

# New method to quantify the degree of hydration of barley grains using a grain scanner

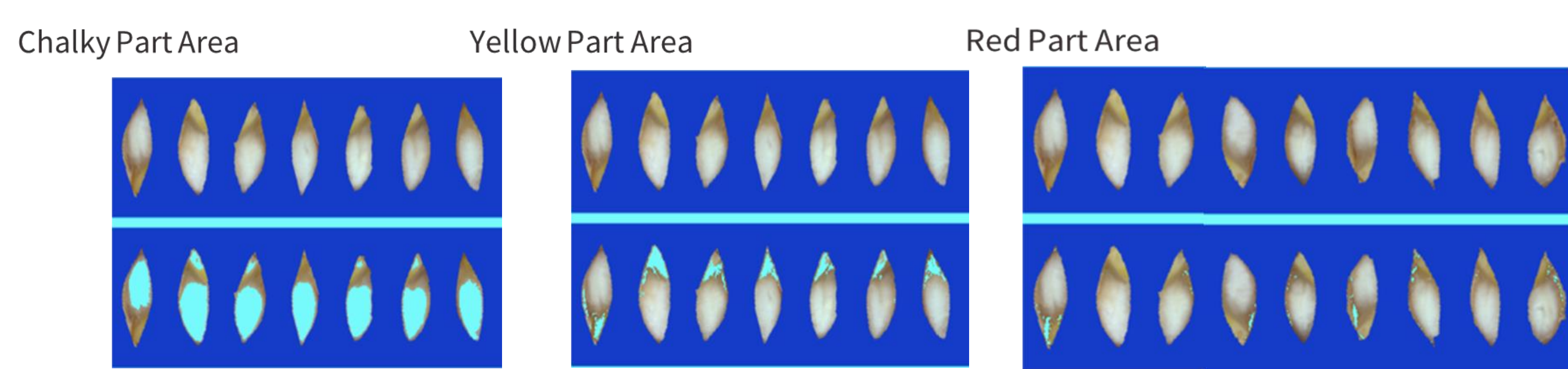
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## Introduction

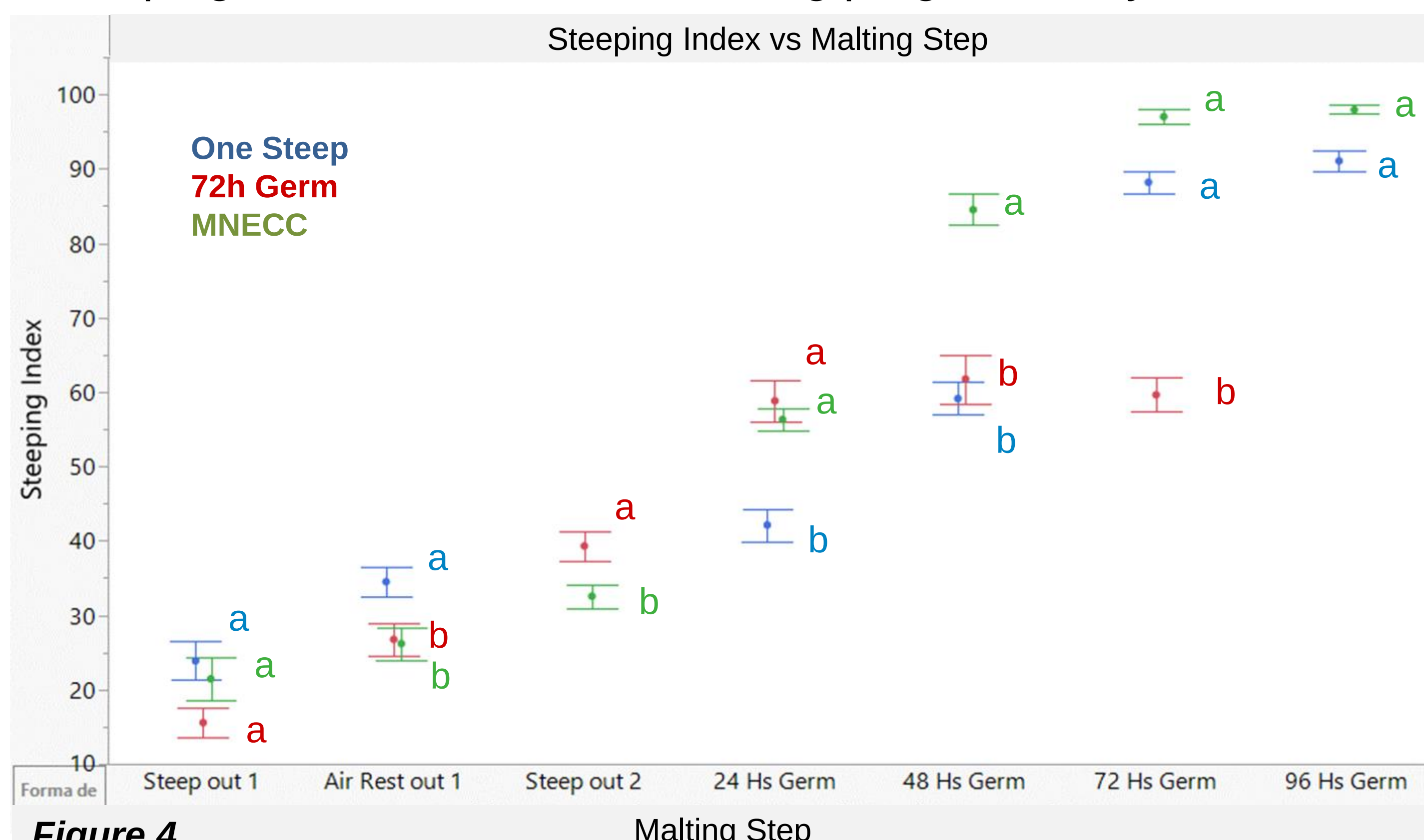
- Steeping process consist in submerging grain in water until the moisture content reached the required level.
- The water absorption depends on barley variety, year or harvesting conditions, the grain size and steeping regime during malting process.
- The degree of hydration of barley during malting process is an important factor to understand and determine.
- The aim of this study was to develop a new and reliable method to quantify the degree of hydration using a grain scanner.

## Results & Discussion



**Figure 3** - Photos of Chalky, Yellow and Red part area of the grains

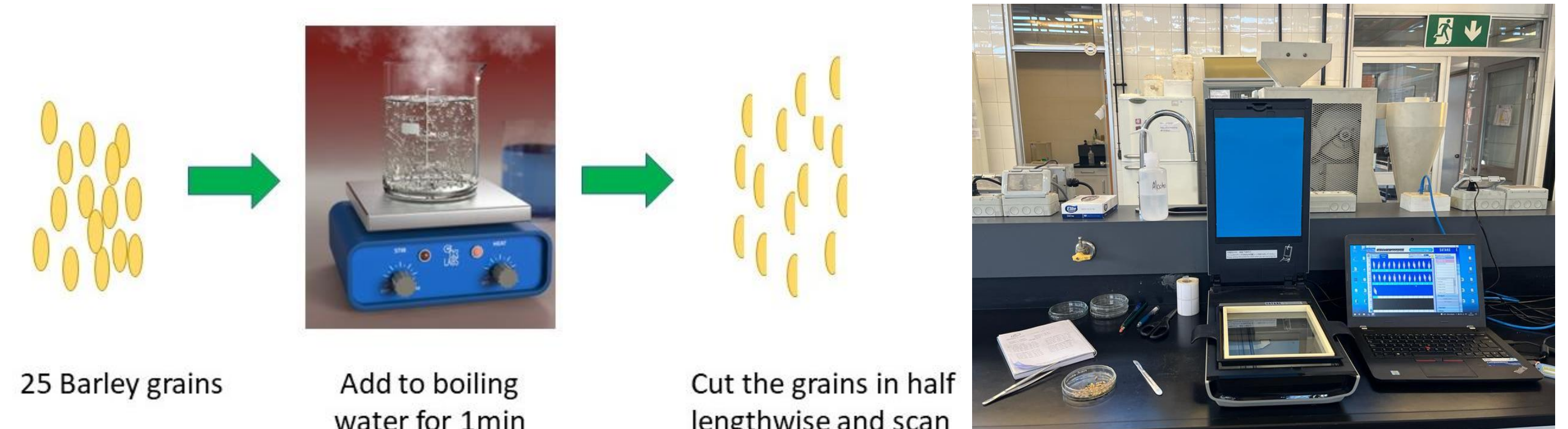
- Chalky Area parameter was adjusted to determine the bright white area that corresponds to the non-hydrated part. The Yellow and Red parameter was adjusted to quantify the husk area (**Figure 3**).
- The classification was based on the Chalky Area Ratio (bright white area/total area of the grain). For non-hydrated barley grains, the data need to be extracted to an excel file, in order to obtain a Chalky Area Ratio according to the classification.
- As 25 grains were used for the analysis, the Steeping Index takes values from 0 (non hydrated, white) to 100 (fully hydrated, translucent).
- Steeping index results, of each malting step, from different malting schedules, without considering variety as variable, are shown in **Figure 4**. Significant differences were found in **72h Germ** program at 44h and 72h, and this was explained by the lack of moisture correction during the germination process. On the other hand, both program (**One Steep** and **MNECC**) that had the moisture correction presented significant differences at 24h and 48h, having lower steeping index **One Steep** than **MNECC**. After 72h and 96h germination, did not present significant differences.
- Including variety as a variable is shown in **Figure 5**. Statistical analysis demonstrate that both variables: malting schedule and variety were significant. Furthermore, the variability of the index was explained by 91,4% from each step of malting schedules, and 3,5% more by the variety. Arcadia variety reached the lowest steeping index value in three malting program analyzed.



**Figure 4**

## Methodology

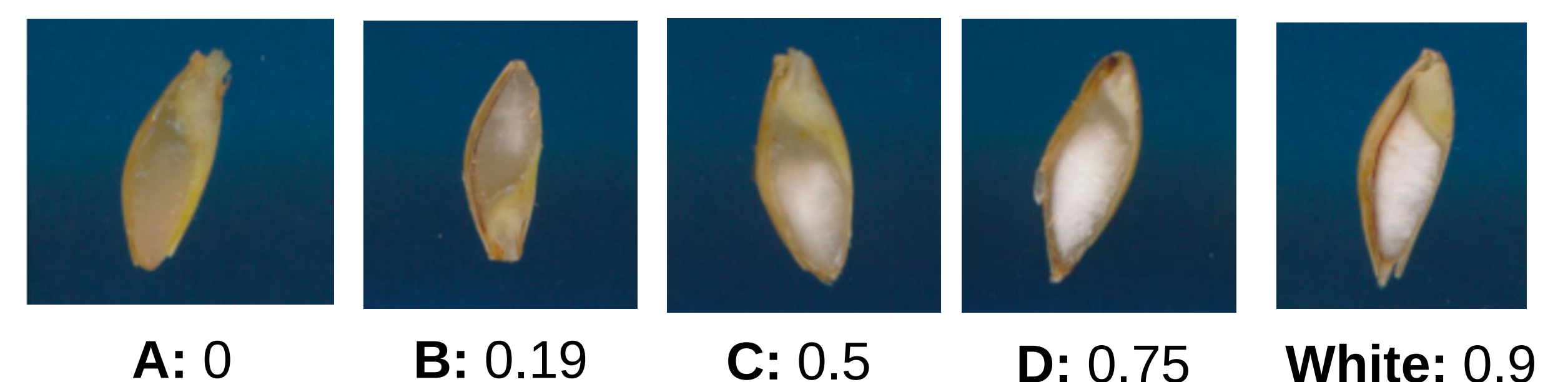
- Four barley varieties from Uruguay were used; Arcadia, Arrayán, Cle 304 and Cle 307.
- Samples were micromalted using CustomLab equipment, under three different malting schedules (**Table 1**)
- The Chapon method was applied and then grains were scanned and evaluated using a Satake scanner grain analyzer color and shape software (**Figure 1**). Steeping Index was calculated as  $A*4 + B*3 + C*2 + D*1$  (**Figure 2**)



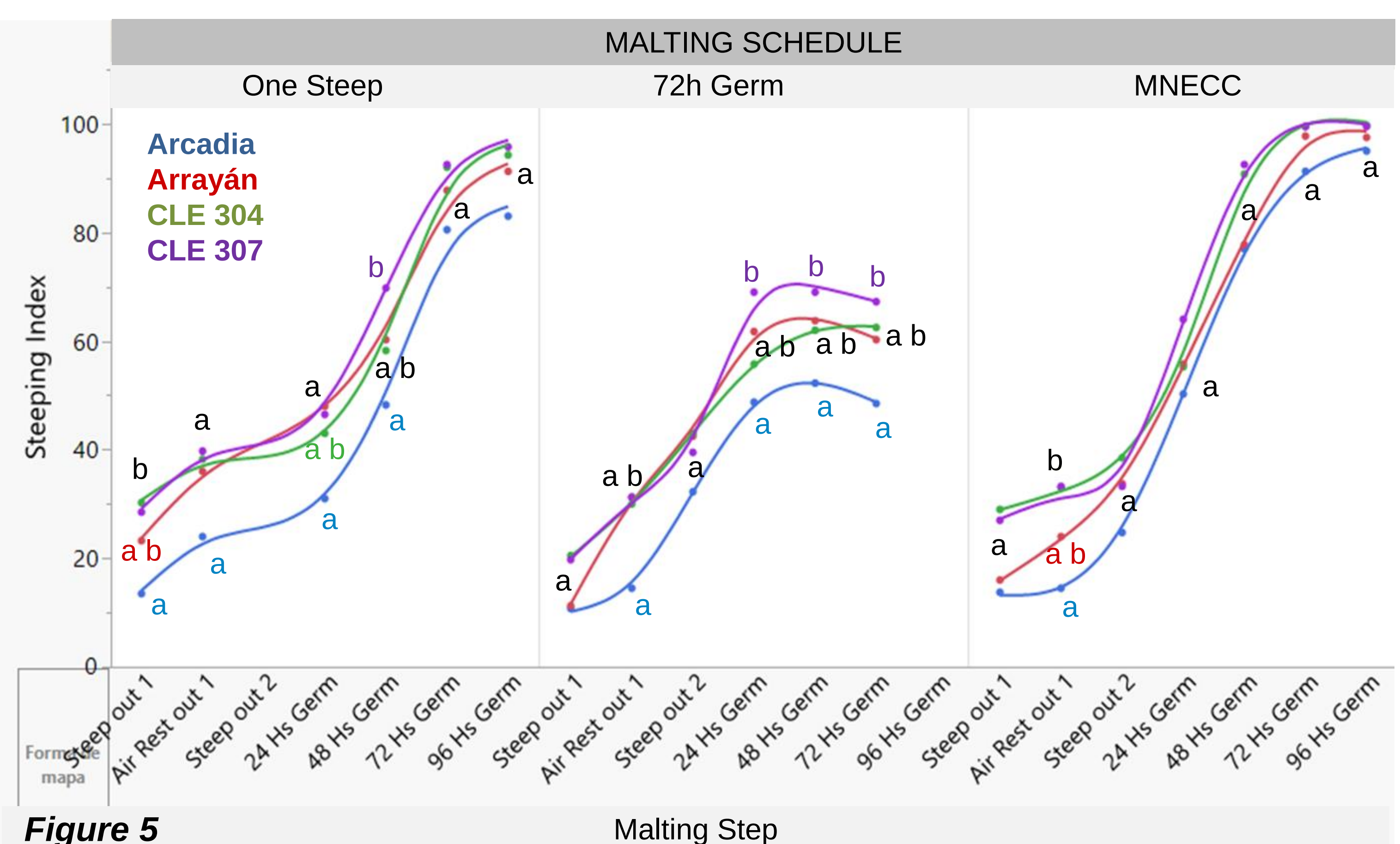
**Figure 1** - Scheme of Chapon method and Satake grain scanner

| Malting Schedule | Steeping        | Germination | Kilning    |
|------------------|-----------------|-------------|------------|
| <b>MNECC</b>     | Steep 1 - 4h    | 43h - 18°C  | 10h - 60°C |
|                  | AirRest 1 - 8h  | 10h - 14°C  | 1h - 70°C  |
|                  | Steep 2 - 4h    | 43h - 15°C  | 8h - 80°C  |
| <b>One Steep</b> | Steep 1 - 10h   | 43h - 18°C  | 10h - 60°C |
|                  | AirRest 1 - 10h | 10h - 14°C  | 1h - 70°C  |
|                  | -               | 43h - 15°C  | 8h - 80°C  |
| <b>72h Germ*</b> | Steep 1 - 4h    | 43h - 18°C  | 10h - 60°C |
|                  | AirRest 1 - 8h  | 10h - 14°C  | 1h - 70°C  |
|                  | Steep 2 - 4h    | 19h - 15°C  | 8h - 80°C  |

**Table 1** - Malting Schedules. \*without moisture correction at 24h and 44h of germination



**Figure 2** – Chapon Scale and values of Chalky Area Ratio



**Figure 5**

## Conclusions

- An equivalent range of Chapon scale was established and samples were quantified and could be differentiated as was expected.
- Malting schedule and barley varieties had a significant effect on steeping index, being malting schedule the most important.
- A reliable and permanent method was achieved since is based on pictures that can be re-analyzed whenever is needed.