

# Studying the effects of environmental conditions on the quality of quinoa seeds

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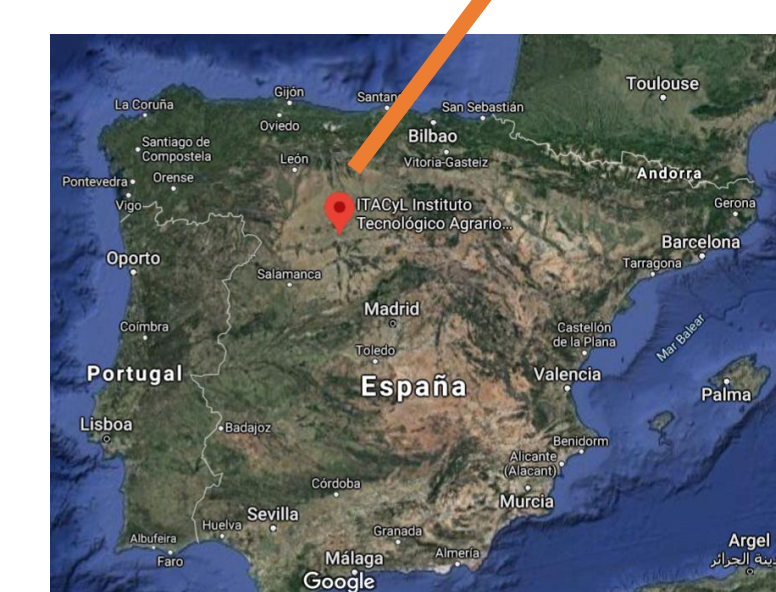
## INTRODUCTION

Quinoa is an agronomically interesting crop due to the high nutritional value of its seeds and its remarkable capacity to grow and adapt to a wide range of agroecological conditions<sup>1</sup>. Despite the importance of developing nutritious varieties to contribute to food security, little efforts have been made trying to identify the mechanisms responsible for changes in the nutritional properties of the seeds under changing environmental conditions.

In this study we aim to evaluate the effect that the adaptation to different environmental conditions has on the nutritional profile of quinoa. We analyzed different physiological and nutritional seed's traits in six different quinoa varieties grown in the field during three consecutive years.

Cultivar
Titicaca
Vikinga
Regalona
Puno
Q3
Q5

Experimental trials:  
Zamadueñas, Valladolid



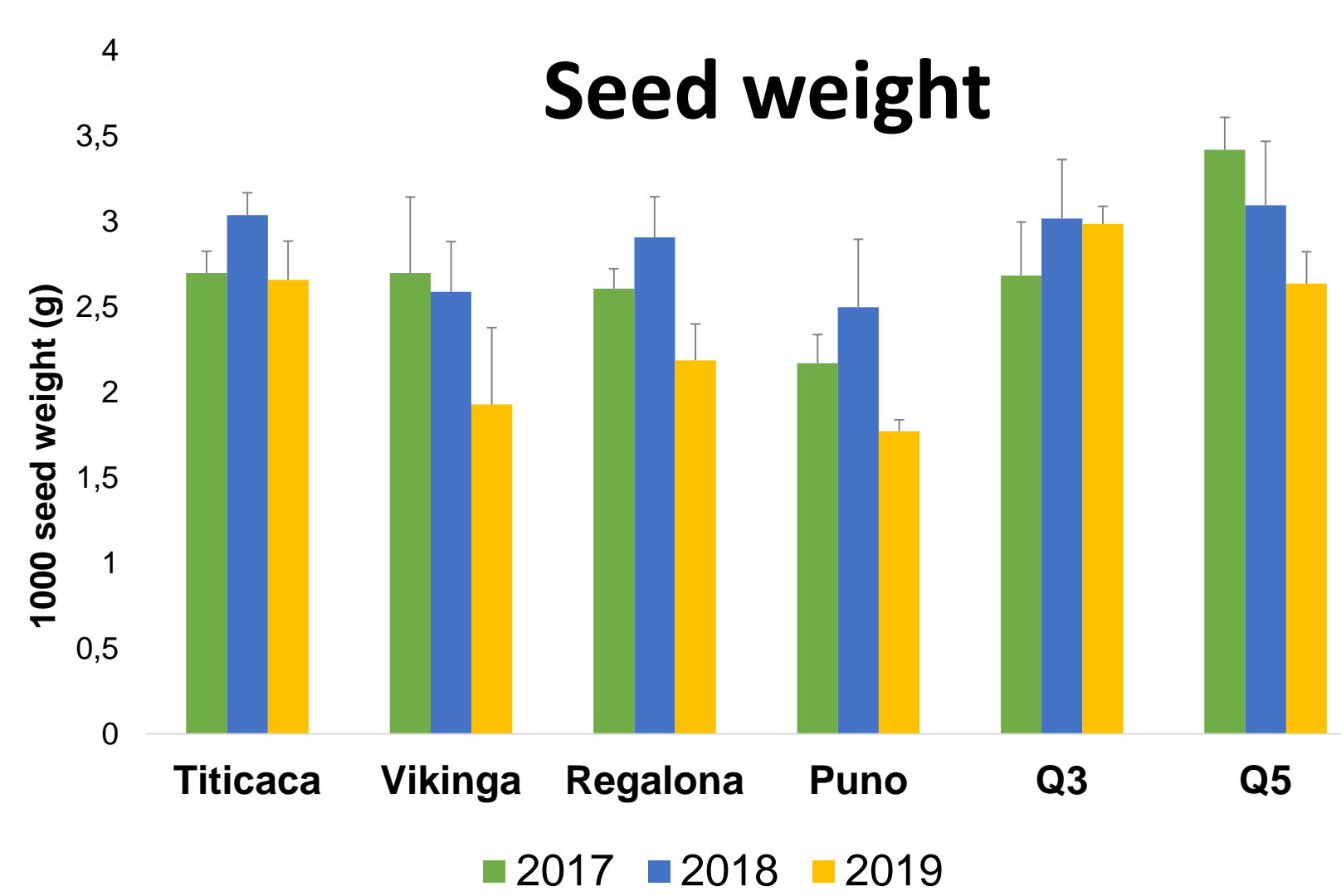
Annuity
2017
2018
2019

## RESULTS

### Yield (t/ha)

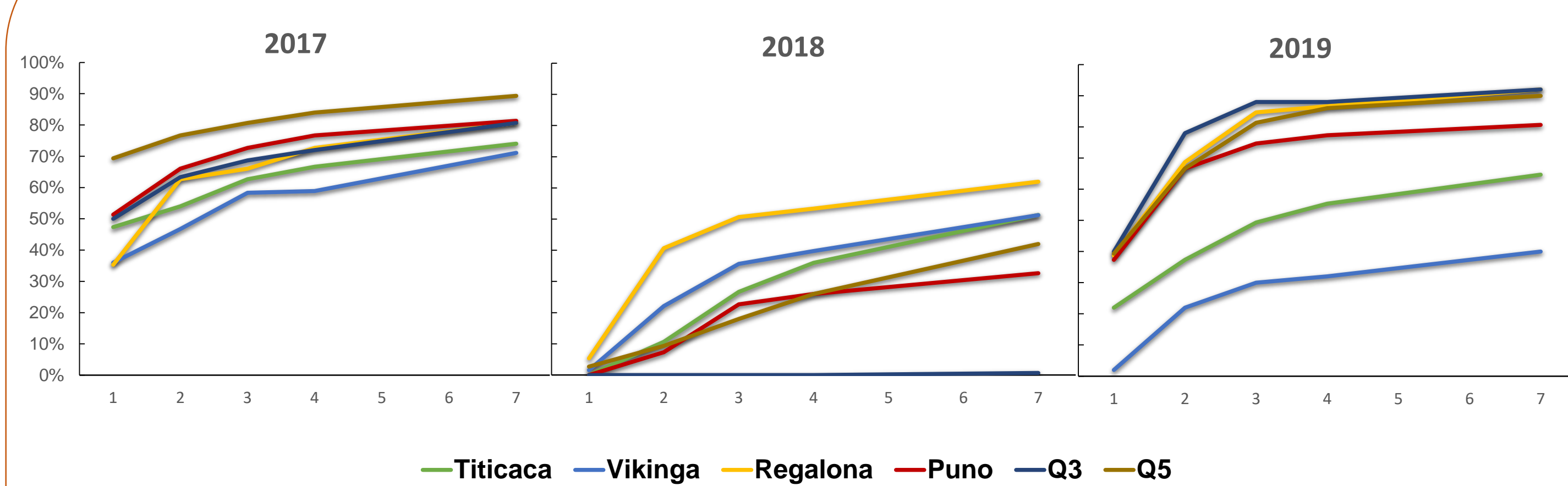
	Titicaca	Vikinga	Regalona	Puno	Q3	Q5
<b>2017</b>	3,06	3,1	2,39	3,25	2,12	3,21
<b>2018</b>	0,79	0,72	0,70	2,29	2,1	0,83
<b>2019</b>	2,72	0,23	2,05	2,25	1,37	2,36

The highest quinoa yields were obtained in 2017, and the 2018 showed the lowest. Vikinga showed large yield penalties in 2018 and 2019.

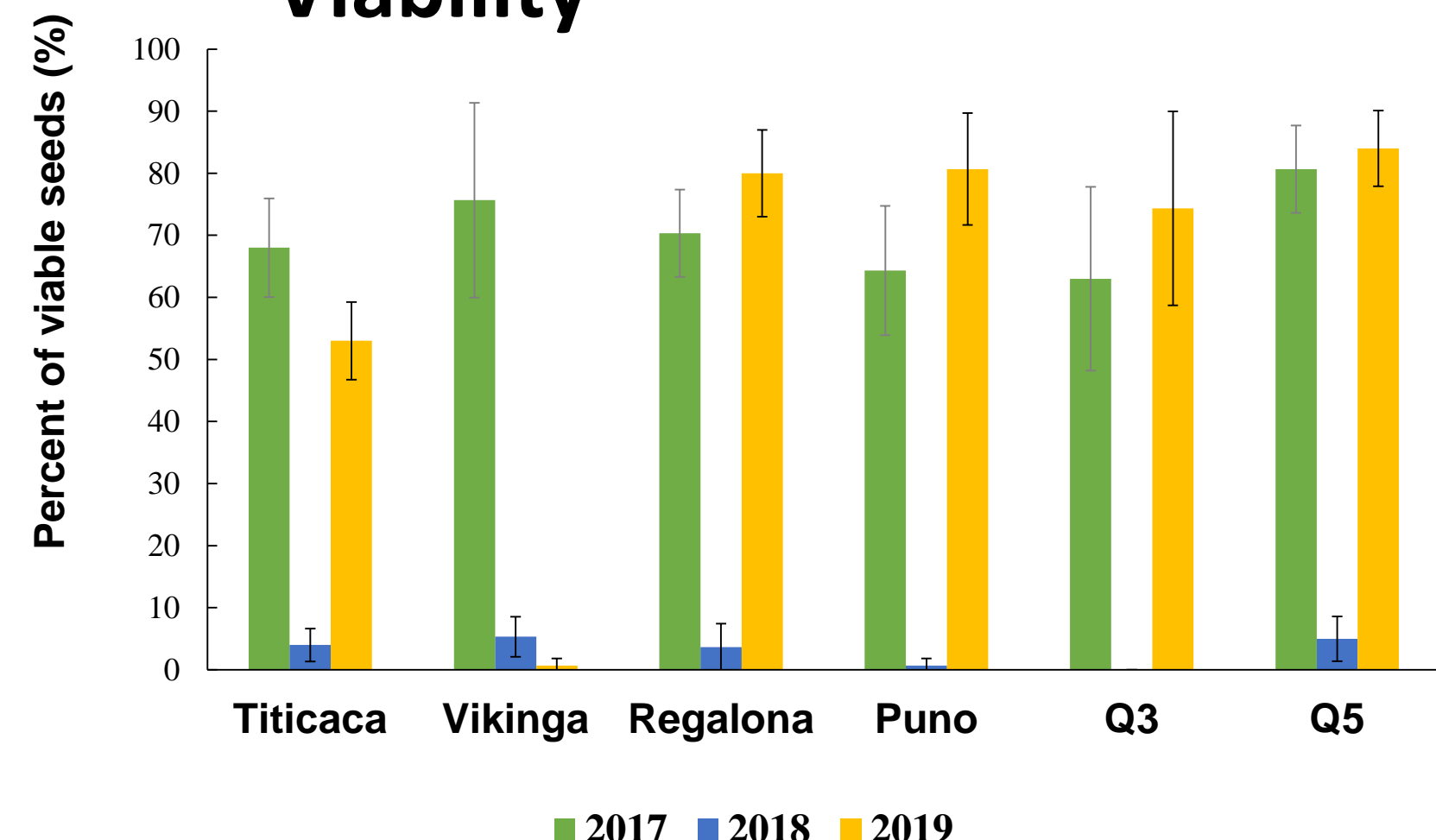


Generally, 2018 presented heavier seeds compared to 2017 or 2019. Changes were found also among varieties, being Puno the lighter variety among them.

### Germinative rate



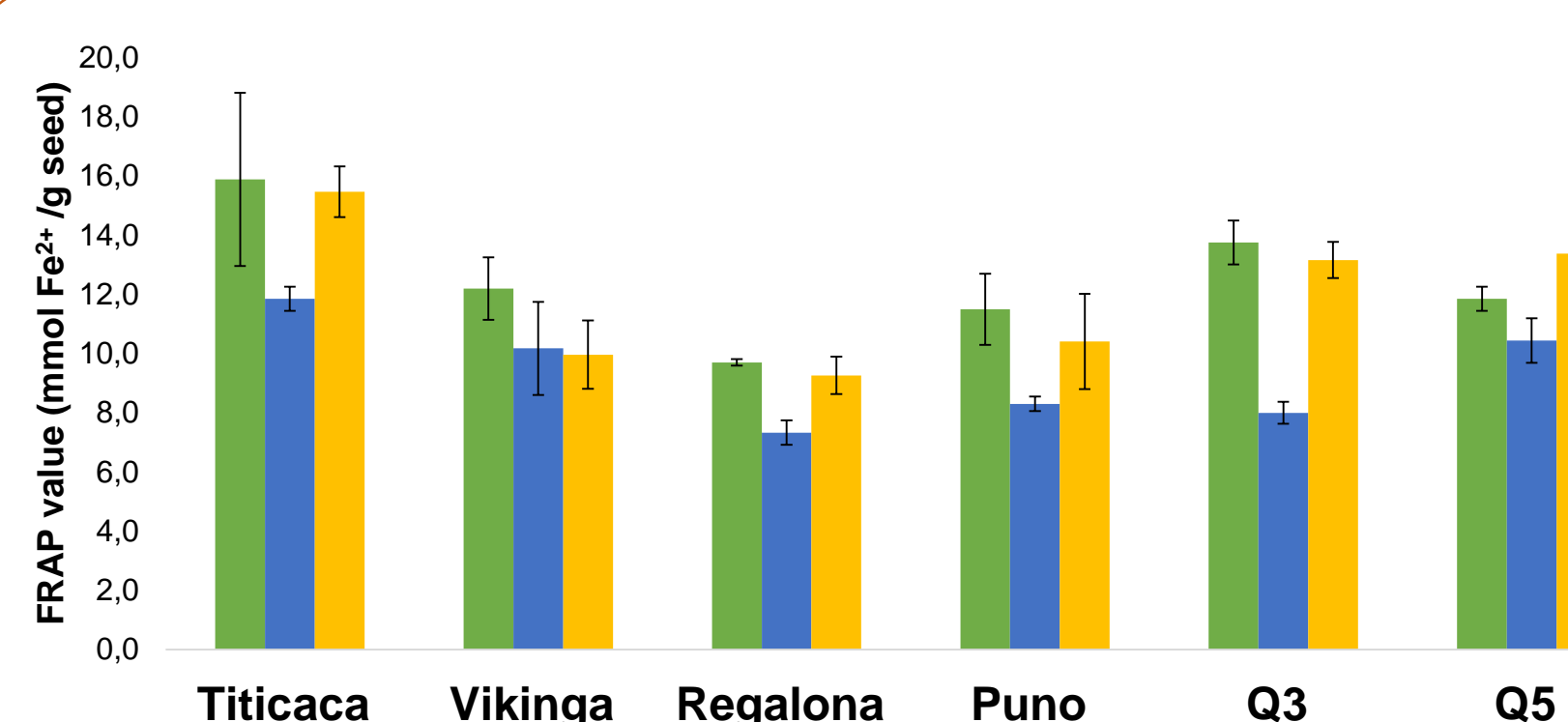
### Viability



Germination rates were significantly lower in 2018 compared to 2017 or 2019.

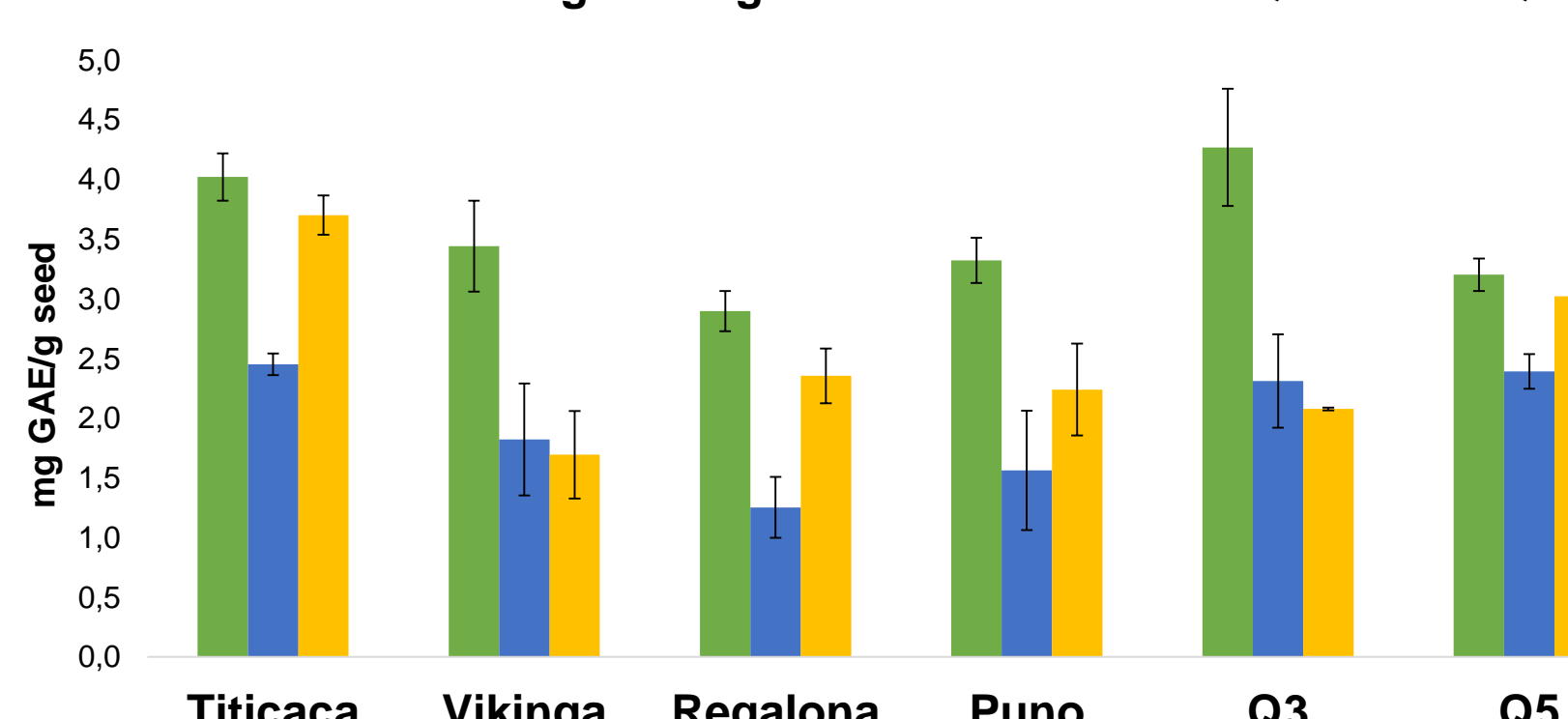
These results were positively correlated with a steeped decrease in seed viability observed in 2018.

### Antioxidant capacity (FRAP assay <sup>2</sup>)



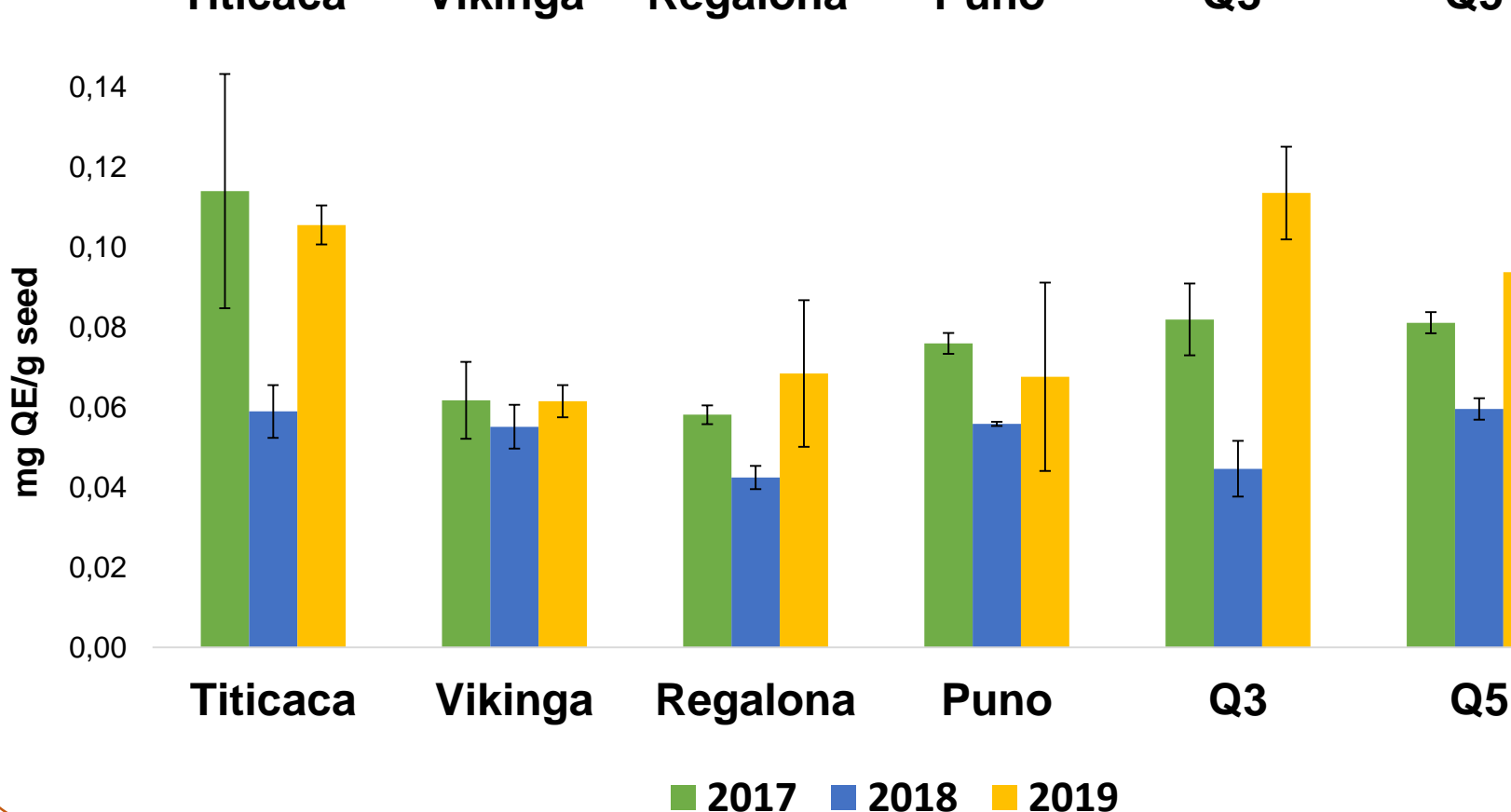
Seeds harvested in 2018 showed significantly lower antioxidant capacity. Titicaca was the cultivar with higher FRAP value while Puno and Regalona had the lowest.

### Total phenolic content



The phenolic content was significantly higher in 2017 seeds, while 2018 seeds showed lower phenolic contents. Titicaca contained more phenolic compounds and Regalona had fewer.

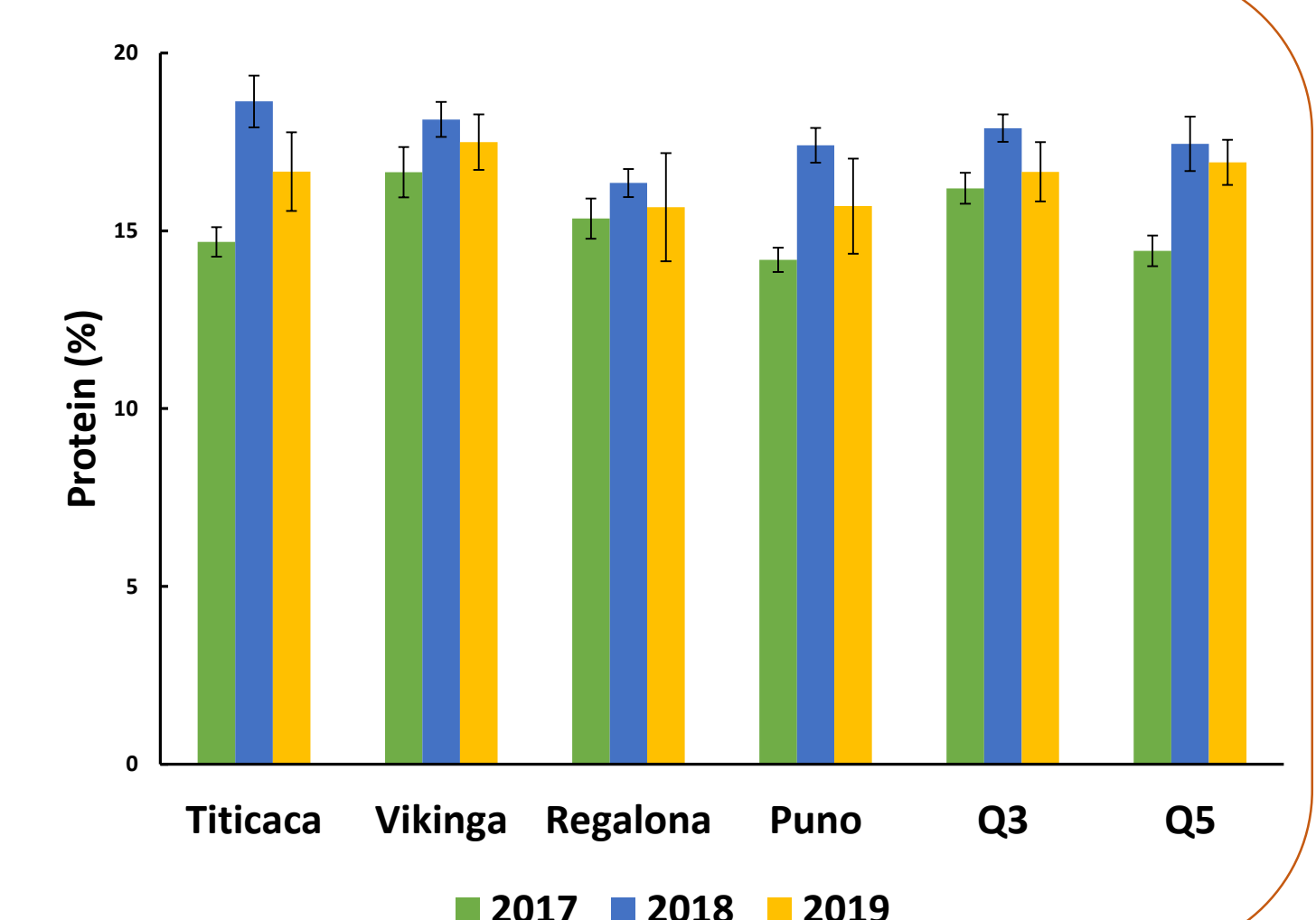
### Total flavonoid content



In general, 2018 seeds had a higher content of flavonoids. Titicaca was the cultivar with the highest flavonoid content while Regalona and Vikinga had lower contents.

### Protein content

In general terms, 2018 presented the highest protein content while 2017 showed the lowest. Puno, Titicaca and Q5 were the only varieties showing significantly different protein content amongst annuities.



## CONCLUSIONS

Our results provide new insights into the impact of environmental factors (such as temperature, water supply or photoperiod, that varied between years) on seed quality (including physiological and nutritional properties). Thus, we can conclude that the environmental factors determine:

- Seed weight, being 2018 the annuity with heavier seeds.
- Seed viability, having 2018 seeds better viability and germinative rates.
- Antioxidants content, which was higher in 2017 and 2019.
- Protein content, which was higher in 2018, the annuity with the lowest yields.

## FUNDING



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## REFERENCES

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2. Benzie, I. F. F., & Strain, J. J. (1996). The Ferric Reducing Ability of Plasma (FRAP) as a Measure of "Antioxidant Power": The FRAP Assay. Analytical Biochemistry, 239, 70–76.