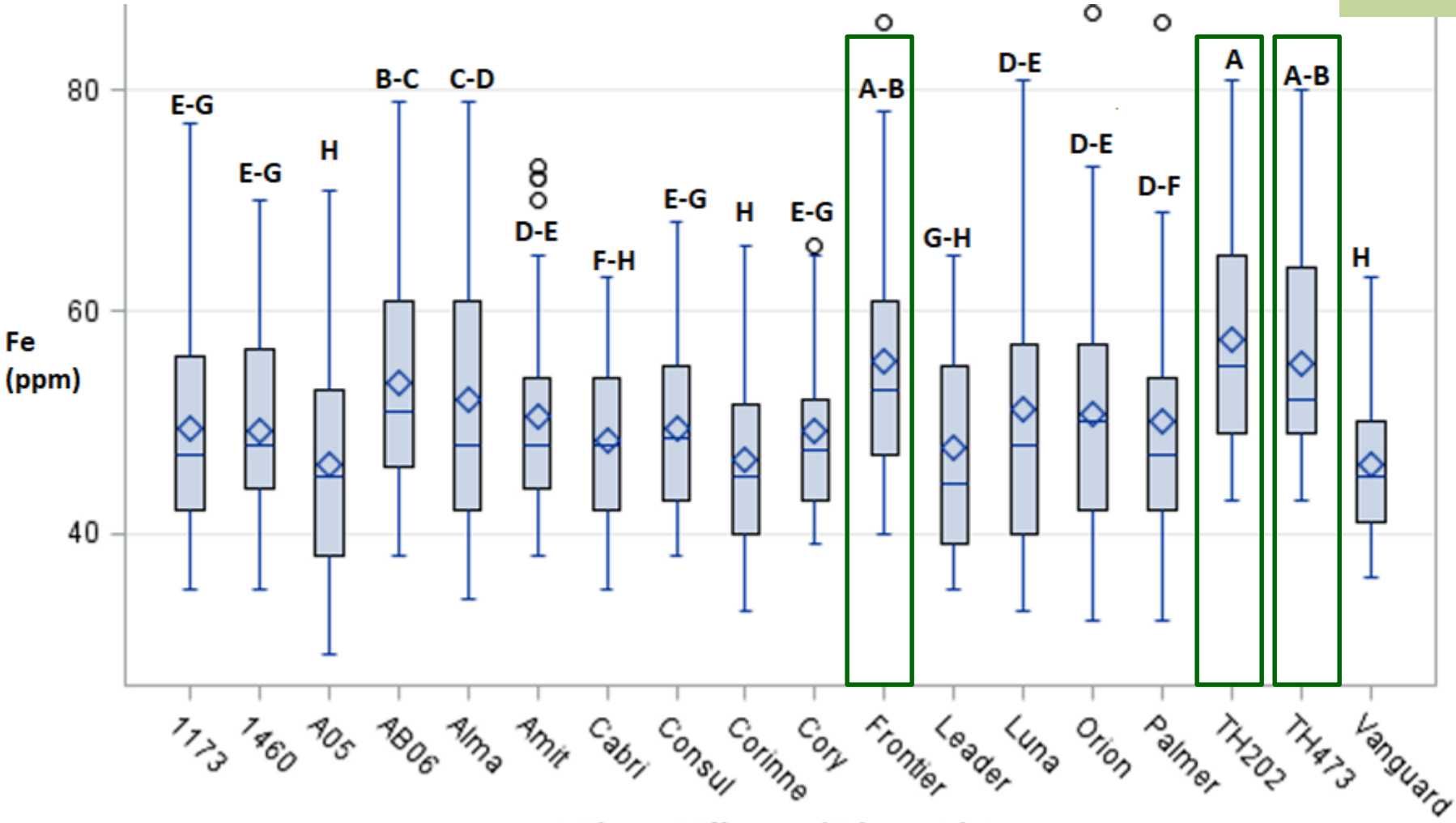
Effect of eighteen different cultivars with three different doses of FeEDDHA on Fe conc. (ppm) of seeds at Elrose and Moose Jaw,2015 & 2016

F-Value
16.3*

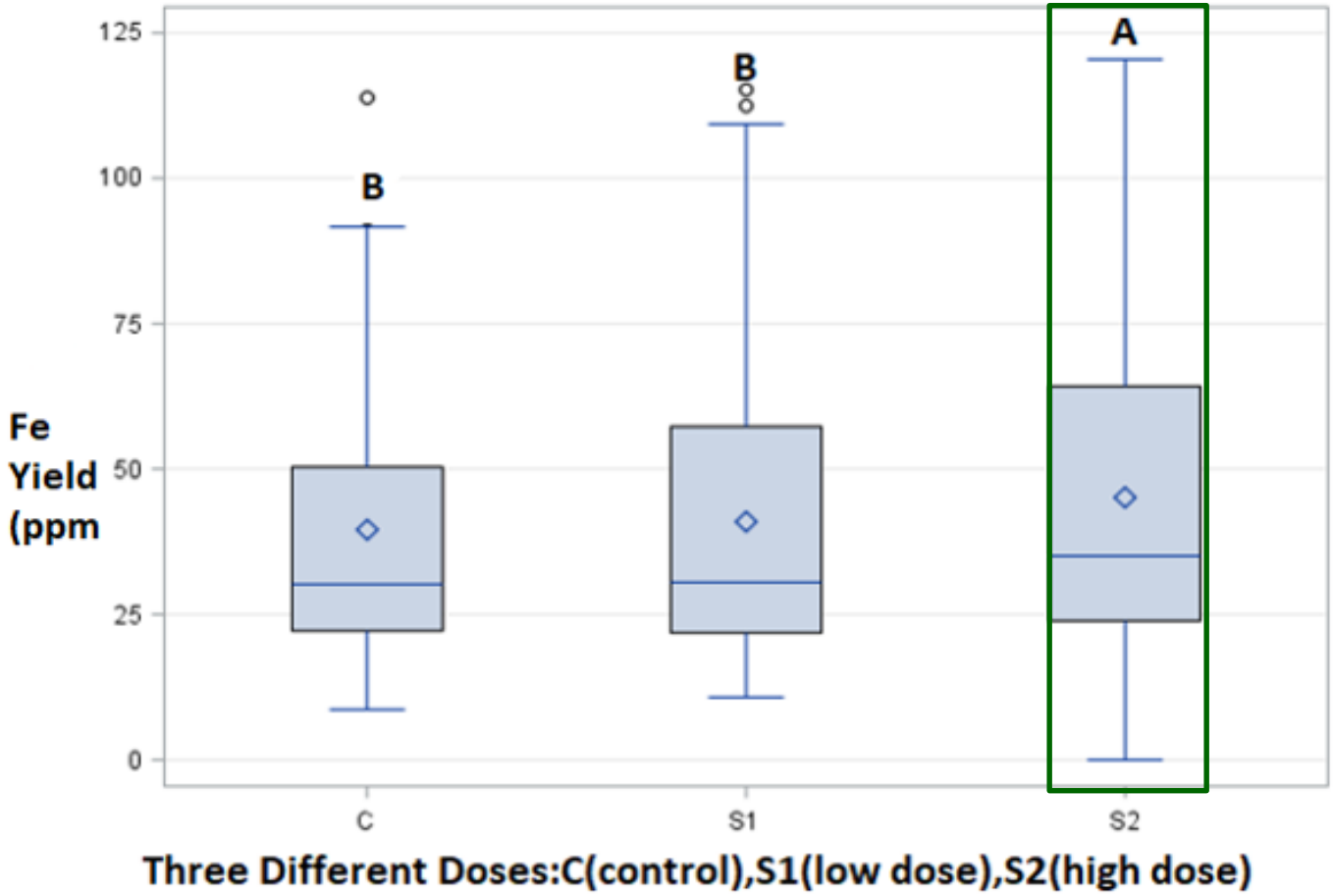


*Significance p<0.05

Results

Fe Yield(ppm)

Effect of three different doses of FeEDDHA on Fe yield (ppm) of seeds at Elrose and Moose Jaw,2015 & 2016



F-Value 3.69*

*Significance p<0.05

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Results

Fe Yield(ppm)(contd.)

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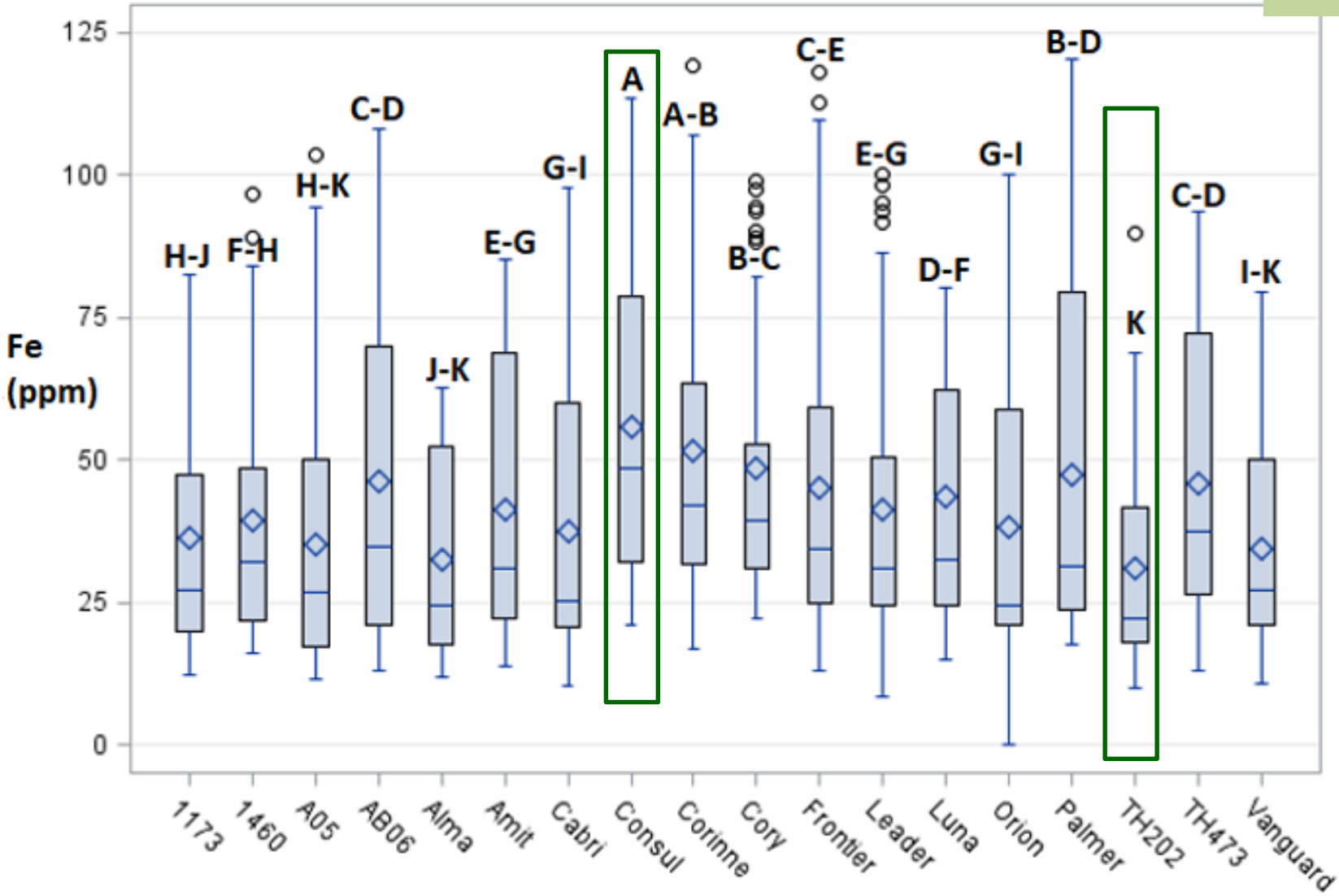
Effect of eighteen different cultivars with three different doses of FeEDDHA on Fe yield (ppm) of seeds at Elrose and Moose Jaw,2015 & 2016

F-Value 3.69*



*Significance p<0.05

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Results

Fe Conc. and Fe Yield(ppm)

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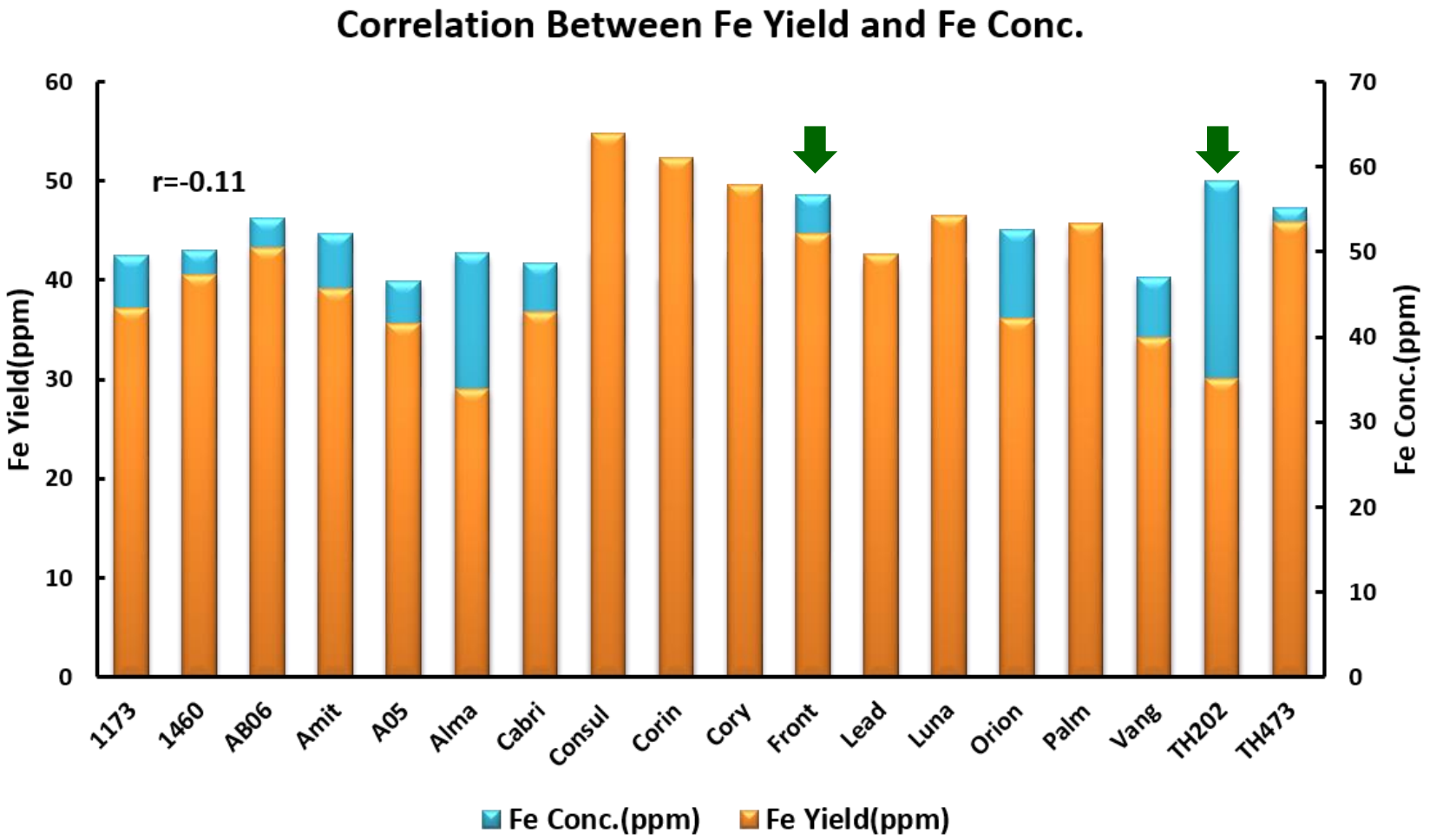

Conclusions

- Iron conc. level increased by adding high doses of FeEDDHA compare to control
- Genotype TH202 showed the highest Fe conc.(ppm) followed by frontier
- Iron yield(ppm) also increased significantly with high doses of FeEDDHA
- Correlation between fe conc. and yield showed weak negative correlation

Main question?

Is it possible to biofortify chickpea seeds with iron (Fe) fertilizer as a rapid way to achieve increased level of iron (Fe) concentration in chickpea to address iron deficiency?

YES!

Acknowledgements

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