Role of selenium on nitrogen fixation and lentil (*Lens culinaris* L.) grain yield

Lukshman J Ekanayake , Dil Thavarajah*, Pushparajah Thavarajah, Eric Viall, Blaine Schatz
Pulse Quality and Nutrition, North Dakota State University, Fargo, North Dakota, USA.
Contact information: lukshman.ekanayake@my.ndsu.edu *corresponding author: dilrukshi.thavarajah@ndsu.edu

Introduction

Selenium (Se) is an essential element in human nutrition. More than 15% of the global population is Se deficient as a result of diets low in bioavailable Se [(2)]. Agronomic biofortification is identified as a sustainable approach to increase the Se level in food crops. Application of Se fertilizer has increased the crop yield of lettuce (*Lactuca sativa*), flax (*Linum usitatissimum*), sorghum (*Sorghum bicolor*), rice (*Oryza sativa*), and corn (*Zea mays*)[(1)]. Lentil (*Lens culinaris* L.) is a major pulse crop grown in the northern plains of the United States and Canada. Lentil is identified as a candidate pulse crop in providing range of micronutrients including Se[(3)]. Therefore, this study was conducted to determine the effect of Se application in response to grain yield and nitrogen fixation in lentils.

Objectives

To determine the physiological role of selenium in field-grown lentils with response to increased grain yield.

Hypothesis

Low dosage of selenium application will increase grain yield as a result of increased antioxidant protection.

Experimental methods

The study was conducted at the Carrington Research and Extension Center (CREC), ND in 2012 and 2013. Five lentil varieties (CDC Maxim, CDC Richlea, CDC Viceroy, CDC Imigreen, and CDC Impress) were grown in a randomized complete block design with four replicates. Three selenium treatments: 1) 30 g ha^{-1} of selenate (SeO_4^{-2}), 2) 30 g ha^{-1} of selenite (SeO_3^{-2}) and 3) no selenium (control) were applied at seeding and 50% flowering. Each plot size was 112 ft^2 with the seeding rate of 18 plants per ft^2. A total of 120 plots were seeded. All agronomic practices were followed as recommended by the CREC. Total plot yield, 1000 seed weight, color, total starch, protein, and seed moisture were measured. Data from both years were combined and analyzed using PROC GLM mixed model (SAS Institute, 2011). Fisher's LSD at ≤0.05 was performed for mean separation.

Results and discussion

Table 1. ANOVA for combine analysis in 2012 and 2013.

Source	DF	Yield (g)	1000 seed weight (g)	Chlorophyll (SPAD)
			Pr > F	
year	1	0.1829	0.0011	0.0014
geno	4	0.4086	0.0001	0.0822
trt	2	<.0001	0.9875	0.3724
rep	3	0.8061	0.6518	0.0131
Year*trt	2	<.0001	0.5180	0.8055
year*geno	4	<.0001	0.0102	0.0289
trt*geno	8	<.0001	0.9355	0.8175
year*trt*geno	8	<.0001	0.7312	0.5662

Values are significantly different at $p<0.05$.

Table 2. Mean values for yield, 1000 seed weight, chlorophyll (Gene*year)

Year	Genotype	Yield (g)	Chlorophyll (SPAD)	1000 seed weight (g)
2012	CDC Maxim	1722a	45ab	38c
	CDC Impress	1278c	39c	51b
	CDC Viceroy	1468b	46b	31d
	CDC Richlea	1189d	45b	50b
	CDC Imigreen	1235d	47a	55a
2013	CDC Maxim	1552b	39a	45d
	CDC Impress	1550b	35b	54c
	CDC Viceroy	1778a	36b	37e
	CDC Richlea	1756a	37b	58b
	CDC Imigreen	1269c	39a	61a

Means followed by different letters within a column and a year are significantly different at $p<0.05$

Table 3. Mean values for yield, 1000 seed weight, chlorophyll (treatment*year)

Year	Treatment	Yield (g)	Chlorophyll (SPAD)	1000 seed weight (g)
2012	Selenite	1627a	44	45
	Selenate	1329b	44	45
	Control	1179c	45	45
2013	Selenite	1712a	37	51
	Selenate	1682a	36	51
	Control	1348b	38	51

Means followed by different letters within a column and a year are significantly different at $p<0.05$

Figure 1. Mean yield (Gene*year)

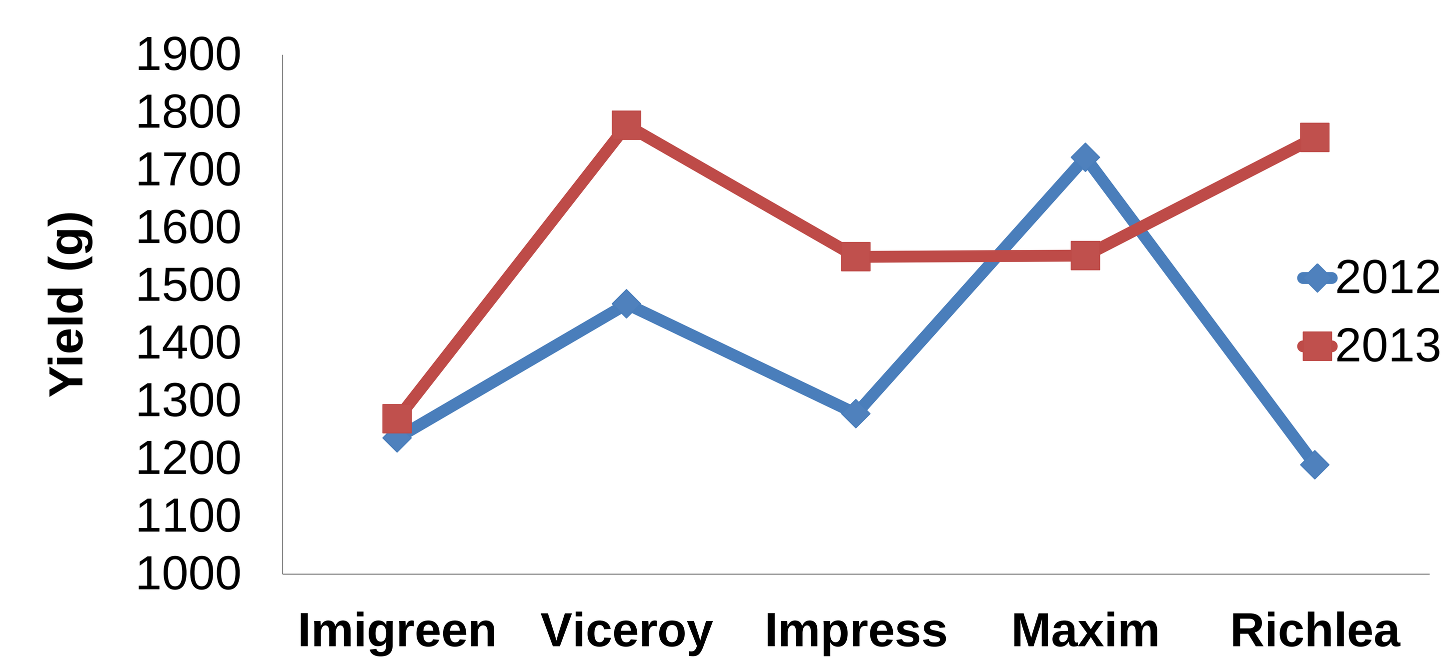
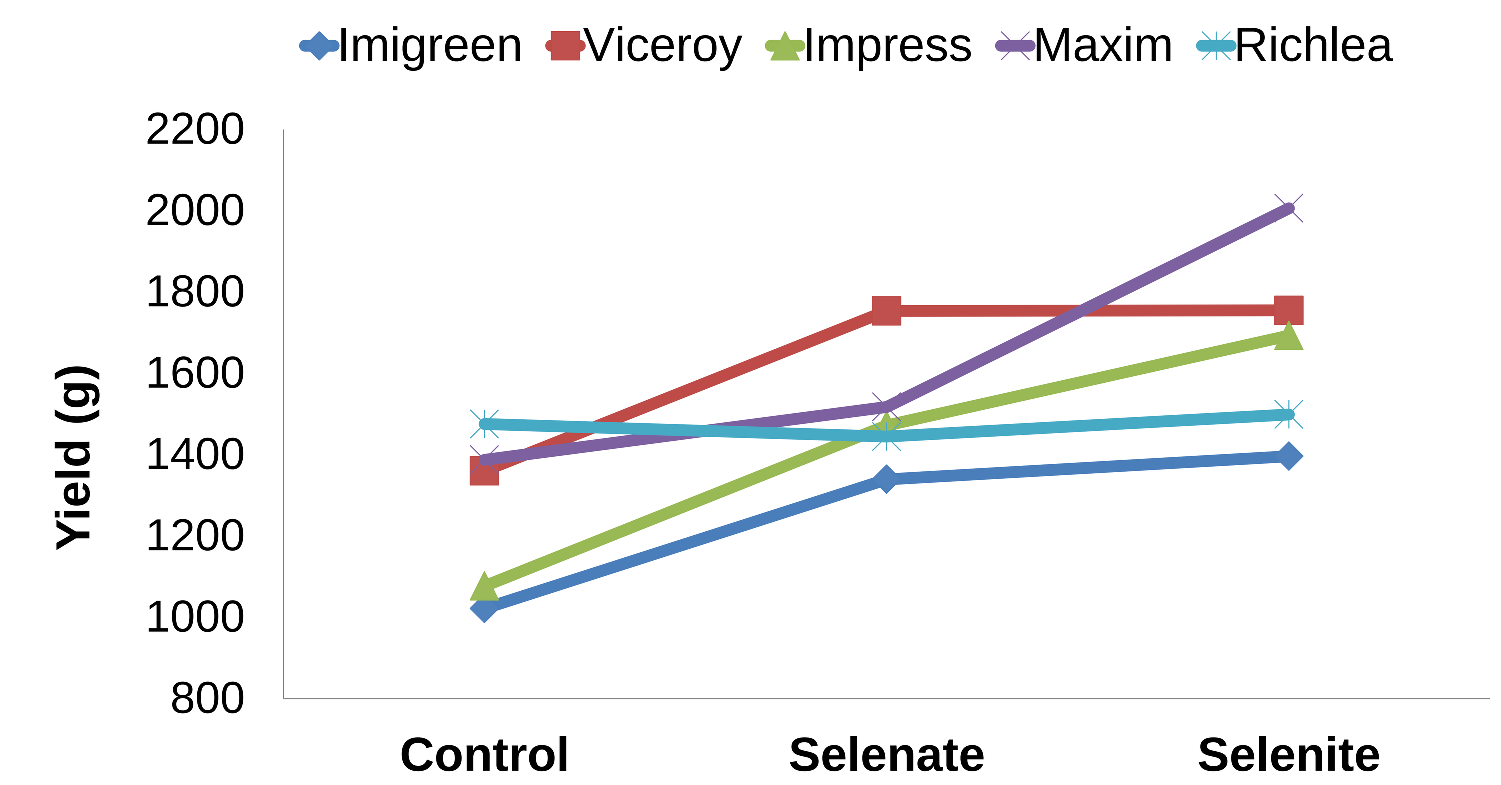


Figure 2. Mean yield (Treatment*gene)



Conclusion

- Application of selenium increases the lentil yield
- Selenite is the effective form of Se fertilizer
- Different lentil genotypes responses to the Se differently

References

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