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Differentiation of soybean quality parameters according to production environment: linkage to the origin

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Soybean grain composition is determined by the genotype, the environment and their interaction. Regarding the environment, Argentina has a wide diversity of homogeneous productive zones in terms of climate and soil, and local production practices related to history and culture (Alimentos Argentinos, 2019). Their combination determines the specific quality and potential of products linked to origin. Soybean protein content varies through the years according to the producing area. A remarkable decrease has been reported in the so-called soybean core producing area (SW and S of Santa Fe, S, SW and NE of Córdoba, and N of Buenos Aires; Cuniberti, 2018) while the protein content has remained nearly constant through the years in the southern producing area, near Quequén port (SE of Buenos Aires). In addition, bibliography about soybean quality is more abundant regarding the core zone (Maestri *et al.*, 1998; Dardanelli *et al.*, 2006; Cuniberti *et al.*, 2006, 2010, 2018; Herrero *et al.*, 2013, 2017; de Felipe *et al.*, 2016; Bosaz *et al.*, 2019; Mir *et al.*, 2018), but there are still few reports available on the SE of Buenos Aires (Carpaneto, 2022). Therefore, the objective of this study was to quantify quality parameters (protein and oil) from soybean produced in different environments in the SE of Buenos Aires, hypothesizing that concentration of both grain components is associated with the environments where they are produced.

During 2021/2022 crop season 261 soybean grain samples were collected from commercial fields from 16 geographical departments that adequately represented the SE Buenos Aires producing area (Azul, Balcarce, Benito Juárez, Bolívar, Cnel. Suárez, Gral. Alvarado, Gral. Alvear, Gral. La Madrid, Gral. Madariaga, Gal. Pueyrredon, Laprida, Lobería, Necochea, Olavarría, San Cayetano, and Tandil). Industrial quality parameters (protein and oil content) were determined by near infrared (NIR) spectroscopic technology, and data is expressed as percentage on a dry basis. Information on planting date, geographical location, and cultivar maturity group (MG) was obtained along with each sample.

Environmental factors, such as location and planting date, were found to contribute with 26 % and 30 % to the total variability for protein content and oil content, respectively, while soybean genotype contributed 32 % and 34 % to the total variability for protein and oil content, respectively.

In the area considered, protein concentration varied between 32,4% and 41,7%, while oil concentration range was between 18,2 % and 24,7 %. A significant reduction in oil content (-0,9 %) and a non-significant increase in protein content (+0,5 %) were found for second crop soybeans (later planting dates), compared to first crop soybeans. In the latter, it was found a relationship between location and protein concentration with a gradient from higher to lower (38,4 % - 35,0 %) in the SE-NW direction (Figure 1). In the same diagonal, the oil concentration was the lowest in the entire explored area (≤ 21 %, Figure 2). Both, protein and oil content varied according to the MG as shown in Table 1.

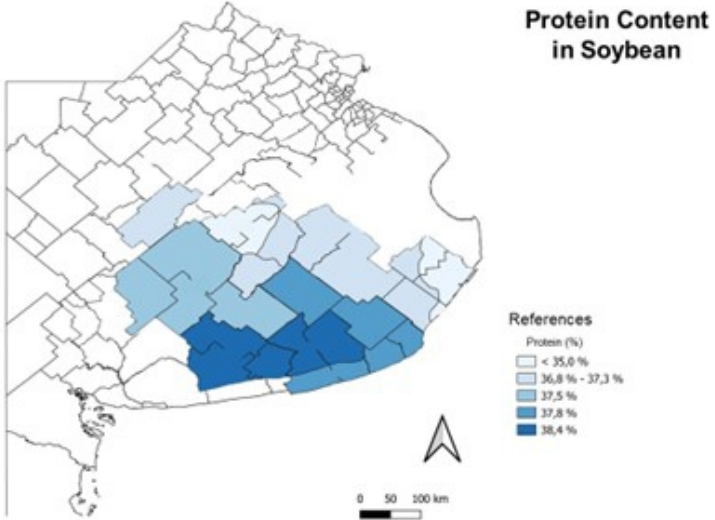


Figure 1. Concentration of protein in soybeans, expressed as a percentage on a dry basis, in the explored area.

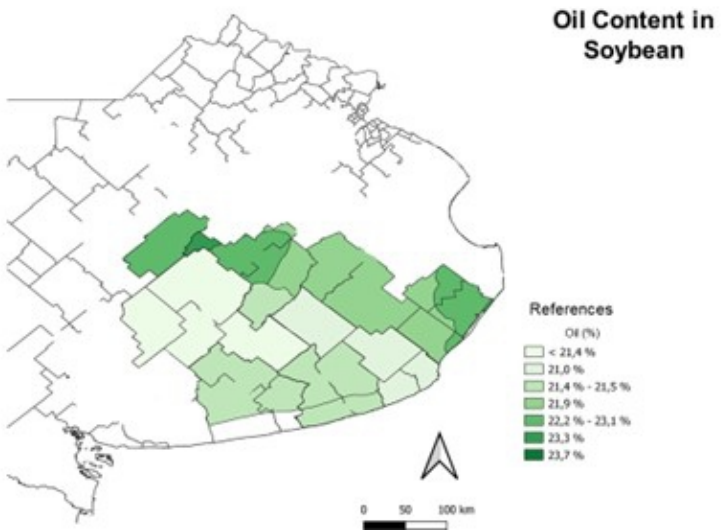


Figure 2. Concentration of oil in soybeans, expressed as a percentage on a dry basis, in the explored area.

Table 1. Average protein and oil content for soybean maturity groups (MG) from SE of Buenos Aires. Values are expressed as percentage on a dry basis.

MG	PROTEIN (%)*	OIL (5)
II C	39,0 a	20,6 b
II L	38,2 ab	20,5 b
III C	37,9 b	20,9 b
III L	37,8 b	20,9 b
IV C	37,7 b	21,1 b
IV L	36,9 c	21,6 a

* Means followed by the same letter in each column indicate non-significant differences according to least significant difference (LSD) test ($\alpha=0,05$).

The relationship of meteorological and location variables with protein content, although some significant regressions were found, their robustness was weak, and those variables would influence soybean protein content additively, as part of a more complex model.

Overall, these results would allow to affirm that the concentration of protein and oil in soybeans from the SE of Buenos Aires were associated with production environment. These findings would make possible to differentiate crop quality according to the environment, and to work for a denomination of origin. These studies should be continued to determine more accurately the effect of the environment on grain quality, identify other quality-related variables linked to the producing origin and promote differentiated local production.

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