

# INSIDE THE POTATO: USING HPLC TO INVESTIGATE BLACKSPOT BRUISING IN RESPONSE TO POTASSIUM FERTILIZATION

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### BLACKSPOT BRUISING:

The mechanism for blackspot bruising damage occurs in two steps. First, physical impact on tubers damage cells and expose vacuolar phenolic compounds to the enzyme polyphenol oxidase (PPO). Second, PPO oxidizes phenolic compounds (e.g. tyrosinase) to quinones that can then polymerize to form melanins, the pigments responsible for the discoloration observed in blackspot bruising.<sup>3</sup>



**INTRODUCTION:** Potato (*Solanum tuberosum*) is the world's top nongrain food crop.<sup>2</sup> Bruising in potatoes is a huge problem that costs the industry an estimated 860 million pounds of product per year.<sup>4</sup> Blackspot bruising is a detrimental blemish that results in dark pigmentation to the internal flesh of the tuber.<sup>3</sup> This project investigates how potassium fertilization effects the biochemical potential of blackspot bruising. Biochemical potential was determined using high pressure liquid chromatography (HPLC) to quantify select compounds potentially contributing to blackspot – ascorbic acid, chlorogenic acid, and tyrosine. HPLC results were evaluated against an enzymatic browning test to determine the correlation on pigmentation.



**HPLC:** HPLC uses the foundational concept of chromatography where a mixture is run through a media that will separate chemical compounds based on their varying affinity to the media. HPLC elevates this concept by operating in a liquid phase and applying high pressure to allow for the analysis of very small particles.<sup>1</sup>



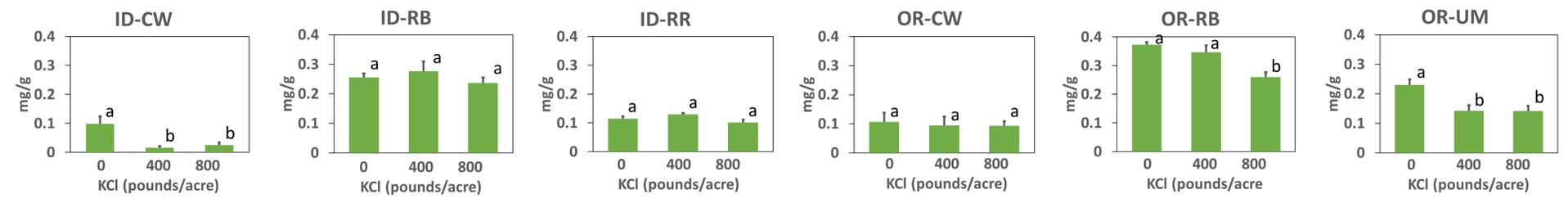
### METHODS:

- 6 trial crops - Idaho varieties include Clearwater Russet, Russet Burbank, and Ranger Russet. Oregon varieties include Clearwater Russet, Russet Burbank, and Umatilla Russet.
- A granular fertilizer of potassium chloride (KCl) was applied at 3 levels of concentration - 0 lbs/acre, 400 lbs/acre, 800 lbs/acre.
- Tubers were freeze dried and ground to powder
- Extractions were performed on the powder samples to determine their biochemical potential by quantifying select compounds via HPLC techniques
- An enzymatic bruising test was performed on the powder samples through spectroscopy

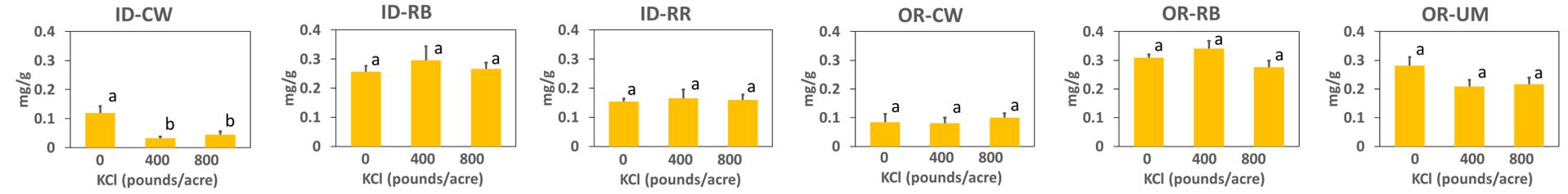


### RESULTS:

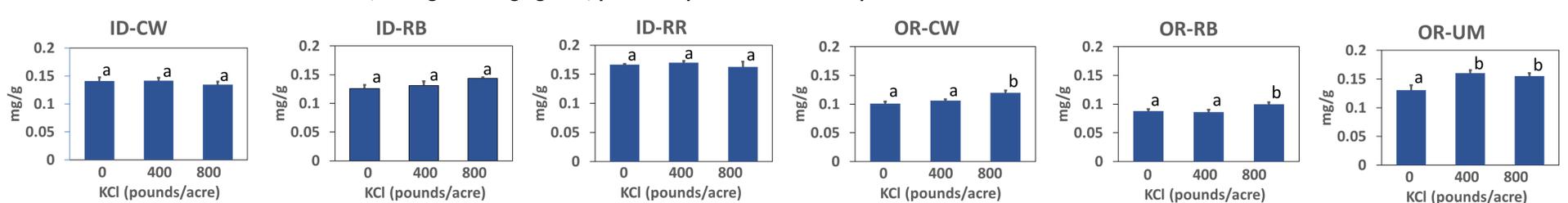
**Tyrosine:** Phenolic compound and binding substrate for PPO<sup>3</sup>; **potential inverse relationship to KCl fertilization**



**Phenylalanine:** involved in the metabolism of phenolic compounds<sup>3</sup>, in same pathway as tyrosine; **potential inverse relationship to KCl fertilization**



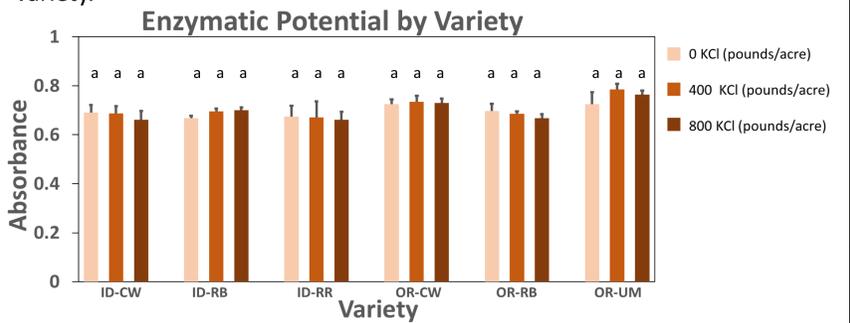
**Ascorbic Acid:** well known antioxidant, strong reducing agent<sup>3</sup>; **potential positive relationship to KCl fertilization**



**Chlorogenic Acid:** Phenolic compound and hypothesized substrate for PPO<sup>3</sup>; **no statistical significance between treatments**

**Tryptophan:** May indicate tuber health and be indirectly influential from a separate pathway; **no statistical significance between treatments, low quantification**

**Enzymatic Browning:** The biochemical potential test for enzymatic browning showed no significant difference between varying concentrations of potassium fertilizer. Error bars are compared for significance within each variety.



### CONCLUSIONS:

- Potassium fertilization may not affect the susceptibility of a tuber to blackspot bruising
- No correlation to KCl fertilizer concentration was found consistently in all six crops
- The results of the enzymatic biochemical potential test showed no difference across any treatment
- The quantity of the compounds and variety of potato appeared to have no influence over the enzymatic potential results either

### References:

1. Dong, M. 2006. *Modern HPLC for Practicing Scientists*. John Wiley and Sons.
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3. Goyer, A., Pelle, J. 2018. Relationships Between Tyrosine, Phenylalanine, Chlorogenic Acid, and Ascorbic Acid Concentrations and Blackspot Biochemical Potential and Blackspot Susceptibility in Stored Russet Potatoes. *Journal of the Science of Food and Agriculture* 98: 3735-3740.
4. Guenther, J. 2017. Economic and Environmental Benefits of Biotech Potatoes with Traits for Bruise Resistance, Late Blight Resistance, and Cold Storage. *AgBioForum* 20: 37-45.

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