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Oryza sativa cv. Inpago 10 Shows Significant Drought Tolerance Differences Based on Relative Water Content (RWC) for National Food Sovereignty

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Abstract

Rice (Oryza sativa) is a key staple crop in Indonesia. This study focuses on using Relative Water Content (RWC) in Oryza sativa cv. Inpago 10 to deepen the understanding of drought tolerance and contribute data that supports national food sovereignty. The RWC measurement involves weighing fresh leaf samples, soaking them in distilled water for 24 hours, re-weighing them to obtain turgid weight, drying them at 60°C for 24 hours, and then measuring their dry weight. The RWC is calculated using a specific formula. The experimental design follows a Randomized Complete Block Design, with Inpago 10 subjected to drought stress and Inpago 5 serving as the control. Results show that Inpago 10 retains water more effectively during drought stress compared to Inpago 5. This research advances understanding of drought tolerance and could facilitate the development of more resilient rice varieties, thereby strengthening national food sovereignty.

Keywords*: Food Sovereignty; Inpago 10; Oryza sativa; Relative Water Content*

Introduction

Rice (*Oryza sativa*) is one of the primary cereal crops in Indonesia and plays a vital role in national food security [1]. As a country with a large population, Indonesia faces many challenges in terms of food security, particularly concerning rice, which is the staple food for more than half of its population. Despite having significant agricultural potential, questions regarding rice imports remain a key issue.

According to data from the Central Bureau of Statistics (BPS), Indonesia's annual rice imports increased by 121.34% compared to previous years. For instance, rice imports in June 2024 reached 376,791 tons, up by 77.06% compared to the same period in 2023 [2]. This indicates that food self-sufficiency has not yet been fully achieved, making national food security vulnerable to fluctuations in global market prices, food cost inflation, and global food crises.

To achieve food sovereignty, the Indonesian government continues to make efforts to increase national rice productivity through the development of new varieties that can adapt to various environmental factors. Varieties such as Inpago 10, developed to reduce the impact of dry seasons on crop yield or growth periods, are crucial in efforts to boost food self-sufficiency and reduce dependency on rice imports [3].

Inpago 10 is a drought-tolerant rice variety with a high adaptability to limited water conditions [4]. Its ability to thrive with limited water supply makes it essential in boosting rice production in areas with low rainfall [5]. Non-irrigated land in Indonesia covers approximately 3.5 million hectares, giving this variety significant potential to meet national rice needs [3]. One of the physiological factors that plays a crucial role in determining this variety's performance is the *Relative Water Content* (RWC), which indicates the plant's drought tolerance. This study will help enhance the understanding of drought tolerance through RWC reports on *Oryza sativa cv*. Inpago 10 and provide data that supports food sovereignty.

Materials and Methods

This research was conducted at the Defense University of the Republic of Indonesia, specifically in the Biology Laboratory, for further analysis. The method for measuring Relative Water Content (RWC) began with leaf sampling from two varieties, Inpago 10 and Inpago 5. After the samples were collected, the first step was to measure the fresh weight of the leaves using a digital scale, which was recorded as the Initial Weight.

To assess the plant's ability to retain water, the leaves were soaked in distilled water (aquadest) for 24 hours. After the soaking process, the drained leaves were weighed again and recorded as the Turgid Weight. Next, the leaves were dried in an oven at 60°C for 24 hours until completely dry. Once dried, the dry weight of the leaves was measured and recorded as the Dry Weight. With the fresh weight (FW), turgid weight (TW), and dry weight (DW) recorded, RWC was calculated using the following formula [6].

$$\mathrm{RWC}(\%) = (\mathrm{FW} - \mathrm{DW}/\mathrm{TW} - \mathrm{DW}) \times 100$$

The research design used a Randomized Block Design (RBD) with two treatments: Inpago 10 as the drought stress treatment and Inpago 5 as the control. This process was conducted on multiple samples for each treatment to ensure representative results and valid analysis.

Results and Discussion

Based on the data collected and analyzed in this study, variations in drought tolerance between the rice varieties Oryza sativa cv. Inpago 10 and Inpago 5 were revealed, with RWC parameters used as indicators. Plants with higher RWC values are considered better at retaining water during dry seasons compared to those with lower RWC values.

Table 1. Fresh Weight Sample Data

Genotype	Fresh Weight (g)			
	1	2	3	4
5.1	0.001	0.0011	0.0014	0.0024
5.2	0.0014	0.0024	0.0024	0.0025
10.1	0.0016	0.0017	0.0017	0.0018
10.2	0.0009	0.0008	0.0010	0.0015

Table 2. Turgid Weight Sample Data

Genotype	Turgid Weight (g)			
	1	2	3	4
5.1	0.0049	0.006	0.0075	0.096
5.2	0.0052	0.0082	0.0093	0.0111
10.1	0.0032	0.0048	0.0057	0.0065
10.2	0.0033	0.0035	0.004	0.0047

Table 3. Dry Weight Sample Data After 1 Day of Drying

Genotype	Dry Weight Sample (g)			
	1	2	3	4
5.1	0.0008	0.0009	0.001	0.0012
5.2	0.0013	0.0013	0.0013	0.0014
10.1	0.0005	0.0006	0.0007	0.0007
10.2	0.0002	0.0002	0.0004	0.0006

Table 4. *Relative water content* (RWC) Test Result

Genotype	RWC (%)			
	1	2	3	4
5.1	4.88	3.92	6.15	1.27
5.2	2.56	15.94203	13.75	11.34
10.1	40.74	26.19048	20.00	18.97
10.2	22.58	18.18182	16.67	21.95

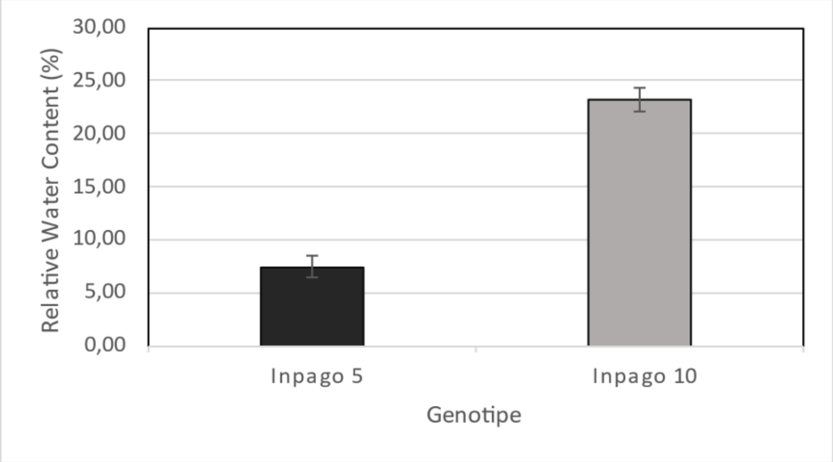

Figure 2. Bar Graph Comparing Inpago 5 and Inpago 10

From the results gathered. the Inpago 10 variety showed significantly higher RWC values compared to Inpago 5 in all the measurements conducted. Samples taken from Inpago 10 plants (10.1 and 10.2) had an average RWC of 23.16%. while Inpago 5 (5.1 and 5.2) had an average RWC of 7.48%. This indicates that Inpago 10 has a better ability to retain water during drought stress.

This difference is also reflected in the calculated standard deviation and standard error. with Inpago 10 showing less variation in RWC results compared to Inpago 5. indicating greater consistency in drought tolerance within the variety. Figure 2 emphasizes this difference. with Inpago 10 displaying much higher bars compared to Inpago 5. effectively visualizing the data to highlight the distinction between the two varieties.

Conclusion

Thus. the use of the relative water content (RWC) measurement method has proven effective in assessing and comparing the drought tolerance capabilities of the Inpago 10 and Inpago 5 varieties. Based on the results. Inpago 10 has a clear advantage in maintaining moisture under drought conditions. This research is expected to provide valuable knowledge and information for the development of new. more drought-resistant varieties as an effective and efficient crop breeding strategy to address climate variability. ultimately strengthening our national food security.

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