Enhanced Accumulation of Phenolics in Pea (*Pisum sativum* L.) Seeds upon Foliar Application of Selenate and Zinc Oxide

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Background

- Selenium (Se) and zinc (Zn) are essential antioxidant enzyme cofactors[1-4]. Improved Se and Zn concentrations in the plant may affect accumulation of bioactive plant compounds
- Foliar Se/Zn application (agronomic biofortification) is a highly effective method of plant biofortification[5,6]
- Pea (*Pisum sativum* L.) is an important legume and staple crop grown globally and employed for animal and human consumption due to its high protein and micronutrient concentrations[7-10]
- Phenolic compounds derived from natural sources may protect against various health problems incl. certain cancers, cardiovascular diseases, type 2 diabetes, etc.[11,12]

Objectives and Methods

A two-year pot-experiment (2014-2015) was conducted in Nitra (Slovakia) to examine effects of foliar-applied sodium selenate (0/50/100g Se/ha) and zinc oxide (0/375/750g Zn/ha) at the flowering stage on the concentration of Se and Zn, total phenolic and total flavonoid contents, and total antioxidant activity (ABTS, FRAP) of seeds of two pea varieties (Ambassador, Premium).

Analyses

- Concentration of Se / Zn: ICP-MS / ICP-OES[13]
- Total phenolic and flavonoid contents: spectrophotometrically[14]
- total antioxidant activity (ABTS, FRAP): spectrophotometrically[14,15]

Statistical analysis: linear mixed models (SPSS, vs. 19)

Figure 1. Pot-experiment with peas conducted in Nitra (Slovakia).

Results

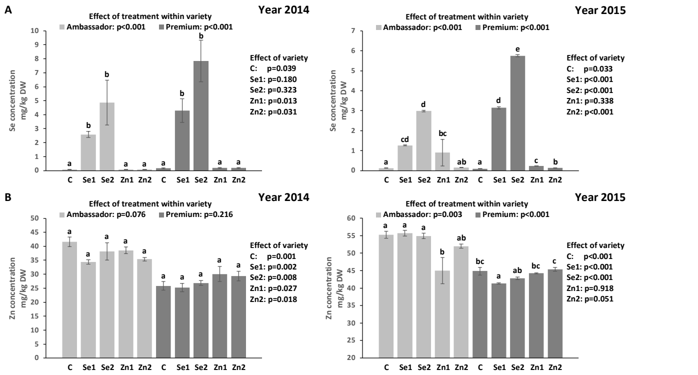

Figure 2. Effect of foliar Se and Zn treatments and variety in two growing seasons (2014 and 2015) on the Se concentration (A) and Zn concentration (B) in pea seeds. C (control): without Se and Zn; Se1: 50 g Se/ha; Se2: 100 g Se/ha; Zn1: 375 g Zn/ha; Zn2: 750 g Zn/ha; mean ± SD; n = 4. Bars not sharing the same superscript are significantly different within variety. P-values on the right side of the figure show the effect of treatment across the 2 varieties (i.e. Ambassador vs. Premium).

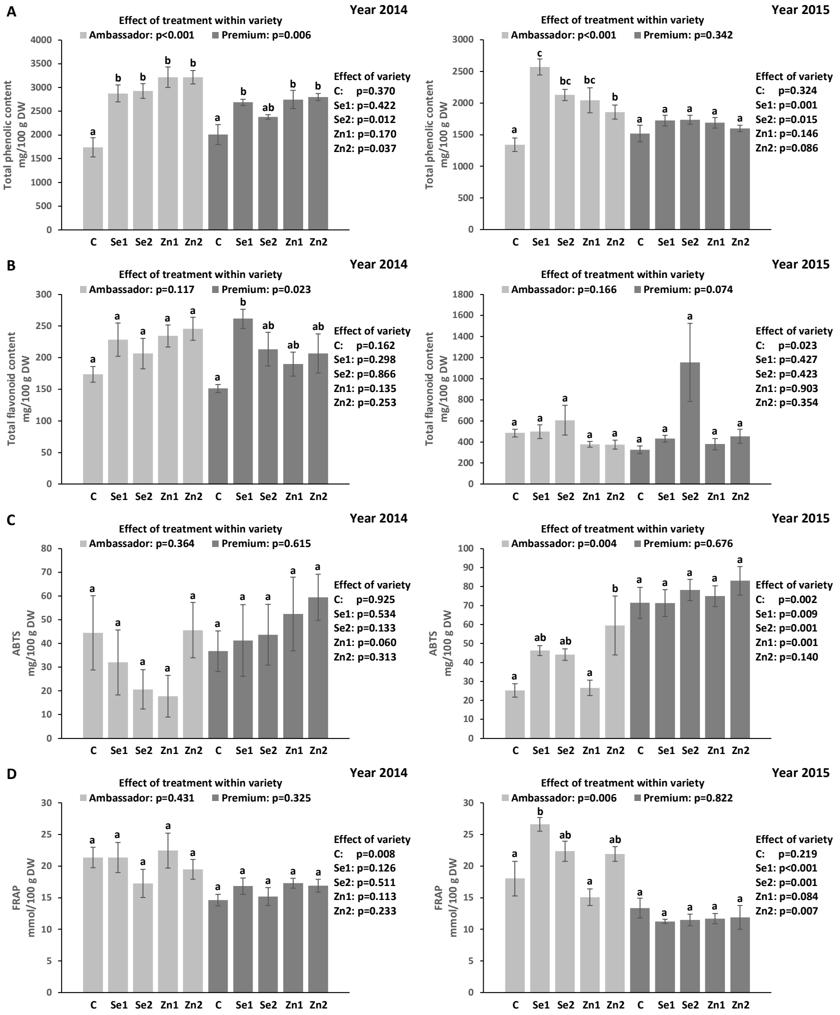

Figure 3. Effect of foliar Se and Zn treatments and variety in two growing seasons (2014 and 2015) on total phenolic content (A), total flavonoid content (B) and total antioxidant activity (ABTS and FRAP) (C and D, respectively) of pea seeds. C (control): without Se and Zn; Se1: 50 g Se/ha; Se2: 100 g Se/ha; Zn1: 375 g Zn/ha; Zn2: 750 g Zn/ha; mean ± SD; n = 4. Bars not sharing the same superscript are significantly different within variety. P-values on the right side of the figure show the effect of treatment across the 2 varieties (i.e. Ambassador vs. Premium).

Conclusions

- While Se treatments improved Se accumulation in both seed varieties dose-dependently, Zn treatments did not improve seed Zn accumulation. Premium accumulated greater amounts of Se in seeds than Ambassador. Selenium concentrations were highest in seeds of Premium treated with 100 g Se/ha (7.84 mg/kg DW) vs. the control (0.16 mg/kg DW)
- Selenium and zinc treatments positively influenced total phenolic content and in part ABTS/FRAP of Ambassador
- The highest total phenolic content was found in Ambassador treated with 100 g Se/ha and 750 g Zn/ha (2926 and 3221 mg/100 g DW, respectively) vs. the control (1737 mg/100 g DW)
- Selenium at 50 g/ha increased total flavonoid content vs. the control (261 vs. 151 mg/100 g DW) in Premium (2014 growing season)
- The results are important for producing pea/pea products rich in health-beneficial bioactive plant compounds

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