Revista Thema
v.23 | n.3 | 2024
p.902-915

DOI: http://dx.doi.org/10.15536/thema.V23.2024.902-915.3914
ISSN: 2177-2894 (online)

CIÊNCIAS AGRÁRIAS

Development and grain yield of barley genotypes according to sowing date

Desenvolvimento e produtividade de grãos de genótipos de cevada em função da data de semeadura

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ABSTRACT

This study aimed to determine the length of subperiods, development cycle, yield, and grain quality of barley genotypes at different sowing dates. Three experimental lines from a barley breeding program Barley01, Barley02, and Barley03 as well as three commercial cultivars ABI Invicta, ABI Valente, and ABI Rubi were sown in 2001 in the municipality of Passo Fundo. Also, lines Barley04, Barley05, and Barley06, in addition to ABI Invicta and ABI Valente, were sown in 2022 in the municipality of Coxilha. Sowings were carried out on June 1st, June 16th, and July 7th, 2021, in Passo Fundo and May 24th, June 15th, and July 4th, 2022, in Coxilha. The barley development cycle decreased from sowings carried out at the end of May until the beginning of July. Lines Barley02 and Barley06 showed higher precocity. A higher proportion of first-class grains was observed in early sowings in both locations. Barley grain yield depends on the genotype, location, and sowing date.

***Keywords**: Hordeum vulgare L.; thermal time; phenology; grain quality.*

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RESUMO

O objetivo do trabalho foi determinar a duração dos subperíodos, ciclo de desenvolvimento, produtividade e qualidade de grãos de genótipos de cevada em diferentes épocas de semeadura. Foram utilizadas três linhagens experimentais de um programa de melhoramento de cevada, Barley01, Barley02 e Barley03, além das cultivares comerciais ABI Invicta, ABI valente e ABI Rubi, no município de Passo Fundo, em 2021. No ano de 2022 em Coxilha, foram utilizadas as linhagens Barley04, Barley05 e Barley06, além da ABI Invicta e ABI Valente. As semeaduras foram realizadas em 01/06/2021, 16/06/2021 e 07/07/2021 em Passo Fundo e em 24/05/2022, 15/06/2022 e 04/07/2022, em Coxilha. O ciclo de desenvolvimento da cevada diminui a partir de semeaduras realizadas no final de maio até o início de julho. As linhagens Barley02 e Barley06 apresentaram maior precocidade. Houve maior proporção de grãos de primeira classe para semeaduras precoces em ambos os locais. A produtividade de grãos de cevada é dependente do genótipo, do local e da época de semeadura.

Palavras-chave: *Hordeum vulgare* L.; soma térmica; fenologia; qualidade de grãos.

1. INTRODUCTION

Barley (*Hordeum vulgare* L.) is a winter cereal widely cultivated worldwide, occupying an area of around 49 million hectares, with a production of more than 145 million tons in 2021 (FAO, 2021). In Brazil, the mean grain yield was 3882 kg ha^{-1}, totaling 498 thousand tons of barley in 2022 (CONAB, 2023), which represents only around 30% of national demand, whose main destination is malt production for brewing purposes. The South region is the main producer in Brazil although it is also an alternative for cultivation in other regions, such as the Brazilian Cerrado (Barzotto *et al.*, 2018).

Unlike other crops, only 21 barley cultivars are available to farmers in Brazil (Mapa, 2023b). However, some of these cultivars are no longer available for commercialization and others are not used for malt production. Genetic breeding and development of new barley cultivars are essential to increase grain yield. Moreover, the characterization regarding the growth, development, and production potential of these cultivars, as well as their interactions with different environments, have also paramount importance, considering that the weather conditions of the production environment influence differently the response of each cultivar (Miralles *et al.*, 2011). Liu *et al.* (2020) reported that the optimal flowering period of barley is more dependent on the environment than on the genotype.

Air temperature and availability of water and solar radiation are the main meteorological variables that influence barley grain yield. Frosts and high rainfall occurrence during the harvest period are among the adverse events that reduce barley grain yield and quality (Caierão *et al.*, 2009). Thus, the crop must be exposed to a condition of high yield potential and, at the same time, to minimal climate risks, which can be achieved with the correct adjustment of the sowing date and the genotype choice, especially in terms of precocity.

Barley development cycle duration is mainly influenced by air temperature, usually accounted for through thermal time (Caierão *et al.*, 2009; McMaster; Wilhelm, 2003; Otero *et al.*, 2021). This variable can be calculated by the difference between the mean daily temperature and the crop base temperature and is normally more accurate for accounting time in plants than the days of the civil calendar (Gilmore; Rogers, 1958). It is noteworthy that barley is a long-day species, and floral induction is delayed when exposed to short photoperiods (Caierão *et al.*, 2009).

New genotypes should be developed by different research institutions and companies in search of Brazilian self-sufficiency in barley production, providing alternatives for higher tolerance to biotic and abiotic stresses, leading to higher productivity and high-quality grains for use in malting (Rodrigues *et al.*, 2020). Furthermore, little information is available to support an improvement in management practices to be used for each genotype, including the correct definition of the sowing date.

This study aimed to evaluate the development, production aspects, and grain quality of brewing barley genotypes at different sowing dates in the Plateau of Rio Grande do Sul.

2. DEVELOPMENT

2.1. MATERIAL AND METHODS

Two field experiments were conducted in the municipalities of Passo Fundo – RS (28°13′07″ S, 52°23′33″ W, 685 m) and Coxilha – RS (28°07′46″ S, 52°24′47″ W, 684 m). The regional climate is classified as humid subtropical (Cfa), without defined dry season, according to Köppen’s classification (Alvares *et al.*, 2013). The soils are classified as typic distroferric Red Oxisol and humic dystrophic Red Oxisol for Passo Fundo and Coxilha, respectively (Streck *et al.*, 2018).

Automatic weather stations were installed in both locations to collect air temperature, air humidity, wind speed, and rainfall data, which were stored at 10-minute intervals. The genotypes ABI Rubi, ABI Valente, ABI Invicta, Barley01, Barley02, and Barley03 were used for the Passo Fundo experiment, while the genotypes ABI Valente, ABI Invicta, Barley04, Barley05, and Barley06 were used for the Coxilha experiment. ABI Rubi, ABI Valente, and ABI Invicta are commercial cultivars, while the other genotypes are experimental lines. A population of 250 plants m^{-2} was established with an inter-row spacing of 17 cm. Base fertilization with 200 kg ha^{-1} of the 13-24-12 formulation and a top dressing with 222 kg ha^{-1} of nitrate-based nitrogen fertilizer (27-00-00) were carried out in Coxilha. In Passo Fundo, base fertilization was carried out with approximately 170 kg ha^{-1} of the 13-24-12 formulation and 30 kg ha^{-1} of potassium chloride, while 259 kg ha^{-1} of nitrate-based nitrogen fertilizer (27-00-00) was used for top dressing.

The field experiments were conducted in a randomized block design, with four replications in Passo Fundo and three replications in Coxilha, for each sowing date. The experimental units were 1 m wide x 5 m long. Sowings were carried out on June 1st, June 16th, and July 7th, 2021, in Passo Fundo and May 24th, June 15th, and July 4th, 2022, in Coxilha.

Phenological assessments in both experiments began after emergence based on the cereal development scale proposed by Large (1954). The genotypes development was evaluated weekly throughout the cycle, identifying the stages of crop development, determining the length of the subperiods of tillering (stages 1 to 5), elongation (stages 6 to 10), heading (10.1 to 10.5.4), and ripening (stages 11.1 to 11.4). The daily thermal time and degree-days (DD) accumulated between sowing and ripe grain (stage 11.4) were calculated using air temperature data for all genotypes, sowing dates, and locations, according to equation (1). The lower basal temperature (Tb) of the barley crop was considered 0 °C (Dreccer *et al.*, 2018).

$$DD = \sum(Tm - Tb) \quad (1)$$

where DD is the daily degree-days (°C day), Tm is the mean daily air temperature (°C), and Tb is the lower basal temperature (°C).

Harvesting was performed in the entire plot, starting when the grains reached a moisture content of 18% or lower. Subsequently, the moisture was corrected to 12%, and grain yield and protein quality of each genotype were determined at the different sowing dates. In addition, the commercial classification of first-class grains (CL1, %) was carried out, consisting of whole barley grains retained on 2.8 and 2.5-mm opening sieves (Brasil, 1996).

Variance analysis (ANOVA) was performed using the F-test using the software Sisvar (Ferreira *et al.*, 2011), to verify the influence of sowing date and genotypes and their interaction. The variables first-class classification, grain yield, and grain protein content were evaluated. The means were compared by the Tukey test ($P \leq 0.05$) when a significant difference was observed.

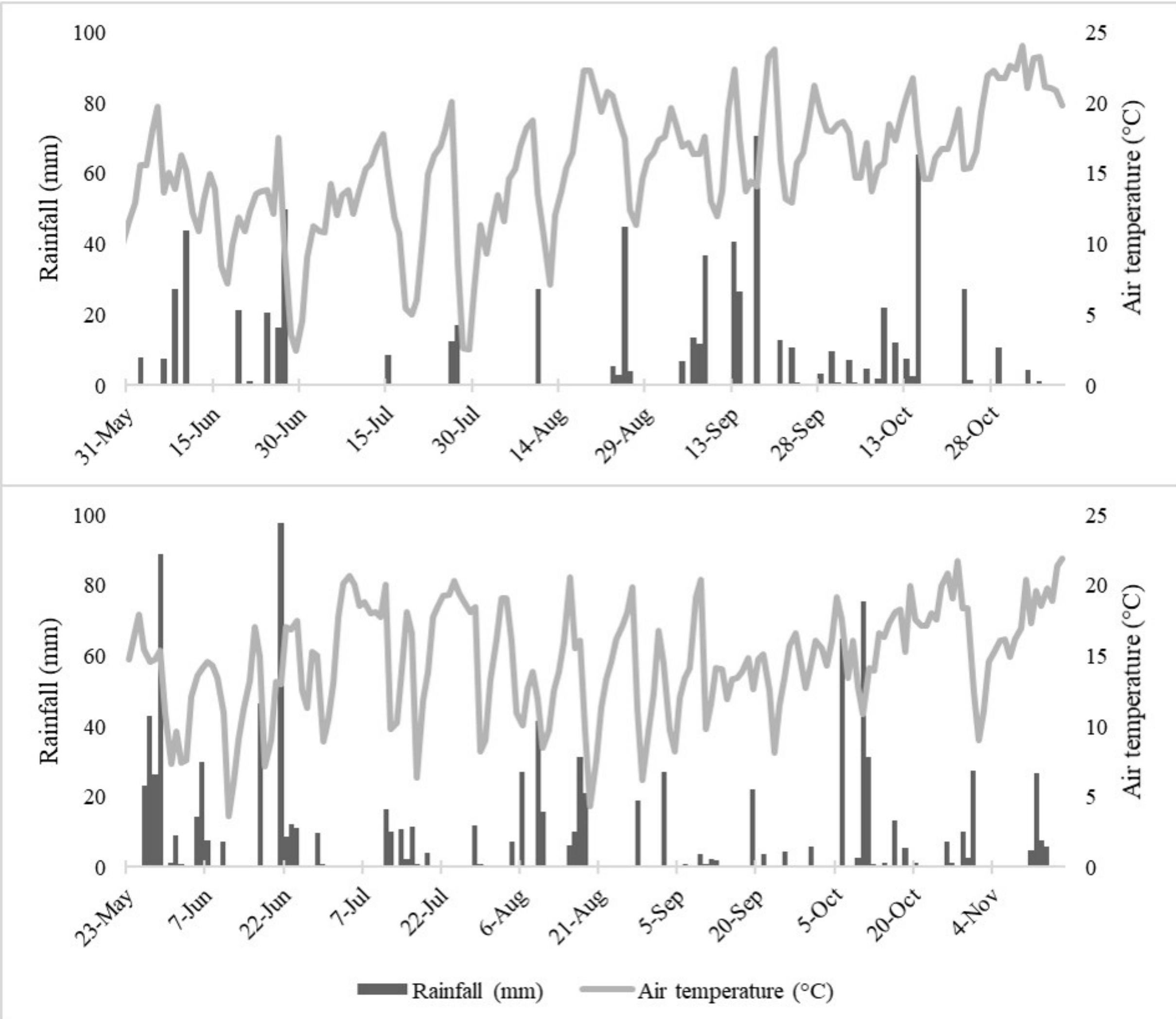
2.2. RESULTS AND DISCUSSION

The rainfall recorded in July and August was 77% and 36% below the climatological normal for Passo Fundo, totaling 38 and 84 mm, respectively (Figure 1A). On the other hand, a total of 243 mm of rain was observed in September and 164 mm in October, above and slightly below the climatological normal values of 166 and 239 mm for these months, respectively (EMBRAPA, 2023). The accumulated rainfall in Coxilha throughout the development cycle was 997, 792, and 606 mm for the first, second, and third sowing dates, respectively (Figure 1B). This difference occurred due to the occurrence of rain shortly after sowing in both the first and second dates.

Filgueira *et al.* (1996) obtained maximum barley grain yield with the application of a water depth of 668 mm under the Cerrado conditions. However, water consumption by plants in the South region of Brazil is significantly lower due to the proximity of the winter solstice, which reduces the availability of energy for crop evapotranspiration. Thus, lower rainfall frequency and accumulation such as those observed in the 2021 and 2022 growing seasons tend to be favorable to winter cereals, as they meet the crop water requirements and, at the same time, are related to the higher solar radiation incidence throughout the cycle.

Mean daily air temperature values ranged from 2.4 °C (June 29th) to 24.0 °C (November 2nd) and 3.6 °C (June 11th) to 21.9 °C (November 17th) in Passo Fundo (Figure 1A) and Coxilha (Figure 1B), respectively. The minimum air temperature was −2.9 °C (July 30th) and −0.8 °C (June 11th) and the maximum air temperature was 33.4 °C (November 5th) and 30.3 °C (October 26th) in Passo Fundo (Figure 1A) and Coxilha (Figure 1B), respectively. According to Caierão *et al.* (2009), the lethal temperature for barley inflorescences is −4 °C, but physiological stresses can be perceived at an air temperature of −1 °C. Low temperatures during tillering tend to increase the number of productive tillers (García Del Moral; García Del Moral, 1995).

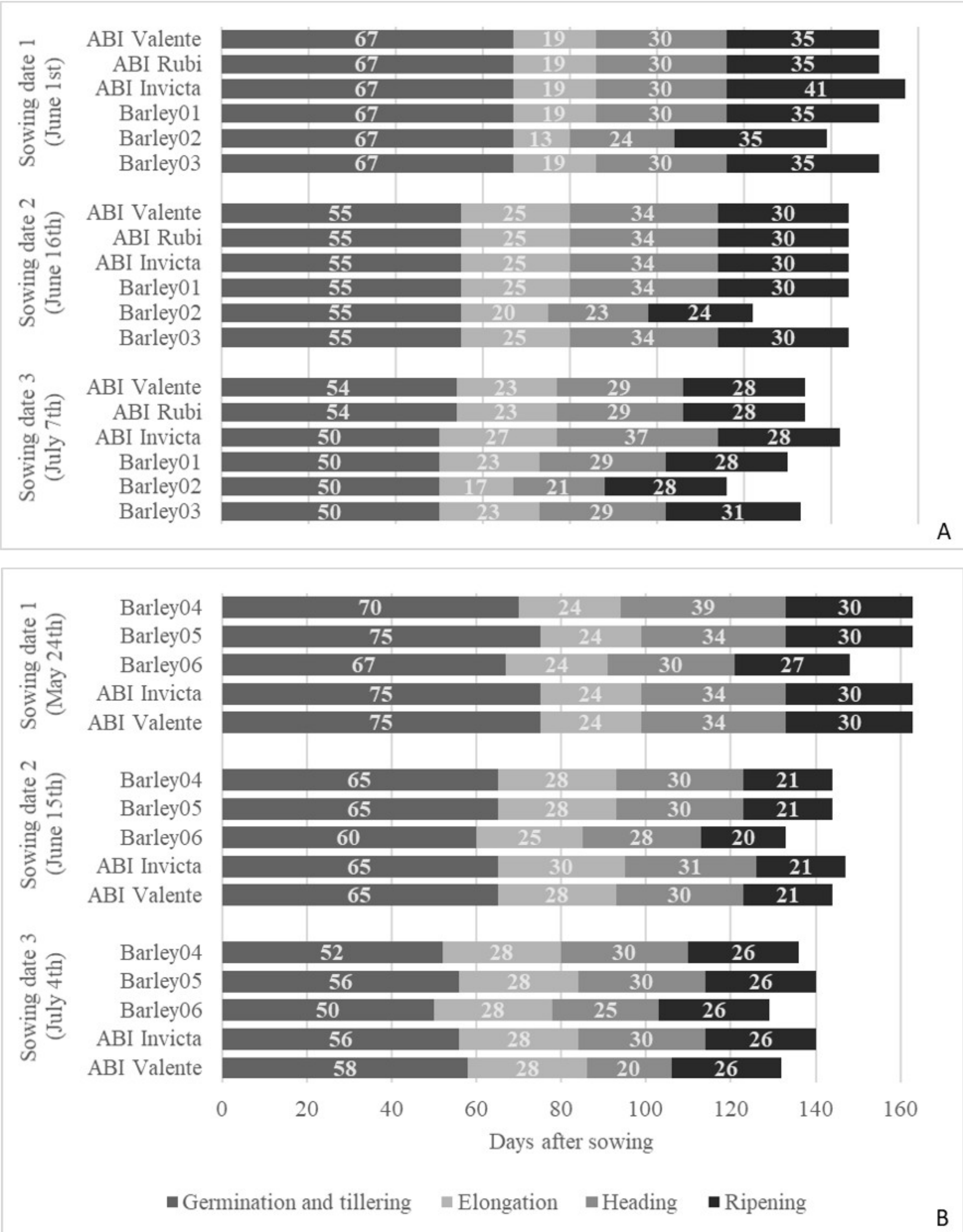
Figure 1 – Daily rainfall data and mean daily air temperature from May 31st to November 9th, 2021, in Passo Fundo – RS (A), and May 23rd to November 17th, 2022, in Coxilha – RS (B). Passo Fundo, 2024.



Source: Authors.

The sowing window predicted by the Agricultural Climate Risk Zoning (ZARC) for barley is between June 1st and July 20th for Passo Fundo and Coxilha (Mapa, 2023a). Our results pointed to a reduction in the length of the sowing cycle carried out on June 1st until sowing on July 7th (Figure 2A) in Passo Fundo, probably due to the more accentuated accumulation of daily thermal time in both the vegetative and reproductive periods in later sowings. It can be observed by the increasing mean air temperature during the experimental period (Figure 1A). The shortening of the cycle, especially the critical period for barley, due to higher air temperature, reduces solar radiation interception, biomass production, and grain yield (García *et al.*, 2015).

Figure 2 – Development cycle subperiods duration of brewing barley genotypes sown three dates in 2021 in Passo Fundo (A) and 2022 in Coxilha (B). Passo Fundo, 2024.



Source: Authors.

The genotype Barley02 appeared to reach physiological maturity in fewer days in Passo Fundo, regardless of the sowing date (Figure 2A). Similarly, this genotype seemed to require the lowest thermal time to complete the development cycle, considering both locations, totaling a mean of 1750 degree-days (Table 1). This higher precocity is an interesting characteristic when the objective is to anticipate the entry of summer crops such as soybean.

Table 1 – Thermal time accumulated throughout the development cycle of brewing barley genotypes sown on June 1st (1), June 16th (2), and July 7th (3), 2021, in the municipality of Passo Fundo – RS, and May 24th (1), June 15th (2), and July 4th (3), 2022, in the municipality of Coxilha – RS. Passo Fundo, 2024.

	Genotype	Thermal time (degree-day)			Mean
		Sowing date 1	Sowing date 2	Sowing date 3	
Passo Fundo (2021)	ABI Valente	2252	2210	2218	2227
	ABI Rubi	2252	2210	2218	2227
	ABI Invicta	2387	2210	2387	2328
	Barley01	2252	2210	2132	2198
	Barley02	2033	1783	1834	1883
	Barley03	2252	2210	2199	2221
	Mean	2238	2139	2165	
Coxilha (2022)	Barley04	2332	2119	2056	2169
	Barley05	2332	2119	2146	2199
	Barley06	2075	1942	1920	1979
	ABI Invicta	2332	2166	2146	2215
	ABI Valente	2332	2119	1977	2143
	Mean	2281	2093	2049	-

Source: Authors.

The length of the barley development cycle in Coxilha also showed a decreasing trend (Figure 2B). A similarity was observed in the length of the development cycle of the five genotypes, except for the genotype Barley06, which reached physiological maturity in 148, 133, and 129 days for sowings carried out on May 24th (sowing date 1), June 15th (sowing date 2), and July 4th (sowing date 3), respectively. This genotype also appeared to have lower accumulated thermal time, requiring a mean of 1979 degree-days (Table 1).

The thermal time accumulated throughout the development cycle of each genotype in the three sowing dates varied from 1783 to 2387 degree-days in Passo Fundo in 2021 and 1920 to 2332 degree-days in Coxilha in 2022 (Table 1). These results were similar to those found by Rodrigues *et al.* (2022), in which the thermal time for five genotypes varied between 1892 and 2070 degree-days. There was a trend towards a reduction in the thermal time necessary to complete the development cycle for later sowings in both locations (Table 1). It occurs considering that the thermal requirement does not depend exclusively on the genotype and air temperature but also other variables such as photoperiod and water and nitrogen availability (Travasso; Magrin, 1998). According to Caierão *et al.* (2009), there is a reduction in the vegetative phase with an increase in the photoperiod.

No significant interaction was observed between sowing date and genotypes for the variable grain yield in both locations, but differences were found between sowing dates and genotypes alone (Table 2). Barley02 stood out among the genotypes, with a mean grain yield for the three sowing dates in Passo Fundo of 7159 kg ha^{-1}, not differing from ABI Rubi, which reached 6725 kg ha^{-1} (Table 2).

Early sowings in Passo Fundo (June 1st) showed a higher discrepancy between genotypes (Table 2), with a difference of almost two tons when comparing Barley02 (7106 kg ha^{-1}) and Barley03 (5190 kg ha^{-1}). It reflects the importance of choosing the appropriate cultivar to be used at each sowing date to obtain high production.

The sowing conducted on June 16th (sowing date 2) presented the highest grain yield relative to sowing dates 1 (June 1st) and 2 (July 7th), with a mean of 7031 kg ha^{-1} (Table 2). In general, this grain yield can be considered high, surpassing the mean obtained in the State of Rio Grande do Sul (RS) in 2021, which was 3812 kg ha^{-1} (Conab, 2022).

In contrast, the sowing carried out on July 7th had a lower grain yield due to the exposure of the crop to higher air temperatures, especially during the grain filling period (Figure 1A), which caused an increase in the respiration rate and a reduction in the crop cycle. The ideal temperature in the ripening stage is around 14 to 18 °C, and higher temperatures result in less assimilation of photoassimilates, negatively affecting grain filling (Schelling *et al.*, 2003; García *et al.*, 2015).

Ferrise *et al.* (2010) found that the delay in wheat sowing caused the crop to be exposed to high temperatures, reducing the cycle and, consequently, the grain filling period by up to 8 days. A similar trend was observed in the present study, in which the cycle was shortened by up to 15 days in sowing date 3 compared to sowing date 1 (Figure 2A), resulting in a lower grain yield (Table 2).

Therefore, the sowing conducted on June 16th provided barley with less exposure to these weather stresses and the occurrence of frosts in the critical period. Concomitantly, a good supply of solar radiation and temperatures close to optimum were observed, leading to higher grain yield compared to other sowing dates. Silva *et al.* (2012) conducted a study in Guarapuava – PR and also obtained high yields of wheat grains in June and July 2008 (around 6500 to 7000 kg ha^{-1}), confirming that the best time is between the second half of June and the second half of July, which is very similar to the experiment conducted in Passo Fundo – RS.

Regarding grain yield obtained in the municipality of Coxilha, the third sowing date (July 4th) stood out positively relative to the others (Table 2). There was less rainfall accumulation throughout the development cycle and, consequently, a higher incidence of solar radiation, in addition to being closer to the summer solstice, favoring grain filling. Furthermore, the plants were exposed to mild temperatures at the end of the cycle, resulting in a decrease in cellular respiration and favoring an increase in net photosynthesis.

The lower grain yield in the first sowing date may be related to the occurrence of wetter days at the end of the barley cycle, with a high volume of rain in September and October (Figure 1A). Furthermore, frost was formed on August 19th, 2022, when the plants were at the heading stage. The most severe frost damage occurs during the flowering and heading of the crop, causing stem strangulation and preventing the formation of grains in the ear (Caierão *et al.*, 2009). Importantly, the sowing date of May 24th is out of the period predicted by ZARC (Mapa, 2023a), which increases the risk of frost occurring in the critical period of the crop.

Table 2 – Grain yield of brewing barley genotypes sown on June 1st (1), June 16th (2), and July 7th (3), 2021, in Passo Fundo – RS, and May 24th (1), June 15th (2), and July 4th (3), 2022, in Coxilha – RS. Passo Fundo, 2024.

	Genotype	Grain yield (kg ha^{-1})			Mean
		Sowing date 1	Sowing date 2	Sowing date 3	
Passo Fundo (2021)	ABI Valente	5298	6864	5916	6026 C*
	ABI Rubi	6463	7210	6504	6725 AB
	ABI Invicta	6094	7048	6154	6432 BC
	Barley01	5717	6881	6083	6227 BC
	Barley02	7106	7642	6730	7159 A
	Barley03	5190	6543	5685	5806 C
	Mean	5978 b	7031 a	6179 b	-
	CV (%)	7.64			
Coxilha (2022)	Barley04	2788	4263	5431	4161 CB
	Barley05	3040	4381	5703	4375 CB
	Barley06	3886	4165	5702	4584 B
	ABI Invicta	4357	4988	6938	5428 A
	ABI Valente	2912	3679	5157	3916 C
	Mean	3396 c	4295 b	5786 a	-
	CV (%)	9.58			

*Means followed by the same lowercase letter in the row and uppercase letter in the column do not differ statistically from each other by the Tukey test at a 5% probability.
Source: Authors.

The recently registered ABI Invicta cultivar had a mean grain yield of 5428 kg ha^{-1}, which is higher than the other genotypes (Table 2). Furthermore, in general, the genotypes used in Coxilha showed similar or higher yields to the commercial cultivar ABI Valente, indicating a high potential for commercial use.

Protein in barley grains showed no interaction between the factors sowing date and genotype, but differences were observed between genotypes and between sowing dates in both locations (Table 3). The genotypes Barley03 and ABI RUBI showed higher protein values in the sowing conducted on June 1st, 2021 (sowing date 1), in Passo

Fundo (Table 3). The other genotypes were within the standard of Brazilian legislation (<12%).

All genotypes in sowing date 2 (June 16th, 2021) and sowing date 3 (July 7th, 2021) fell within the standard for malting (Table 3). In general, the malt that will be formed from these barley grains containing these protein levels will be able to provide sufficient by-products in the form of essential nutrients for the yeasts in the malting process. According to Jaeger *et al.* (2021), barley grains with a protein content above 12% compromise beer quality, leading to lower starch content, reducing fermentable sugars, and resulting in longer malting time and poor quality.

There was a trend towards a decrease in protein content from sowing date 1, with 11.4%, to sowing dates 2 and 3, in which mean values of 11.1 and 10.7% were obtained, respectively, in Passo Fundo (Table 3). The commercial cultivar ABI Rubi easily reaches high percentages of protein content, as do the genotypes ABI Valente and Barley03 (Table 3). This information is important as it can contribute to adjusting nitrogen fertilizer management.

Table 3 – Protein content of brewing barley genotypes sown on June 1st (1), June 16th (2), and July 7th (3), 2021, in the municipality of Passo Fundo – RS, and May 24th (1), June 15th (2), and July 4th (3), 2022, in the municipality of Coxilha – RS. Passo Fundo, 2024.

	Genotype	Protein content (%)			Mean
		Sowing date 1	Sowing date 2	Sowing date 3	
Passo Fundo (2021)	ABI Valente	11.7	11.5	11.1	11.4 A*
	ABI Rubi	12.2	11.8	11.6	11.9 A
	ABI Invicta	10.4	10.5	9.8	10.2 B
	Barley01	10.9	10.7	10.1	10.6 B
	Barley02	11.0	10.7	10.4	10.7 B
	Barley03	12.5	11.7	11.2	11.8 A
	Mean	11.4 a	11.1 b	10.7 c	
	CV (%)	3.73			
Coxilha (2022)	Barley04	9.2	10.9	10.0	10.0 B
	Barley05	9.1	10.4	10.1	9.8 B
	Barley06	9.6	11.5	10.8	10.6 A
	ABI Invicta	8.6	10.1	9.7	9.5 B
	ABI Valente	10.1	11.6	11.2	10.9 A
	Mean	9.3 c	10.9 a	10.4 b	
	CV (%)	3.95			

*Means followed by the same lowercase letter in the row and uppercase letter in the column do not differ statistically from each other by the Tukey test at a 5% probability.
Source: Authors.

The mean protein contents of the grains in Coxilha were negatively affected in the first sowing date, with a value of 9.3%, probably due to the frost that occurred on August 19th, 2022. Only the genotype Barley02 presented a protein content above 10%, considered ideal. The other sowing dates showed adequate protein content, with the highest content observed in sowing date 2 (Table 3). The genotypes Barley06 and Barley02 presented the highest protein contents, considering the three sowing dates.

A significant interaction was observed between the factors sowing date and genotype for the first-class classification (CL1, %) in the experiment conducted in Passo Fundo (Table 4). No difference was observed between genotypes for the first sowing date. On the other hand, considering sowing dates 2 and 3, the genotypes ABI Valente and Barley03 stood out with the highest first-class evaluation for both sowing dates. It indicates the possibility of implementing these genotypes throughout the sowing window without reducing grain quality, which indicates higher stability and versatility. The grain quality of the other genotypes is reduced as sowing is postponed (Table 4). These differences were expected, considering that this quality attribute is strongly influenced by the environment and genotype (Fox *et al.*, 2006).

Table 4 – First-class classification (CL1, %) of brewing barley genotypes sown on June 1st (1), June 16th (2), and July 7th (3), 2021, in the municipality of Passo Fundo – RS, and May 24th (1), June 15th (2), and July 4th (3), 2022, in the municipality of Coxilha – RS. Passo Fundo, 2024.

	Genotype	**CL1 (%)**			**Mean**
		Sowing date 1	**Sowing date 2**	**Sowing date 3**	
Passo Fundo (2021)	ABI Valente	95.7 Aa*	94.2 Aa	91.2 Aa	93.7 A
	ABI Rubi	94.0 Aa	88.7 ABab	82.7 Bb	88.5 BC
	ABI Invicta	93.7 Aa	89.0 ABa	76.5 Bb	86.4 BC
	Barley01	91.2 Aa	85.5 Ba	75.0 Bb	83.9 C
	Barley02	94.7 Aa	89.5 ABa	82.7 Bb	89.0 B
	Barley03	94.2 Aa	96.0 Aa	94.7 Aa	95.0 A
	Mean	93.9 a	90.5 b	83.8 c	
	CV (%)	4.36			
Coxilha (2022)	Barley04	87.3	85.0	81.7	84.7 BC
	Barley05	86.7	80.0	80.7	82.4 C
	Barley06	96.7	90.0	91.3	92.7 A
	ABI Invicta	94.3	84.3	87.0	88.6 AB
	ABI Valente	89.0	89.0	92.0	90.0 A
	Mean	90.8 a	85.7 b	86.5 b	
	CV (%)	3.63			

*Means followed by the same lowercase letter in the row and uppercase letter in the column do not differ statistically from each other by the Tukey test at a 5% probability. Source: Authors.

No significant interaction was observed between the factors genotype and sowing date for CL1 in Coxilha (Table 4). Considering the mean of each genotype in the three sowing dates, the highest proportion of first-class grains was obtained for Barley06 and Barley02, while Barley05 had the worst performance (Table 4). As observed in Passo Fundo, the genotypes presented a higher percentage of first-class grains at the earliest sowing (Table 4) but with a low protein content in the grains (Table 3). Therefore, the selection of genotypes that provide high yield and grain quality is a complex task and depends on the location, sowing date, and interannual variability of weather conditions, being an important management strategy to generate benefits for both the producer and the beer industry.

3. FINAL CONSIDERATIONS

The barley development cycle shows a tendency to shorten in sowings conducted from the end of May to the beginning of July. ABI Valente and Barley06 seemed to exhibit greater precocity. Passo Fundo showed higher grain yield for commercial cultivars relative to the lines from the breeding program, with better performance for the sowing conducted on June 16th. On the other hand, a higher grain yield was obtained for the sowing carried out on July 4th in Coxilha, with the lines standing out.

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Revisão de Língua Inglesa: Jillian Dalrymple[6]

Submetido em: **26/04/2024**

Aceito em: **15/08/2024**

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