The effect of planting season on physical and chemical characteristics of local rice varieties

K Fahmy¹, D Yanti*, D A Permata²

¹Department of Agricultural Engineering and Biosystem, Faculty of Agricultural Technology, Andalas University, Indonesia
²Department of Agriculture Industry Technology, Faculty of Agricultural Technology, Andalas University, Indonesia

*Email: delviyanti@ae.unand.ac.id

Abstract. The season is the time interval with the most frequent weather. The rainy season is the time when it rains a lot, while the dry season is the time when it rains a little. Planting season is one of the factors that affect the quality of the grain, which directly determines the quality of rice. This study aims to determine the effect of the growing season on the physical-chemical characteristics of rice. The sample observed was the Bujang Marantau rice (local variety) which was taken from two seasons (dry season and rainy season) in the same location, which is Nagari Singkarak, X Koto Singkarak District, Solok Regency, West Sumatra Province. The physical characteristics examined were head rice, broken rice, and groats. Chemical characteristics analyzed were amylose content determined by the IRRI method (1971). Meanwhile, water content and ash content were analyzed by the gravimetric method. In addition, fat content was determined by the Soxhlet method with Weibull modification. Furthermore, protein content was determined by the Kjeldahl method. The results showed that the growing season did not affect the ash content, fat content, and carbohydrates of the Bujang Marantau rice, but affected the water, protein, and amylose content. Based on the quality requirements (SNI 6128:2015), Bujang Marantau rice is included in the medium quality class 1.

1. Introduction

The season is the time interval with the most frequent or striking weather. Indonesia is known for its rainy season and dry season. The two seasons are distinguished by the amount of rainfall. The rainy season is the period where there is a lot of rain, while the dry season is the time when it rains a little. The beginning of the rainy or dry season in each region is different each year, depending on several conditions and other weather arrangements on a large scale. The length of the season in each region varies according to its geographical location. Indonesian weather or climate elements have seasonal variations, which can be seen from rainfall.

Food crops are very dependent on the season, including rice. The season that takes place at the time of planting will affect the quality of the grain produced, which directly determines the quality of the rice. The quality of rice is determined by its physical and chemical characteristics. According [1]; [2], rice quality characteristics are influenced by genetics, environment, and post-harvest handling. According [3] the quality of rice is influenced by seven main factors, which are: 1) the rice variety to be milled, 2) the grain quality as the raw material, 3) the grain post-harvest handling of the grain, 4)
the condition of the grinding machine, 5) the completeness of grinding machines series, 6) milling techniques, and 7) operators as implementing personnel. While the factors that affect the quality of the grain itself, among others: 1) cultivation techniques, 2) climate, 3) biotic and abiotic condition, and 4) post-harvest handling. This study aims to determine the effect of the planting season on the physical-chemical characteristics of rice.

2. Materials and methods
Proximate and amylose tests were carried out at the Center for Food and Nutrition Studies, Gadjah Mada University, in July 2021. The main ingredient used was Bujang Marantau rice (a local variety). Rice samples were taken from two seasons (dry season and rainy season) at the same location, which was Nagari Singkarak, X Koto Singkarak District, Solok Regency, West Sumatra Province. Rice samples for testing the physical characteristic was each 1 kg, and for testing the levels of amylose and proximate was each 30 grams.

The rice cultivation method at the sampling site used is conventional, which are: seedling age is 20–25 days after sowing, planting process use more than one seed hole (about 3-5 seeds), alternation of puddle water is given up to 2 cm from 1-75 days old, and saturated alteration to field capacity is after 75 days until harvest.

The physical-chemical characteristics of rice analyzed include:

- Physical characteristics: head rice, broken rice, and groats were analyzed using the SNI 6128-2015 method [4]. Head rice is rice grains with a size greater than or equal to 0.8 parts of whole rice grains. Broken rice is rice grains with a size greater than 0.2 to 0.8 parts smaller than whole rice grains. Grains of groats are rice grains with a size smaller than 0.2 parts of whole grains of rice.
- Amylose and proximate levels: amylose content was analyzed using the IRRI method (1971). Water and ash content were analyzed by the gravimetric method. In addition, fat content was determined by the Soxhlet method with Weibull modification. Furthermore, protein content was determined by the Kjeldahl method.

Data analysis was carried out by single-factor ANOVA variance at the level of $\alpha = 0.05$. P-value less than 0.05 ($p<0.05$) was considered to have a statistically significant difference. The rice quality data obtained were then compared with the quality requirements of SNI 6128: 2015 (Table 1).

| No | Quality requirements | Measurement | Quality classes |
|----|---------------------|-------------|----------------|
|    |                     |             | Premium | 1 | Medium | 2 | 3 |
| 1  | Rice head (min)    | %           | 95      | 78 | 73      | 60 |
| 2  | Broken grain (max) | %           | 5       | 20 | 35      | 25 |
| 3  | Groats (max)       | %           | 0       | 2  | 2       | 5  |

3. Results and discussion
Bujang Marantau rice is a local variety in Tanah Datar Regency, West Sumatra Province, with a Plant Variety Protection registration number 160/PVL/2014 on March 23, 2015. Based on the official PVP news [5], Bujang Marantau rice has components as yield of broken skin rice 73.75%, the yield of milled rice 64.75%, head rice 91.67%, broken grains 5.11%, calcified grains 3.00%, yellow grains 0.00%, groats 0.22%. Meanwhile, the analysis results on the physical characteristics of the Bujang Marantau rice planted in different seasons in Nagari Singkarak, Solok Regency, West Sumatra Province are presented in Table 2.
Broken rice planted in the rainy season is generally 77.65% rather than that planted in the dry season. The carbohydrate content of Bujang Marantau rice for the rainy season is 8.57%, while the percentages of broken grains and groats are higher. The difference in the percentages of head rice, broken grains, and groats are caused by the location of rice planting or different post-harvest handling. The percentage of broken rice planted in the rainy season is higher than broken rice planted in the dry season due to the difference in water content.

The higher water content is available for rice planted in the rainy season rather than rice planted in the dry season. Rice with high water content is relatively soft and easily breaks. However, based on the rice quality requirements (SNI 6128: 2015), the Bujang Marantau rice is included in the medium quality class 1. The analysis results on the chemical characteristics of the Bujang Marantau rice are presented in Table 3.

| No | Planting Season | Head rice (%) | Broken grains (%) | Groats (%) |
|----|----------------|---------------|-------------------|-----------|
| 1  | Rainy Season   | 86.6          | 11.8              | 1.2       |
| 2  | Dry Season     | 91.6          | 6.6               | 1.8       |

Based on Table 2, the percentage of head rice is lower than the percentage of head rice based on the description of rice [5], while the percentages of broken grains and groats are higher. The difference in the percentages of head rice, broken grains, and groats are caused by the location of rice planting or different post-harvest handling. The percentage of broken rice planted in the rainy season is higher than broken rice planted in the dry season due to the difference in water content. The higher water content is available for rice planted in the rainy season rather than rice planted in the dry season. Rice with high water content is relatively soft and easily breaks. However, based on the rice quality requirements (SNI 6128: 2015), the Bujang Marantau rice is included in the medium quality class 1. The analysis results on the chemical characteristics of the Bujang Marantau rice are presented in Table 3.

| No | Planting Season | Water (%) | Ash* (%) | Fat* (%) | Protein (%) | Carbohydrate* (%) | Amylose (%) |
|----|----------------|-----------|----------|----------|-------------|-------------------|-------------|
| 1  | Rainy Season   | 13.29     | 0.30     | 0.19     | 8.57        | 77.65             | 22.18       |
| 2  | Dry Season     | 11.81     | 0.41     | 0.22     | 9.97        | 77.37             | 23.25       |

*not significantly different at the level of α = 0.05

In Table 3, there is no difference in the average ash content, fat content, and carbohydrate content of rice grown in different seasons, but there are differences in the average water content, protein, and amylose. Therefore, rice planting in the same location, the same cultivation system, the same post-harvest handling, but different planting seasons affects the water, protein, and amylose content. The average water content of rice planted during the rainy season is 13.29%, and it is higher than rice planted in the dry season, which is 11.81%. The water content of rice planted in the dry and rainy seasons has met the maximum standard (14%) according to SNI No. 6128 in 2015. Rice water content of more than 14% causes faster spoilage during storage.

Next, the ash content of the Bujang Marantau rice for the rainy season is 0.30%, and the dry planting season is 0.41%. The ash content of rice planted in the dry season is higher than rice planted in the rainy season. The ash content is influenced by the level of grinding. A high grinding rate can provide a low mineral content [6]. Furthermore, the fat content of Bujang Marantau rice for the rainy season is 0.19%, and for the dry planting season is 0.22%. The fat content of rice is lower than the fat content according [7], which is around 0.58% to 1.23%. Rice with high-fat content is damaged faster because undergoing fat oxidation more quickly results in a musty smell.

In addition, the protein content of Bujang Marantau rice for the rainy season is 8.57%, and the dry planting season is 9.97%. The protein content of rice planted in the dry season is higher than rice planted in the rainy season. Then, the carbohydrate content of rice grown in the rainy season is higher than that planted in the dry season. The carbohydrate content of Bujang Marantau rice for the rainy season is 77.65%, and the dry planting season is 77.37%. According [8], the carbohydrate content of rice is generally 78%. The carbohydrate levels of the tested research samples were lower, most likely because post-harvest handling is affected.

The amylose content of rice grown in the dry season was higher than that of rice grown in the dry season. [9] stated, based on its amylose content, rice is grouped into glutinous rice with amylose content percentage of 0% to 2% dry weight, low amylose rice with amylose content between 9% to 20% dry weight, medium amylose rice with amylose percentage content of 20% to 25% dry weight, dry, and high amylose rice with an amylose content percentage of more than 25% dry weight. Bujang
Marantau rice used in this study included rice with medium amylose content, which is with an amylose content of 22.18% (rainy season) and 23.25% amylose content (dry season). [10] stated that the higher the fat content, there is possibility that the rice will undergo fat oxidation faster, resulting in a musty smell. Rice with a high-fat content spoils more quickly.

4. Conclusions
The planting season did not affect the ash content, fat content, and carbohydrates of the Bujang Marantau rice, but it affected the water, protein, and amylose content. Based on the specification of quality requirements (SNI 6128:2015), Bujang Marantau rice is included in the medium quality class I.

References
[1] Aliawati, G. (2003). Teknik Analisis Kadar Amilosa dalam Beras. *Buletin Teknik Pertanian*, 8(2), 82–84.
[2] Hairmansis, A., Aswidinnoor, H., & Suwarno, W. B. (2013). Potensi Hasil dan Mutu Beras Sepuluh Galur Harapan Padi untuk Lahan Rawa Pasang Surut. *Jurnal Agronomi Indonesia (Indonesian Journal of Agronomy)*, 41(1), 1–8. https://doi.org/10.24831/jai.v41l1.7069
[3] Setyono, Agus; Kuslantoro, Bram; Jumali; Wirbo, Prihadi; Guswara, A. (2008). Evaluasi Mutu Beras di Beberapa Wilayah Sentra Prodksi Padi. *Seminar Nasional Padi*, 1429–1448.
[4] Badan Standar Nasional. (2015). SNI Beras (SNI 6128:2015).
[5] Kementerian Pertanian Republik Indonesia. (2015). *Berita Resmi PVT, Pendaftaran Varietas Lokal, No. Publikasi : 041/BR/PVL/04/2015*. Jakarta
[6] Hasnelly, H., Fitriani, E., Ayu, S. P., & Hervelly, H. (2020). Pengaruh Drjat Penyosohan terhadap Mutu Fisik dan Nilai Gizi Beberapa Jenis Beras. *AgriTECH*, 40(3), 182. https://doi.org/10.22146/agritech.47487
[7] Widowati, Sri; Santosa, Susila B.A; Astawan, M. A. (2018). Penurunan Indeks Glikemik berbagai Varietas Beras Melalui Proses Pratanak. *Jurnal Penelitian Pascapanen Pertanian, 6*(1), 1–9. https://doi.org/10.21082/jpasca.v6n1.2009-1-9
[8] Hernawan, E., & Meylan, V. (2016). Analisis Karakteristik Fisikokimia Beras Putih, Beras Merah, dan Beras Hitam (Oryza sativa L., Oryza nivara dan Oryza sativa L. indica). *Jurnal Kesehatan Bakti Tunas Husada: Jurnal Ilmu-Ilmu Keperawatan, Analis Kesehatan dan Farmasi*, 15(1), 79. https://doi.org/10.36465/jkbah.v15i1.154
[9] Hariyadi. 2008. Teknologi Pengolahan Beras. Yogyakarta: Gajah Mada University Press.
[10] Kamsiati, Elmi; Dharmawati, Emmy; Haryadi, Y. (2018). Karakteristik Fisik dan Kimia Beras Indigenous dari Lahan Pasang Surut di Kalimantan Tengah. *Pangan*, 27(2 (Agustus 2018)), 107–116.