THESIS

RESPON BEBERAPA VARIETAS PADI (Oryza sativa) TERHADAP CEKAMAN KEKERINGAN PADA FASE GENERATIF

THE RESPONSE OF SEVERAL RICE VARIETIES (Oryza sativa) ON DROUGHT STRESS IN THE GENERATIVE PHASE

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APPROVAL SHEET

THE RESPONSE OF SEVERAL RICE VARIETIES (Oryza sativa) ON DROUGHT STRESS IN THE GENERATIVE PHASE

THESIS

This thesis was written to fulfill one of the requirements to accomplish a Bachelor's Degree in Agriculture at the Faculty of Agriculture, Sriwijaya University

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SUMMARY

RISNA RUSDAN, The Response of Several Rice Varieties (*Oryza sativa*) On Drought Stress in the Generative Phase (Supervised by **RUJITO AGUS SUWIGNYO** and **SUSILAWATI**).

This research was conducted to determine the growth and production of some rice varieties that were tolerant to drought stress in the generative phase. The research was conducted at the Agrotech Training Center (ATC) Faculty of Agriculture, Sriwijaya University in April to July 2019. The research used 14 rice varieties namely Inpago Unsoed 1, Inpago 4, Inpago 5, Inpago 8, Inpago 9, Inpago 10, Inpago 12, Rindang 1, Rindang 2, Situ Patengang, Inpara 8, Inpara 9,Towuti and Batu Tegi. This research used a split plot design and the parameters observed were plant height, number of tillers, number of panicle per clump, number of grain per panicle, number of grain per clump, grain weight per panicle, grain weight per clump, weight of grain content per panicle, weight of filled grain per clump, weight of 1000 grains, percentage of empty grain, flowering age, proportion of dry weight of plants, dry weight of stover and harvest age. Analysis of variance used the Annova test and followed by a 5% LSD test. From the 14 rice varieties that had been tested, the order of varieties that were more tolerant of drought stress in the generative phase were Inpago 5, Inpago Unsoed 1, Inpara 8, Inpago 12, Inpago 9, Inpago 8, Situ Patenggang, Inpago 4, Inpago 10, Inpara 1 9, Towuti, Batu Tegi, Rindang 1, Rindang 2.

Keywords: *Drought stress, Generative phase, Rice*

BIOGRAPHY

Risna Rusdan, who is fondly called Risna or Ina, is the 2nd daughter of 3 siblings born to Rusdan Kazwan and Radema Nasution. She has two brothers, Adam Rusdan and Adnan Rusdan. The writer lives in Pangautan Village, Mandailing Natal, North Sumatra.

The writer was born in Natal on May 31, 1998. Her education level began at TK ABA Natal in 2003. In 2004 she studied at state elementary school 142705 and graduated in 2010. Then, she continued her junior high school at MTs. Muhammadiyah 20 and graduated in 2013. At senior high school level, she continued her education at the Chairul Tanjung Foundation Superior High School and graduated in 2016. The writer was currently studying at the VIII semester of tertiary education majoring in agricultural cultivation, agronomy study program, faculty of agriculture, Sriwijaya University.

During her study, the writer was a practicum assistant for the Agroclimatology course, and the assistant coordinator for the Botanical course. She served as general secretary of the Agronomy Student Association from 2016-2017 and 2017/2018, secretary of the Competition and Achievement Department at the Student Research Community (KURMA) from 2018-2019. In addition, the witer was also the Secretary of the National Scientific Writing Competition at Sriwijaya University.

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The purpose of writing this thesis was to serve as a requirement for obtaining a Bachelor's Degree in Agriculture at the Faculty of Agriculture, Sriwijaya University. On this occasion the writer would like to thank Prof. Dr. Ir. H. Rujito Agus Suwignyo, M.Agr. and Mrs. Dr. Ir. Susilawati, M. Si. as the advisors who have been willing to provide guidance, direction and motivation so that the implementation and writing of this thesis can be completed properly along with Prof. Dr. Ir. H. Benjamin Lakitan, M.Sc. and Mr. Dr. Ir. Firdaus Sulaiman, M. Si. as thesis examiners who have been willing to take the time to be the examiners and provide suggestions and input to further refine for this thesis.

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The writer hopes that this thesis can be useful for readers as a means to develop knowledge. Last, the writer would like to say thank you.

Indralaya, March 2020

Writer

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CHAPTER 1
INTRODUCTION

1.1. Background

Rice (Oryza sativa) is a source of food for Indonesian people in which the need for rice always increases from year to year. Based on the Central Agency of Statistics (BPS), rice production in 2016 reached 79.14 million tons of dry milled grain (BPS, 2016).

The rice field area has decreased due to land conversion which has resulted in rice production and made the area no longer reliable (Sudana, 2005). Utilization of swamp land is one of the opportunities to increase rice production. The swamp area has a large enough prospect to be developed into productive agricultural land for national food security system particularly rice. Indonesia has an area of 13.28 million hectares of swamp area, including 4,166,000 ha of shallow swampy area, 6,076,000 ha of middle swampy area and 3,039,000 ha of deep swampy area (Rafieq, 2004). Out of these areas, there are 650,000 ha located in South Sumatra, and only 190,000 ha used for agriculture (Thamrin, 2010).

The condition of shallow swamps is characterized by water problems that are not compatible with plant needs. It is known as hydrotopography, rainfall and local river water levels. Plants cultivated in shallow swamps will suffer from submergence and drought stress where inundation occurs in the rainy season and drought in the dry season which cannot be predicted (Djafar, 2013). According to Guswara and Widyantorcin (2012), the excess water or drought does not only occur on individual land, but in one area remains a problem that is difficult for individual farmers to overcome.

This research will focus on the swamp agroecosystem area which covers 4,166,000 ha in Indonesia. One of the problems faced by farmers is the occurrence of drought stress in the generative phase of plant growth.

Drought stress experienced by plants during growth can affect plant growth and production. Drought stress in plants spurs plants to adapt morphologically and anatomically (Radwan, 2007).

Drought stress will result in a low rate of water absorption by plant roots, and this will also affect metabolic processes and cause a decrease in plant growth. Absorption of water by plant roots and loss of roots in water causes imbalance and makes plants wilt due to transpiration. During drought stress, the rate of transpiration of water and nutrients decreases as a result of a decrease in the potential water gradient between the roots and the soil (Taiz and Zeiger, 2002). In addition, it will affect plant morphology like reducing the number of productive tillers, flowering age and plant longevity (Sulistyono et al., 2011).

The generative phase is a phase that is sensitive to drought stress. Plants that experience drought stress in the generative phase, marked by plants starting to flower, will experience a decline. Indonesia has already had rice varieties that are relatively tolerant to drought stress. These varieties used in this study to determine the level of tolerance to drought stress in the generative phase. Based on the description above, it was necessary to study several rice varieties that were tolerant to drought stress.

1.2. Objectives

This study aimed to determine the growth and production of several rice varieties that were tolerant to drought stress in the generative phase.

1.3. Hypothesis

It was suspected that there were several rice varieties that were tolerant to drought stress in the generative phase

CHAPTER 2
LITERATURE REVIEW

2.1. Overview of Rice Plant

Rice plants, in Latin named Oryza sativa, are classified into the divisions known as Spermatophyta, class Monocotyledone, order Poales, family Graminae, and genus Oryza. Rice is a plant that has segments on the stem. The type of the rice can be identified from the length of the rice stem for example the superior rice varieties have shorter stem than the local ones. It is also known that the series of rice stem segments have different sizes in length. The higher the rice, the longer the rice stem segments are in which the first segment from above is the longest one with hollow inside and round shape (Hasanah, 2007).

The roots of rice plants which are very effective in nutrient absorption are fibrous roots. However, these are sensitive to drought. To know the ages of the roots, it can be seen from the color. The roots which have matured and have formed saplings are brown, meanwhile the new (young) roots are white (Suwignyo, 2007).

Rice plants are classified as self-pollinating plants. This means that rice plants have pistils and stamens in one flower. Rice flowers are classified as flowers that have one ovule, six stamens, and one pistil with two-headed pistils. Rice fruit, classified as caryopsis, is covered by a part called *palea* and *lemma* in which after filling process of the grain, the palea and lemmea will become the grain skin or husk. The flower organs of rice plants are arranged in panicles that arise from the topmost of stem.

Rice plants have different life cycle patterns. According to Makarim et al. (2009), the growth of rice plants is divided into three phases, namely:

1. Vegetative (early growth to the formation of panicle/primordia).

The vegetative phase is the growth phase of vegetative organs, such as increasing the number of tillers, plant height, weight, and leaf area. This phase causes differences in the age of the plant because it has various lengths of time.

2. Reproductive (primordia to flowering)

The characteristics of the reproductive phase are: (a) the top segment of the plant is elongated; (b) the number of tillers is reduced (productive tillers die); (c) the flag leaf appears; (d) pregnancy and (e) flowering

3. Maturation (flowering until the grain is ripe)

The maturation phase is divided into three stages, namely A) the ripe rice grain stage is marked by the panicles starting to turn green and drooping, and the grain begins to fill with a thick, milky white liquid. Then, withering at the base of the tiller continues. B) The half-ripe grain stage is marked by the grain in the panicle starting to turn yellow, as the panicle ends of the last two leaves on each tiller begin to dry out. C) The third stage, which is fully ripe grain, is marked by each grain in the panicle being fully ripe, hardened and yellow in color. A number of dead leaves will accumulate at the base of the plant.

2.1.1. Rice Plant Taxonomy

According to Azhar (2010) the classification of rice plants (Oryza sativa L.) is:

Kingdom: Plantae

Division: Spermatophyta

Class : Monocotyledonae

Order: Poales

Family: Gramina

Genus: Oryza

Species: Oryza sativa

2.2. Drought Stress

The term swampy land is used for lands that are affected by the water regime and are generally associated with conditions of waterlogging, tidal overflow, flooding, and mud. Swamp land is an area that is characterized by its shallow groundwater table and thinly inundated, where one of the wetland ecosystems (wetland) is located between an area with a land system (terrestrial) and a deep water system (aquatic). According to the the coordination team of Preparation of the National Planning for Sustainable Management of Swamplands (P2NPLRB), it is classified to be swamp land if it meets the following 4 (four) main elements, namely: (1) saturated water until it is flooded continuously or periodically causing an anaerobic atmosphere, (2) topography which is sloping, flat to concave, (3) mineral sediments (caused by erosion carried by river water) and/or peat (due to piles of remnants of local vegetation), and (4) overgrown with natural vegetation (Waclimad, 2012).

Indonesian food crops particularly rice, are agricultural areas that can be developed in lowland swamps because they are one of the most potential resources. Lowland swamp is a swamp located on the left and right of a large river and its tributaries with a flat topography, waterlogged in the rainy season, and dry in the dry season. In the dry season, the lowland swamp area gradually dries up so that the availability of water for plants is reduced and causes drought stress (Djamhari, 2009).

Drought is defined as a condition where there is a lack of water intake in a settlement for a long time. This situation is caused by continuous low rainfall or the absence of rain for a long time. In the long dry season, there is no water (drought) because the water reserves in the soil are depleted due to evaporation, transpiration and other uses by the community in a sustainable manner. Drought caused by the climate can make rice to reduce its yield and quality because it is vulnerable to water shortages (Tao et al., 2006). The beginning of a drought in one season begins with a decrease in the amount of rainfall which is a characteristic of meteorological drought. Then the supply of groundwater becomes reduced at the surface and groundwater. This condition is called hydrological drought. Hydrological drought causes the water content in the soil to shrink so that it cannot meet the water needs of plants.

Dry land is one type of marginal lands that can have a negative impact on crops caused by drought. The negative impact of drought on plants is that plant metabolic processes will be disrupted such as inhibition of nutrient absorption, cell division and cell enlargement, stomata closure, and decreased enzyme activity so that plant growth and development is hampered (Asmara, 2011).

Lack of water results in the speed of the photosynthesis process and the stomata will also close (Jumin, 2002). Water in plant tissue, apart from being the main constituent of active tissue, also has a function to carry out physiological activities, namely maintaining the turgidity needed for cell growth and enlargement. In this case, the effect of water shortage is determined by the time the water shortage lasts (Kramer, 1969 in Supriyanto, Bambang, 2013). This important role has consequences either directly or indirectly. Water deficit in plants will affect all metabolic processes in plants which result in disruption of the growth process (Pugnaire and Pardos, 1999 in Supriyanto, Bambang, 2013).

Water is needed by plants as a process of forming and filling organ cells, regulating cell turgidity to carry out organ movement mechanisms (opening and closing stomata), which is a reactant in the photosynthesis process, and having functions as a temperature regulator for plant organs and as a solvent for solid materials (Nasit, 2001).

Rice is a plant that is easily stressed during drought stress. Lack of water in plants results in impaired cell function in rice and reproduction and will have a negative impact on plant growth (Bray, 2001). The form of plants against drought stress depends on the severity of the drought. (Kadir, 2011).

Plants respond to drought starting with a physiological response which consists of a series of processes in plants. Then, it will proceed with morphological changes which are known as morphological changes in terms of plant resistance on the impact of drought stress. Besides that, it also impacts on the continuity of physiological processes and causes an impact between the two effects

The ways of plants resistance to drought are:

a) Drought escape or escaping (escape from drought), which means managing the completion of its life cycle before drought stress occurs in plants. The short flowering period can also save the plant from drying out. Naturally rice plants will lengthen their roots to seek the presence of water when drought stress occurs, this is a morphological plant mechanism to escape from drought (Abdullah et al., 2010).

b) Actual drought resistance, there are two things, namely:

• Drought avoidance is a mechanism to keep the water in the cells high when the drought level is getting higher. The way to keep the turgidity cell high is by reducing water loss or increasing water absorption. Rice plants deepen their root system is one way to increase water absorption (Tubur et al., 2012).

• Drought tolerance is a way of adjusting to the osmotic state of the cell at the time of the cell potential. This was done to maintain high turgidity even though the cells decreased due to dryness. The amino acid proline is a soluble material that increases in levels when drought occurs. Therefore, the genotypes of drought-tolerant plants have high proline (Man et al., 2011).

1. Plants have a tolerance for high tissue water potential (dehydration avoidance), which is a way for plants to maintain tissue potential by suppressing water loss and increasing water absorption. Improves root system and decreases epidermal conduction by regulation of stomata, formation of waxy layer, thick fur and decreased surface evatranspiration through leaf constriction and through shedding of old leaves (Xiong et al., 2006).

2. Plants tolerance with tissue potential (dehydration tolerance), is a way for plants to maintain cell turgor pressure by reducing water potential through accumulation of solutions like increasing cell elasticity or sugar and amino acids (Martinez et al., 2007).

CHAPTER 3
RESEARCH METHODOLOGY

3.1. Place and Time

The research was conducted at the Agrotech Training Center (ATC), Faculty of Agriculture, Sriwijaya University, Indralaya, Ogan Ilir. The research was conducted from April to July 2019.

3.2. Tools and Materials

The tools used in this research were: 1) Stationery, 2) Hoe, 3) Camera, 4) Meter, 5) Analytical balance, 6) Oven, 7) Water pipe and 8) Scales.

The materials used in this study were: 1) Water, 2) Tray, 3) Rice seeds of Inpago 12, Inpago Unsoed 1, Inpago 4, Inpago 5, Inpago 9, Inpago 8, Inpago 10, Inpara 8, Inpara 9, Rindang 1 , Rindang 2, Situ Patenggang, Towuti, and Batu Tegi, 4) Wood, 5) Label, 6) Nails, 7) Plastic Fiber, 8) Fertilizer and 9) Rope.

3.3. Research Method

The method used in this research was the split plot design method. Main plots were soil moisture content and sub-plots were varieties.

The main plots of water content used were:

K0 = 100% Water Saturated Condition (Soil Moisture Content 32-35%)

K1 = Groundwater Condition 50%-75% K0 (Soil Moisture Content 21% - 26%) The sub-plots of rice varieties used were:

V1 = Inpago Unsoed 1 Variety

V2 = Inpago 4 Variety

V3 = Inpago 5 Variety

V4 = Inpago 8 Variety

V5 = Inpago 9 Variety

V6 = Inpago 10 Variety

V7 = Inpago 12 Variety

V8 = Rindang 1 Variety

V9 = Rindang 2 Variety

V10 = Situ Patenggang Variety

V11 = Inpara 8 Variety

V12 = Inpara 9 Variety

V13 = Towuti Variety

V14 = Batu Tegi Variety

The research was conducted with 3 replications, in each replication there were 3 samples of plants.

3.4. Procedures

3.4.1. Land Preparation

The land used was rice fields located at the Agrotech Training Center (ATC). The land used was firstly plowed to loosen the soil. Then, a 7 x 11 meter plot of land was divided into two parts. In the first plot, rice was planted with 100% soil moisture content of field capacity, and in the second plot with 50%-75% groundwater conditions. The barrier between the first plot and the second plot was fiber plastic which serves to keep no water from entering other than the water provided. In addition, plastic houses were made on the research area to keep rainwater from entering the research site. The spacing used in this study was 25 x 25 cm.

3.4.2. Planting Materials Preparation

Planting materials used were 14 varieties of rice. Those rice seeds were Inpago Unsoed 1, Inpago 4, Inpago 5, Inpago 8, Inpago 9, Inpago 10, Inpago 12, Rindang 1, Rindang 2, Situ Patenggang, Inpara 8, Inpara 9, Towuti, and Batu Tegi. The seeds were soaked in water for 24 hours. During the soaking process, the floating seeds were discarded. After that, it was continued by draining the good seeds for 24 hours.

3.4.3. Nursery

Seeds that have been drained and sprouted (radicles) were then transferred to the nursery for 17 days.

3.4.4. Planting

Planting was carried out after the seeds had been sown for 17 days. Then, they were planted on the land provided in the plastic house according to the replication and design that had been determined.

3.4.5. Maintenance

Plant maintenance included water management, fertilization, embroidery, weed control and pest and disease control. Water management was carried out every afternoon. Fertilization was carried out by giving different numbers of NPK Mutiara fertilizer during the process which were the first was 1.8 kg, the second was 1.2 kg, and the third was 600 grams. Embroidery was applied as a replacement for the dead plants. Weed control was undergone manually by pulling it out around the plant. Pests and plant diseases were carried out using pesticides.

3.4.6. Drought Stress Treatment

Drought stress treatment was given on day 57 after planting, which was the end of the flowering age phase and entering the panicle filling phase. Drought stress was applied to 50%-75% groundwater conditions. It was given by gradual drying (Gradual Drying), which were on day 57 after planting. The watering was stopped and continued by observing the soil moisture content on day 9, day 27 and day 36 after drought treatment (on 65, 83 and 92 days after planting) using Ring Sample. Meanwhile, at 100% of water saturation conditions, watering was still carried out every day with stagnant water conditions and observations were still carried out with similar conditions at 50%-75% soil moisture content.

3.4.7. Harvest

Harvesting was carried out on rice that had reached its maximum age with optimally filled panicles, which were hard and dried along with the leaves that turned yellow.

3.5. Parameters

3.5.1. Plant Height (Cm)

Plant height was measured from the base of the stem to the tip of the flag leaf, which was the tip of the longest leaf calculated from the beginning to the end of the study with an observation period of once every 2 weeks.

3.5.2. Number of Tillers Per Clump (Stem)

The number of tillers was counted every 2 weeks.

3.5.3. Flowering Age (Days)

The flowering age was calculated at the time of the first flowering, namely the transition from the vegetative phase to the generative phase.

3.5.4. Number of Panicles Per Clump

The number of panicles was calculated after the harvesting process was completed by counting panicles per plant clump.

3.5.5. Number of Grains Per Panicle (Grain)

The calculation of the number of grain per panicle was carried out after the harvest was complete by separating the grain from the panicle. Calculation of the number of grain per panicle was calculated as a whole among empty grain, lost grain, and pithy grain.

3.5.6. Number of Grain Per Clump (Grain)

The calculation of the number of grain per clump was carried out after the harvest was complete by separating the grain from the panicle. Calculation of the number of grain per clump was calculated as a whole among empty grain, lost grain, and pithy grain.

3.5.7. Grain Weight Per Panicle (Gram)

The weight of grain per panicle was carried out by weighing the entire grain of empty, lost, and pimpled grain.

3.5.8. Grain Weight Per Clump (Gram)

The weight of the grain per clump was carried out by weighing the entire grain of grain between empty, lost and pithy grain in one clump.

3.5.9. Weight of Grain Content Per Panicle (Gram)

The weight of grain content per panicle was carried out by weighing the grains contained in one panicle.

3.5.10. Weight of Filled Grain Per Clump (Gram)

The weight of filled grain per clump was carried out by weighing the grains contained in one clump.

3.5.11. Weight of 1000 Grains (Gram)

The calculation of the weight of 1000 grains was carried out by taking 1000 grains randomly. Then, those were weighed.

3.5.12. Percentage of Empty Grain (%)

The calculation of the percentage of empty grain was carried out by selecting among the pithy and empty grains

$$\text{The percentage of empty grains} = \frac{\text{Number of empty grains}}{\text{Total of grains}} \times 100$$

3.5.13. Proportion of Plant Dry Weight

The proportion of plant dry weight was done by dividing between roots, shoots and seeds of plants in a value of 100%.

3.5.14. Dry Weight of Stover

Parameters of dry weight of stover were calculated by weighing dry weight of rice plant canopy.

3.5.15. Harvest Age (days)

Harvest age was calculated from the plant nursery until it was ready to harvest or based on the criteria for ripening. The ripening criteria for the harvest were when the rice had entered stage 9, known as the ripe stage.

CHAPTER 4
RESULTS AND DISCUSSION

4.1. Results

The treatment of 50%-75% soil moisture content was observed three times which were on day 9, day 27, and day 36 after the gradual drought treatment was given. The results of the observations showed that the moisture content of the soil was 26%, 25%, 21%. Meanwhile, for the treatment of 100% soil moisture content, the soil moisture content was 33%, 35% and 32%. The results of this observation showed that the soil moisture content treatment distributed on day 9, day 27 and day 36 after the drought treatment was 75.92%, 75.30% and 66.34% compared to the control moisture content.

The results showed that the drought stress treatment had a significant effect on the dry weight parameters of the stover as the main plot. The results of the study on sub-plots (between varieties) had a very significant effect on the parameters of plant height, number of tillers per clump, number of panicles per clump, number of grain per panicle, number of grain per clump, weight of grain per panicle, weight of grain per clump, weight of grain content per panicle, weight of filled grain per clump, weight of 1000 grains of grain, flowering age. Drought stress treatment had no significant effect on the percentage of empty grain parameters in both main plots and sub-plots.

Table 4.1. The F-count value and coefficient of variation on drought stress treatment

No	Observed Variable	F count			CV_D	CVv
		D	V	D x P	(%)	(%)
1	Plant Height	13.93 tn	13.93 **	0.13 tn	5.3	5.62
2	Number of Tillers	0.30 tn	3.66 **	0.56 tn	26.99	28.56
3	Number of Panicles Per Clump	3.58 tn	2.78 **	0.98 tn	27.84	20.63
4	Number of Grains Per Panicle	1.49 tn	21.01 **	1.56 tn	49.66	20.82
5	Number of Grain Per Clump	0.94 tn	6.09 **	0.94 tn	61.73	26.02
6	Grain Weight Per Panicle	0.07 tn	7.79 **	0.64 tn	44.04	38.5
7	Grain Weight Per Clump	0.09 tn	5.87 **	1.06 tn	31.55	44.98
8	Weight of Grain Content Per Panicle	3.30 tn	6.60 **	1.03 tn	83.31	69.72

9	Weight of Filled Grain Per Clump	5.80 tn	12.62 **	0.91 tn	62.21	44.11
10	Weight of 1000 Grains	3.12 tn	2.75 **	0.59 tn	10.62	18.82
11	Percentage of Empty Grain	1.77 tn	0.58 tn	0.53 tn	64.89	26.58
12	Flowering Age	0.02 tn	13.61 **	2.13 *	2.90	3.56
13	Dry Weight of Stover	26.08*	1.69 tn	0.22 tn	24.32	20.85
	F Table 0.05	18.51	1.91	1.91		
	F Table 0.01	98.50	2.49	2.49		

Descriptions: D = Drought

V= Variety

CV = Coefficient of Variation

** = Very Significant Effect

* = Significant Effect

tn = Insignificant Effect

Table 4.2. The results of the observation of all parameters tested on drought stress using a Split Plot Design

Varieties	Plant Height	Number of Tillers	Number of Panicle Per Clump	Number of Grains Per Panicle	Number of Grain Per Clump	Grain Weight Per Panicle	Grain Weight Per Clump	Weight of Grain Content Per Panicle	Weight of Filled Grain Per Clump	Weight of 1000 Grains	Percentage of Empty Grain	Flowering Age	Dry Weight of Stover
Unsoed 1	127.78 b	11.89 bc	7.83 c	102.82 a	979.75 ab	0.58 ab	6.86 ab	0.32 a	4.20 c	17.32 bc	55.88	56.78 c	23.16
Inpago 4	157.92 e	8.94 a	7.19 c	227.31 d	1699.61 d	2.18 c	13.04 c	1.3 bc	8.65 d	22.12 d	62.45	58.15 cd	22.69
Inpago 5	129.69 bc	7.72 a	6.94 bc	135.89 bc	863.25 ab	0.74 ab	4.51 a	0.48 a	1.93 ab	16.60 bc	62.37	59.15 d	26.32
Inpago 8	133.11 bc	7.17 a	6.31 bc	157.23 bc	891.44 ab	0.95 ab	5.42 ab	0.46 a	2.67 b	18.40 bc	65.05	56.55 c	28.62
Inpago 9	139.83 cd	9.11 a	7.17 c	152.28 bc	1059.53 b	0.81 ab	5.05 a	0.34 a	1.95 ab	14.80 ab	60.28	53.43 b	23.61
Inpago 10	133.69 bc	8.72 a	7.64 c	179.42 c	1363.81 c	0.88 ab	9.27 b	0.50 a	3.42 bc	15.74 ab	60.40	57.17 cd	27.72
Inpago 12	130.86 bc	8.83 a	6.94 bc	177.28 c	1110.42 a	0.86 ab	5.75 ab	0.46 a	2.14 ab	16.52 b	61.75	54.37 b	26.91
Rindang 1	131.06 bc	7.61 a	6.47 bc	128.69 ab	805.28 a	0.96 b	5.24 ab	1.23 bc	3.35 bc	19.18 c	65.77	54.78 b	25.65
Rindang 2	134.03 c	7.89 a	5.67 b	162.52 c	960.67 ab	1.08 b	9.36 b	0.84 b	5.00 c	17.68 bc	62.60	54.64 b	21.234
S.Patenggang	129.75 bc	8.28 a	6.39 bc	132.53 b	859.17 ab	0.7 ab	4.77 a	0.29 a	1.26 a	14.20 ab	74.16	51.85 ab	21.84
Inpara 8	129 bc	7.33 a	5.97 b	142.89 bc	766.5 a	0.82 ab	5.62 ab	0.44 a	2.15 ab	15.97 ab	61.08	58.55 d	25.57
Inpara 9	136.97 c	11.22 b	8.03 c	153.90 bc	1239.94 bc	0.90 ab	8.38 b	1.08 b	4.16 c	18.00 bc	68.91	61.59 e	27.06
Towuti	105.08 a	13.78 c	6.72 bc	143.15 bc	1040.58 b	0.56 a	4.30 a	0.32 a	1.02 a	13.81 a	65.30	50.61 a	20.08
Batu Tegi	144.61 d	7.06 a	4.44 a	364.63 e	1509.64 cd	2.37 c	13.42 c	1.53 c	7.62 d	17.90 bc	58.88	58.09 cd	21.11

Note: The numbers followed by letters in the same column indicated the notation because they are significantly different at the level of Least Significant Different (LSD) 5%.

4.1.1. Plant Height

The results of the analysis of tested varieties showed significant differences in plant height, in (Table 4.2) it showed that the Inpago 4 variety was significantly different in height from other varieties. In (Figure 4.1) at soil moisture content of 100% and 50%-75% the difference in height was not too significant, but at 100% soil moisture content the result was higher than the soil moisture content of 50%-75%. The Towuti variety had a lower height than all varieties, the Inpago 4 and Batu tegi varieties had the best genetic height, and apart from that, the rest of varieties had almost the same height.

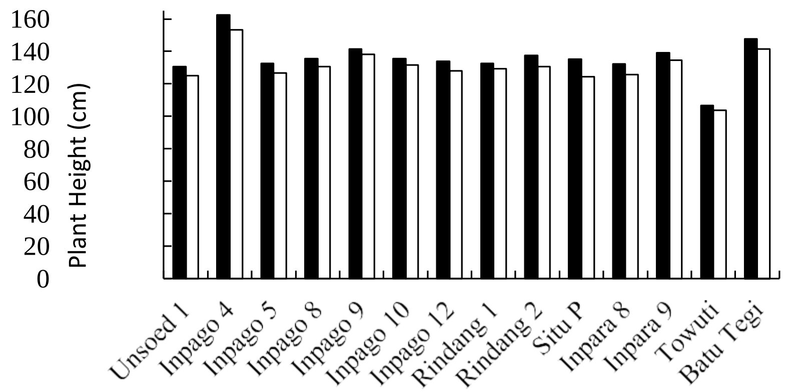


Figure 4.1 The effect of soil moisture content at 100% (■) and 50%-75% (□) on the plant height of rice varieties at the age of 12 weeks after planting

4.1.2. Number of tillers

The results of the variance analysis showed that the number of Towuti tillers was significantly different from all varieties except the Unsoed 1 variety which was not significantly different (Table 4.2). The Unsoed 1, Inpago 8, 10, Inpago 12, Situ Patenggang, Inpara 8, Inpara 9 and Batu tegi varieties were very tolerant at 50%-75% soil moisture content. Inpago 4 variety was tolerant at 50%-75% and at 100% of soil water content, and Inpago 5, Inpago 9, Rindang 1, Rindang 2 and Towuti varieties were intolerant to levels of 50%-75% (Figure 4.2). Inpago 5, 8, Situ patenggang, Inpara 8 and Batu tegi varieties had almost the same genetic value. Inpago varieties 4, 9 and Inpara 9 also had almost the same value.

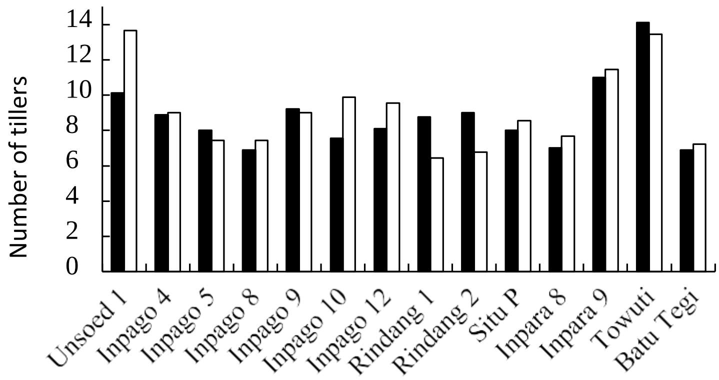


Figure 4.2 The effect of soil moisture content at 100% (■) and 50%-75% (□) on number of tillers of rice varieties at the age of 12 weeks after planting

4.1.3. Flowering Age

The flowering age parameter in the analysis of variance showed that Inpara 9 variety was significantly different from other varieties (Table 4.2). The Unsoed 1, Inpago 8 and Batu Tegi varieties had relatively the same flowering time at 50%-75% and 100% soil moisture content. On the varieties of Inpago 12, Inpago 9, Inpago 10, Inpara 8, and Situ Patenggang, they had a relatively long flowering period at 100% soil moisture content and relatively short at 50%-75% soil moisture content (Figure 4.3). Meanwhile, Inpago 4, 5, Rindang 1, 2, Inpara 9 and Towuti varieties had a relatively long flowering age at 50%-75% soil moisture content.

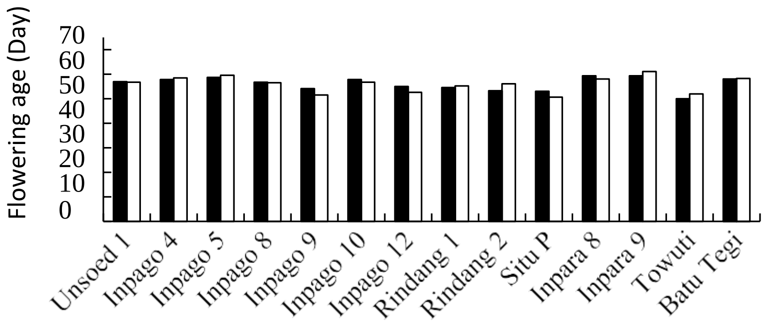


Figure 4.3 Flowering age of rice plants tested at 100% soil moisture content (■) and at 50%-75% soil moisture content (□).

4.1.4. Number of Panicles Per Clump

Based on the average results of the analysis of variance on the panicle number parameter, the Unsoed 1 variety was significantly different from the Rindang 2, Inpara 8 and Batu tegi varieties, but it was not significantly different from the other varieties (Table 4.2). On Unsoed 1, Inpago 4, 5, 10, 12, Rindang 2, Situ Patenggang, Inpara 8, 9, and Towuti varieties were very tolerant of 50%-75% soil moisture content, while Inpago 8, 9, Rindang 1, and Batu Tegi varieties were intolerant at the same percentage of soil moisture content. On the other hand, the Inpago 5 and Rindang 2 varieties were intolerant to the number of tillers, but it had more productive panicles at 50%-75% soil moisture content. Moreover, Rindang 1 was intolerant of the number of tillers and the number of panicles per clump (Figure 4.4).

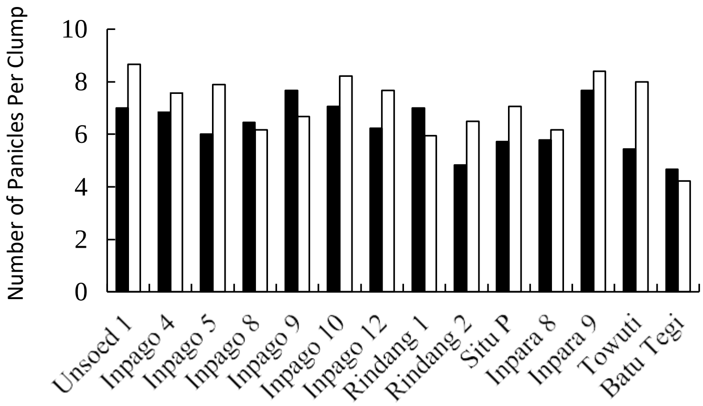


Figure 4.4 Number of panicles per rice clump tested at 100% soil moisture content (■) and at 50%-75% soil moisture content (□).

4.1.5. Number of Grains Per Panicle

The number of panicle grains in the analysis of variance showed that the Batu Tegi variety was significantly different from other varieties (Table 4.2). The Rindang 2, Towuti and Batu Tegi varieties were intolerant of soil moisture content at 50%-75%. Genetically, the Batu Tegi variety had a high value on the amount of grain in the cluster, but the Unsoed 1, Inpago 4, Inpago 5, Inpago 8, Inpago 9, Inpago 10, Inpago 12, Situ Patenggang, Inpara 8, and Inpara 9 were very tolerant to soil moisture content at 50% -75%, and the Rindang 1 variety was tolerant to water content at 50%-75% and 100%. On Inpago 5, Inpago 8, Inpago 9, Inpago 10, Inpago 12, Rindang 2, Situ Patenggang, Inpara 8, Inpara 9, and Towuti varieties, they had relatively the same number (Figure 4.5).

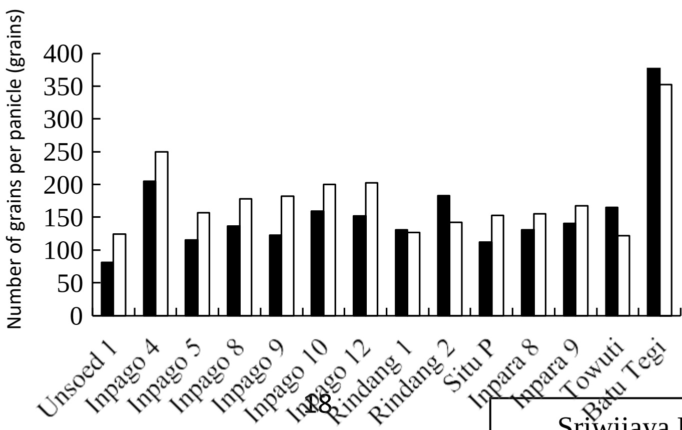


Figure 4.5 The amount of rice grain per panicle tested at 100% soil moisture content (■) and at 50%-75% of moisture content (□).

4.1.6. Number of Grains Per Clump

The results of the analysis of variance showed that the Inpago 4 variety was significantly different from all varieties other than the Batu Tegi variety which showed no significant difference (Table 4.2). The Rindang 2, Towuti, and Batu Tegi varieties were intolerant at 50%-75% soil moisture content (Figure 4.6). Meawhile, the Rindang 1 and Situ Patenggang varieties were tolerant at 50%-75% and 100% soil moisture content. Apart from these varieties, the rest of rice varieties had very tolerant at 50%-75% of drought stress especially on Unsoed 1 and Inpago 5 varieties, and the number of grains per clump was in line with the number of grain per panicles.

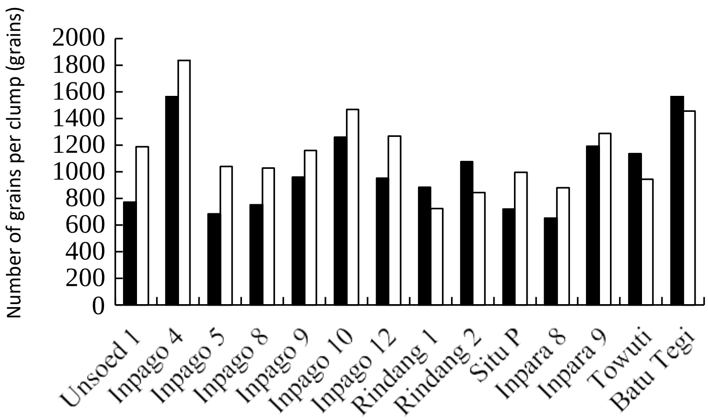


Figure 4.6 The amount of rice grain per clump tested at 100% soil moisture content (■) and at 50%-75% soil moisture content (□).

4.1.7. Grain Weight Per Panicle

The results of the analysis of variance showed that the Inpago 4 variety was significantly different from all varieties, but it was not significantly different from the Batu Tegi variety (Table 4.2). The Inpago 4 and Batu Tegi varieties showed the highest genetic values, but the Inpago 4 variety were intolerant at 50%-75% soil moisture content. The Inpago 4, Inpago 10, Rindang 2, Inpara 9, Towuti and Batu Tegi varieties were intolerant at 50%-75%of soil moisture content, while the Unsoed 1, Inpago 5, 8, 9, 12 and Batu Tegi varieties (Figure 4.7) had a very tolerant nature at 50%-75% soil moisture content. Furthermore, the Rindang 1, Situ Patenggang, and Inpara 8 varieties were relatively tolerant to soil moisture content at 50%-75% and 100% respectively.

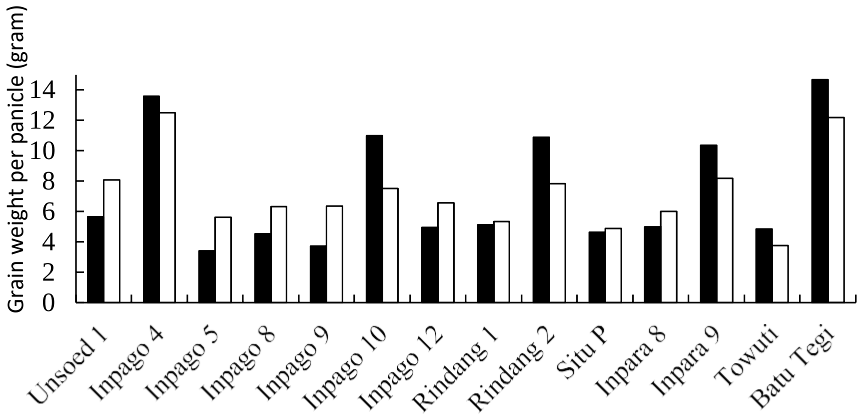


Figure 4.7 Weight of rice grain per panicle tested at 100% soil moisture content (■) and at 50%-75% soil moisture content (□).

4.1.8. Grain Weight Per Clump

Grain weight per clump in the analysis of variance showed that the Inpago 4 variety was not significantly different from the batu tegi variety, but it was significantly different from the other varieties (Table 4.2). The Unsoed 1, Inpago 5, Inpago 8, Inpago 9, Inpago 12, and Inpara 8 varieties were very tolerant to soil moisture content at 50%-75%, but the Inpado 4, Inpago 10, Rindang 2, Inpara 9, Towuti and Batu Tegi varieties were not tolerant to aoil moisture content at 50%-75%. Meanwhile, the varieties of Rindang 1 and Situ Patenggang were relatively tolerant to water content at 100% and 50%-75% (Figure 4.8).

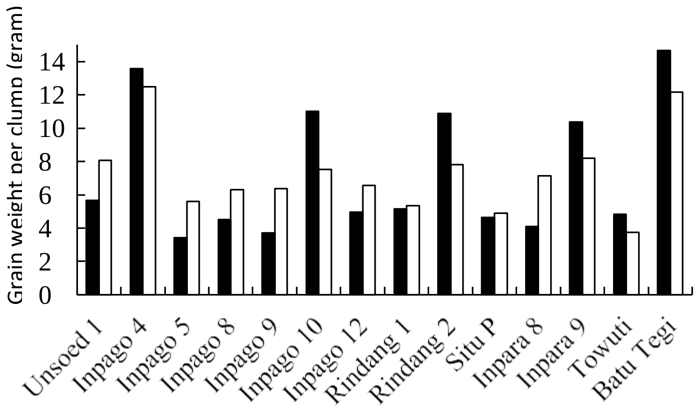


Figure 4.8. Weight of rice grain per panicle tested at 100% soil moisture content (■) and at 50%-75% soil moisture content (□).

4.1.9. Weight of Grain Content Per panicle

Grain-content weight per panicle showed that the Batu Tegi variety was not significantly different from the Inpago 4 and Rindang 1 varieties, but it was significantly different from the other varieties (Table 4.2). In Inpago 4, 8, 10, & 12, Rindang 1, & 2, Inpara 9, Towuti and Batu Tegi varieties were intolerant at 50%-

75% soil moisture content, while Inpago 5 varieties were tolerant at 50%-75% soil moisture content. The Unsoed 1, Inpago 9, Inpara 8, and Situ patenggang varieties were relatively tolerant to soil moisture content at 100% and 50%-75% (Figure 4.9). Furthermore, the highest variety was Batu Tegi and the lowest was Situ Patenggang.

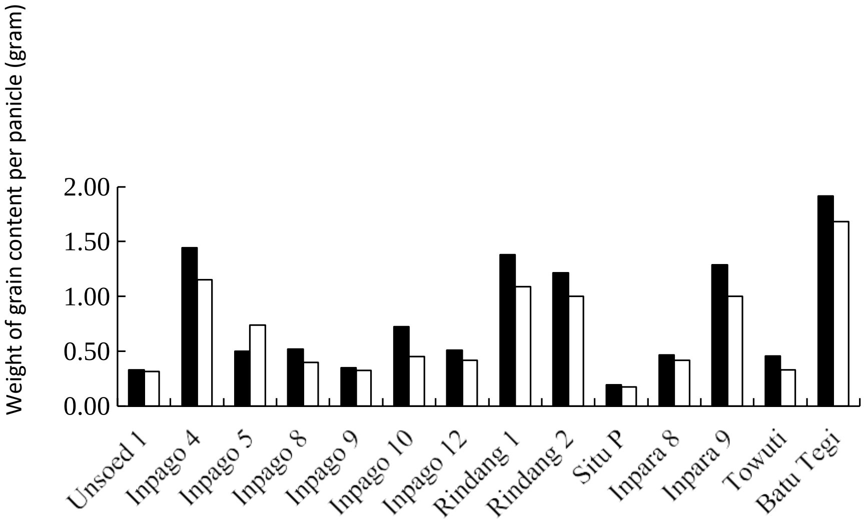


Figure 4.9 Weight of rice grain content per panicle tested at 100% soil moisture content (■) and at 50%-75% soil moisture content (□).

4.1.10. Weight of Filled Grain Per Clump

In terms of weight of filled grain per clump, the results of the variance analysis showed that the Inpago 4 variety was not significantly different from the Batu tegi variety but it was significantly different from other varieties (Table 4.2). Inpago 5 variety was very tolerant at 50%-75% soil moisture content. Furthermore, the rest of varieties were not tolerant at 50%-75% soil moisture content except Inpago 5 (Figure 4.10).

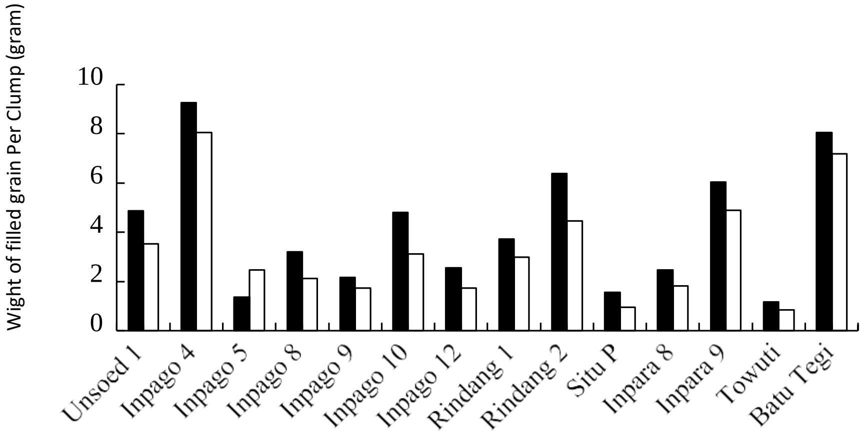


Figure 4.10 Weight of filled rice grain per clump tested at 100% soil moisture content (■) and at 50%-75% soil moisture content (□).

4.1.11. Weight of 1000 Grains

The results of the variance analysis showed that the weight of 1000 grains of Inpago 4 variety was significantly different from other varieties (Table 4.2). The Inpago 5, Inpago 9, Rindang 1, and Inpara 8 variety were tolerant at 50%-75% soil moisture content. The Inpago 4, and Situ Patenggang varieties were relatively tolerant at 50%-75% soil moisture content, and the Unsoed 1, Inpago 8, 10, & 12, Rindang 2, Inpara 9, Towuti and Batu Tegi varieties were intolerant of soil moisture content at 50%-75% (Figure 4.11).

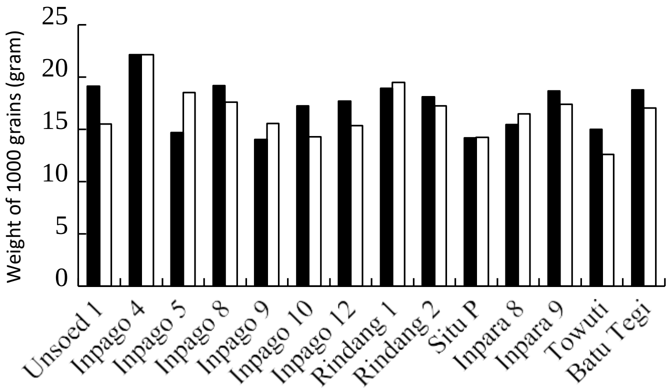


Figure 4.11 Weight of 1000 rice grains tested at 100% soil moisture content (■) and at 50%-75% soil moisture content (□).

4.1.12. Percentage of Empty Grain

The results of the analysis of variance showed that the variable percentage of empty grain had no significant effect (Table 4.2). The Unsoed 1, Inpago 4, 5, 8, 9, & 10, Rindang 1, 2, Situ Patenggang, Inpara 8, 9, Towuti and Batu Tegi varieties were very tolerant at 50%-75% soil moisture content. The Situ Patenggang variety at 50%-75% soil moisture content had a higher value than all varieties (Figure 4.12).

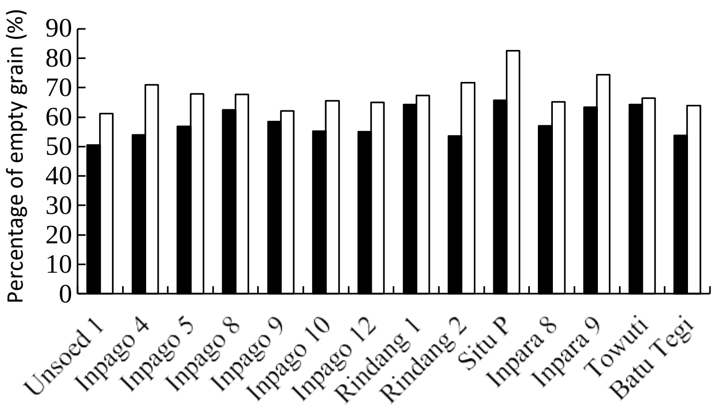


Figure 4.12 Effect of Percentage of empty grain of rice plants tested at 100% soil moisture content (■) and at 50%-75% soil moisture content (□).

4.1.13. Proportion of Plant Dry Weight

The results of the analysis of variance showed that in absolute quantitative of the proportion of dry weight plants at 100% soil moisture content. It was found that the highest root value was the Inpago 5 variety and the lowest root was Rindang 2 variety. The highest canopy quantity was the Towuti variety and the lowest canopy was the Inpago 12 variety. Furthermore, the highest seed quantity was Inpago 4 variety and the lowest was Situ Patenggang (Figure 4.13).

Meanwhile, the absolute quantitative of dry weight of the plant at 50%-75% soil moisture content, it was found that the highest root value was Inpago 8 variety and the lowest was the Rindang 1 variety. Then, the highest canopy quantity was Inpago 8 and the lowest was Inpago 4, and the highest seed quantity was the Inpago 4 variety and the lowest was Rindang 1 variety (Figure 4.14).

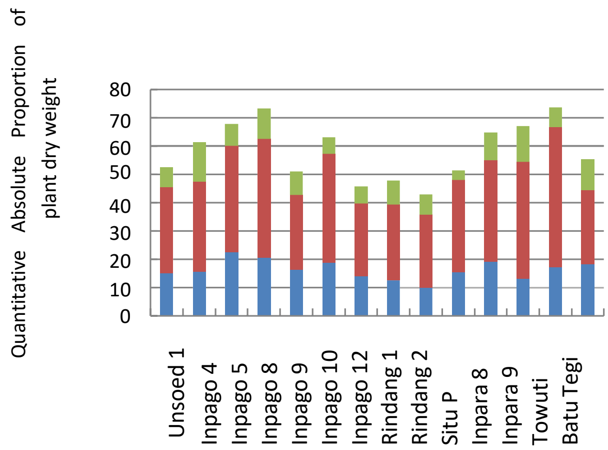


Figure 4.13 Quantitative absolute proportion of plant dry weight at 100% soil moisture content.

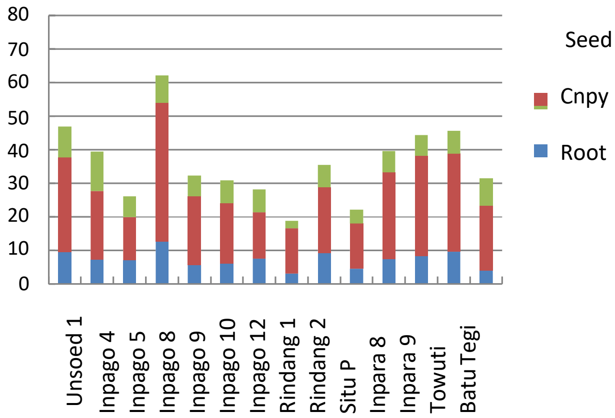
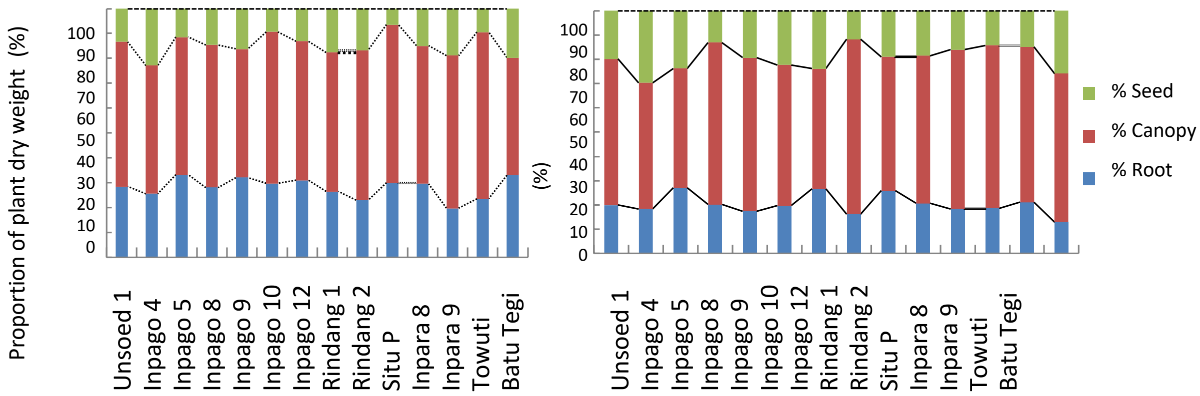


Figure 4.14 Quantitative absolute proportion of plant dry weight at 50%-75% soil moisture content.



In terms of proportion of plant dry weight at 100% soil moisture content, it was found that the highest seed value was the Inpago 4 variety, the highest canopy was the Towuti variety, and the highest root was the Batu Tegi variety. Then, the lowest proportion of seeds was the Situ Patenggang variety, the lowest proportion of shoots was the Batu Tegi variety and the lowest proportion of roots was the Rindang 2 variety (Figure 4.15).

In the proportion of plant dry weight at 50%-75% soil moisture content, it was found that the highest proportion of seed values was the Inpago 4 variety, the highest canopy was Inpago 8 variety, and the highest root proportion was Inpago 5 variety. Furthermore, the lowest seed proportion was Rindang 1 variety, the lowest proportion of canopy was the Inpago 12 variety and the lowest proportion of roots was Batu Tegi variety (Figure 4.16).

4.1.14. Dry Weight of Stover

The results of the analysis of variance showed that the Inpago 12 variety was significantly different from the Rindang 2, Towuti and Batu Tegi varieties, but it was not significantly different from the other varieties (Table 4.2). In (Figure 4.15) from all varieties, it can be seen that at soil moisture content of 50%-75%, the dry weight of stover was lower than at soil moisture content of 100%.

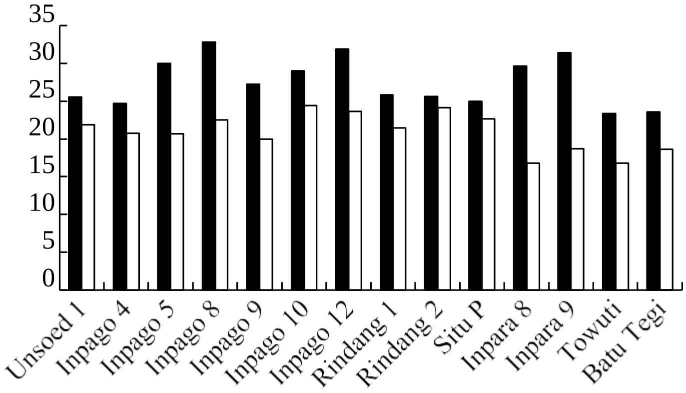


Figure 4.17 The dry weight of the rice plant stover tested at soil moisture content of 100% (■) and at soil moisture content of 50%-75% (□).

4.2. Discussion

Based on (Table 4.4) the ranking of the 14 rice varieties observed from the treatment at 50%-75% and 100% soil moisture content as well as the parameters of the number of tillers, number of panicles per cluster, number of grain per panicle, number of grain per clump, weight of grain per panicle, weight of filled grain per clump and flowering age of rice plants, it was found that they were Inpago 5, Inpago Unsoed 1, Inpara 8, Inpago 12, Inpago 9, Inpago 8, Situ Patenggang, Inpago 4, Inpago 10, Inpara 9, Towuti, Batu tegi, Rindang 1, and Rindang 2.

From the research, it was found that the Inpago 4 variety genetically had a high value, but based on (Table 4.4) the variety that was tolerant to drought stress was Inpago 5, this was because environmental factors also supported the growth of rice plants. According to Lakitan (2008) that environmental factors that can affect the photosynthesis process are the availability of water, Co2, light, and air. If this element is in a limited state as a result of competition among plants and the results of photosynthesis are also small.

In Table 4.4 it showed that the Rindang 2 variety was the variety that is not tolerant to drought stress. This condition was influenced by genetic factors from the Rindang 2 variety which is not resistant to drought stress. In drought-stressed plants, water plays an important role in the translocation of nutrients from the roots of all parts of the plant, so that the lack of water affect a decrease in the photosynthesis process which results in inhibition of plant growth and development.

Based on the results of the average plant height to drought stress in the generative phase, it was found that the Inpago 4 variety was the highest, which was 157.92 cm. while the other varieties experienced relatively the same growth in height. Rice plants height at 50% -75% soil moisture content treatment were depressed compared to rice plants at 100% soil moisture content treatment. The differences in plant height growth at soil moisture content of 50%-75% and 100% happened because the drought that occurs in plants causes disruption of plant metabolic processes such as inhibition of nutrient absorption, inhibition of cell division and enlargement, decreased enzyme activity and stomata closure so that plant growth and development becomes hampered. (Asmara, 2011).

The number of tillers of Rindang 1, Rindang 2, Towuti varieties was intolerant at 50%-75% soil moisture content. This was because in the transcolation process, water acts as a nutrient supplier from the roots to all parts of the plant, so that lack of water will result in a decrease in the photosynthesis process and stunted growth. plants (Jumin, 2002). On the other hand, the Unsoed 1, Inpago 8, Inpago 10, Inpago 12, Situ Patenggang, Inpara 8, Inpara 9 and Batu Tegi varieties were tolerant to soil moisture content of 50%-75%. This was because these varieties are superior varieties which have tolerant resistance to drought and can be planted in areas with short rainy climates (Suardi, 2000).

The results of the analysis of variance showed that the relatively long flowering age was Inpara 9 variety with an average of 61.59 days and the Towuti variety with an average of 50.61 days. The flowering age in this study showed that the Inpara variety had a longer flowering period than the Inpago variety.

Based on the results of the average number of panicles per clump, Inpago 8, Inpago 9, Rindang 1 and Batu Tegi varieties were intolerant of 50%-75% soil moisture content. This is because drought stress that occurs during the generative phase will interfere with the initiation of the number of panicles which causes the emergence of panicles to be few (Mostajeran and Eichi 2009). Meanwhile, other varieties that were very tolerant to soil moisture content of 50%-75% were in line with Yugi's research (2011) it showed that the varieties Unsoed1, Inpago 4, Inpago 5, Inpago 10, Inpago 12, Rindang 2, Inpara 8, Inpara 9, Situ Patenggang and Towuti had a high level of tolerance to drought which was the ability to last a long time under 100% soil moisture content.

In the parameters of the number of grains per panicle and the number of grains per clump, Unsoed 1, Inpago 4, Inpago 5, Inpago 8, Inpago 9, Inpago 10, Inpago 12, Situ Patenggang, Inpara 8 and Inpara 9 produced the number of seeds per panicle and the number of seeds per cluster higher at 50%-75% soil moisture content. This indicated that even when the plants were in a drought-stressed condition at the beginning of the flowering period & the seed filling period, they were still able to produce a higher number of grains per panicle and were not significantly different when under control.

Tabel 4.3. The results of all treatment parameters at 50%-75% soil moisture content and at 100% soil moisture content

Varieties	Plant Height (%)	Number of tillers (%)	Flowering age (%)	Number of panicle per clump (%)	Number of grain per panicle (%)	Number of grain per clump (%)	Weight of grain per panicle (%)	Weight of grain per clump (%)	Weight of filled grain per panicle (%)	Weight of filled grain per clump (%)	Weight of 1000 grain (%)	Percentage of empty grain (%)	Dry weight harvest (%)
Unsoed 1	95.74	135.16	99.61	123.81	152.63	153.66	158.75	142.82	95.42	72.52	81.17	121.31	81.12
Inpago 4	94.43	101.25	101.28	110.57	121.53	117.43	85.30	91.92	79.75	86.78	100.17	131.47	83.69
Inpago 5	95.68	93.06	101.41	131.48	135.77	151.55	183.16	164.59	322.63	179.46	126.02	119.27	75.02
Inpago 8	96.15	108.06	99.34	95.69	130.50	136.81	123.15	139.53	76.63	66.42	91.83	108.20	74.42
Inpago 9	97.64	97.59	92.85	86.96	148.56	120.66	171.08	171.16	92.38	80.74	110.72	106.36	73.50
Inpago 10	97.17	130.88	98.13	116.54	125.51	116.36	74.14	68.43	39.51	42.24	82.92	118.58	81.65
Inpago 12	95.56	117.81	93.65	123.21	133.26	132.89	116.27	132.47	81.26	67.92	86.77	100.23	68.49
Rindang 1	97.49	73.42	101.25	84.92	97.28	81.98	104.72	103.67	78.81	80.18	103.03	104.83	87.57
Rindang 2	94.95	75.31	105.04	134.48	77.81	78.51	90.86	71.78	37.81	56.69	95.16	133.54	65.64
S.Patenggang	91.99	106.94	95.53	123.30	136.90	137.85	107.10	104.99	88.32	62.02	100.36	125.63	74.76
Inpara 8	95.13	109.52	97.73	106.73	118.75	134.40	106.62	174.50	89.31	73.61	106.60	114.16	72.42
Inpara 9	96.69	104.04	107.49	109.42	118.80	108.14	53.47	79.01	64.42	37.66	93.16	117.41	76.70
Towuti	97.24	95.28	105.64	146.94	73.87	83.01	54.48	77.41	71.78	72.60	83.91	103.19	72.01
Batu Tegi	95.71	104.84	100.19	90.48	93.58	93.19	82.75	83.07	114.02	89.29	90.71	118.90	78.93

Table 4.4 Percentage of increase and decrease of several important parameters observed from treatment at 50%-75% soil moisture content and treatment at 100% soil moisture content on all tested varieties

Varieties	Number of Tillers %	Number of Panicle Per Clump %	Number of Grain Per Panicle %	Number of Grain Per Clump %	Weight of Grain Per Clump %	Weight of Filled Grain Per Clump %	Flowering age %	Total of Increase & Decrease	Varieties Ranking
Unsoed 1	35.16	23.81	52.63	53.66	42.82	-27.48	-0.39	180.21	2
Inpago 4	1.25	10.57	21.53	17.43	-8.08	-13.22	1.28	30.76	8
Inpago 5	-6.94	31.48	35.77	51.55	64.59	79.46	1.41	257.32	1
Inpago 8	8.06	-4.31	30.50	36.81	39.53	-33.58	-0.66	76.35	6
Inpago 9	-2.41	-13.04	48.56	20.66	71.16	-19.26	-7.15	98.52	5
Inpago 10	30.88	16.54	25.51	16.36	-31.57	-57.76	-1.87	-1.91	9
Inpago 12	17.81	23.21	33.26	32.89	32.47	-32.08	-6.35	101.21	4
Rindang 1	-26.58	-15.08	-2.72	-18.02	3.67	-19.82	1.25	-77.30	13
Rindang 2	-24.69	34.48	-22.19	-21.49	-28.22	-43.31	5.04	-100.38	14
S.Patenggang	6.94	23.30	36.90	37.85	4.99	-37.98	-4.47	67.53	7
Inpara 8	9.52	6.73	18.75	34.40	74.50	-26.39	-2.27	115.24	3
Inpara 9	4.04	9.42	18.80	8.14	-20.99	-62.34	7.49	-35.44	10
Towuti	-4.72	46.94	-26.13	-16.99	-22.59	-27.4	5.64	-45.25	11
Batu Tegi	4.84	-9.52	-6.42	-6.81	-16.93	-10.71	0.19	-45.36	12

In previous research, Tubur et al. (2012) said if drought occurred since the flowering and seed filling period, this relatively had no effect on the decrease in the percentage of rice production. The smaller the value of the percent decrease in production, the better plants were to able to maintain their productivity under drought stress conditions, in other words, plants were more tolerant of drought stress (Sulistyo et al., 2016). The Rindang 1, Rindang 2, Towuti and Batu Tegi varieties were intolerant at 50%-75% soil moisture. This was because drought stress at the time of panicle initiation could reduce the number of grains per panicle, this had an impact on decreasing grain production. This is in line with Djazuli's research (2010) which said that drought stress did not only suppress the growth and production of rice plants, including the amount of grain, but drought that occurred in plants would cause disruption of plant metabolic processes such as inhibition of nutrient absorption, inhibition of cell division and enlargement, decreased enzyme activity and stomata closure so that plant growth and development was hampered (Asmara, 2011).

Based on the results of the average grain weight per panicle and grain weight per clump, it was shown that Inpago 4 and Batu Tegi genetically had higher values, but they were not tolerant to drought stress. The difference in grain weight was caused by differences in the nature of each variety and the environmental conditions in which it grew (Suprihatno et al., 2007). Meanwhile, Unsoed 1, Inpago 5, Inpago 8, Inpago 9, Inpago 12, Rindang 1 varieties were tolerant of 50%-75% soil moisture content (Figure 3.6).This was in line with the research of Suardi, (2000) which stated that several rice varieties were resistant to a short rainy climate and produce panicles and clump of grain optimally. The difference in the grain weight per clump of each variety was thought to be due to changes in physiological factors of the plants to defend themselves under drought stress, especially the generative phase. In Rindang 1 and Situ Patenggang varieties, there were a balance between 50%-75% and 100% soil moisture content, this could be due to the adequate supply of nutrients, groundwater supply and sunlight so that the grain weight became optimum (Tao et al., 2006).

Weight of grain content per panicle and weight of filled grain per clump on the varieties Unsoed 1, Inpago 4, Inpago 8, Inpago 9, Inpago 10, Inpago 12, Rindang 1, Rindang 2, Situ Patenggang, Inpara 8, Inpara 9, Towuti and Batu Tegi were intolerant to soil moisture content of 50%-75%. This indicated that drought stress during seed filling was able to reduce grain weight per panicle and per clump. The drought stress treatment had an effect on low grain weight. The results of Tubur et al. (2012) showed that the drought period in the tillering phase could reduce grain production by up to 80% due to the low number of tillers formed. Low grain weight was obtained in the drought stress treatment before seed filling. In this treatment, the plants were gripped when they entered the seed filling phase, so that stopping watering caused a large number of empty seeds, this would affect the weight of the filled grain. The results of the research by Effendi (2008) showed that the weight loss of grain was significant in all tested rice varieties due to the increase in the intensity of drought stress. This result is supported by the opinion of Sulistyo et al. (2016) stated that drought in the reproductive phase can increase the percentage of empty grain and reduce grain weight. In the weight of grain content per panicle of the Unsoed 1 variety, the weight of grain content per panicle was relatively the same from both treatments. This difference is thought to be influenced by genetic factors for each variety tested (Guswara, 2007).

The weight of 1000 grains of grain in (Figure 3.10), varieties Unsoed 1, Inpago 8, Inpago 10, Inpago 12, Rindang 2, Inpara 9, Towuti and Batu Tegi had a weight value of 1000 grains more at 100% soil moisture content than at 50%-75%. Based on the research results of Ruminta et al. (2016), it stated that the technique of giving water intermittently to rice plants resulted in a thousand seeds heavier than submerged irrigation because the growth of root tissue was more perfect so that the transport of nutrients was smoother. Meanwhile, Inpago 4 and Situ Patenggang varieties were tolerant to soil moisture content of 50%-75% and 100%. One of the factors that also affected the weight equation of a thousand seeds between stress and control treatments was seed uniformity. Based on the research results of Nirmala et al. (2016) the weight of 100 hanjeli seeds was not significantly different from the control, presumably because the seed yields were almost uniform in size in each treatment.

The percentage of empty grain had a higher value in all varieties at 50%-75% soil moisture content. The percentage of empty grain was in line with the research of Oukarroum (2007). It stated that the physiological character associated with plant resistance to drought stress was a decrease in transpiration by reducing the number of stomata and having an impact on the percentage of empty grain.

Parameters of the proportion of dry weight of plants, the proportion of roots in the soil moisture content of 50%-75% less than the soil moisture content of 100%. This was because in the generative phase, photosynthates was transferred to the generative part namely panicles and grain, so that root growth was more inhibited than the growth of the canopy. Supriyanto (2013) states that lack of water in plant tissues can be caused by excessive water loss during transpiration through stomata and other cells such as the cuticle or caused by both.

Dry weight of rice stover in the treatment was not tolerant to soil moisture content of 50%-75%. The difference in dry weight of the Inpago 4 variety in the two treatments was due to the drought that occurred in the plant which would disrupt plant metabolic processes such as inhibition of nutrient absorption, inhibition of cell division and enlargement, decreased enzyme activity and stomata closure so that plant growth and development was hampered in all varieties at a soil moisture content of 50%-75% (Asmara, 2011). This was because the decrease in dry weight was also caused by biochemical activity in plant cells in an effort to defend themselves from drought stress. As long as the plant is experiencing drought stress, the plant will utilize the results of photosynthesis more as a source of energy in biochemical processes that aim to increase its tolerance to drought stress so that the available photosynthesis results are underutilized for the formation of plant organs (Jaleel, 2008).

Rice varieties Inpago 12, Unsoed 1, Inpago 4, Inpago 5, Inpago 9, Inpago 8, Inpago 10, Rindang 1, Rindang 2, Situ Patenggang, Inpara 8, Inpara 9, Towuti, Batu Tegi were harvested on day 92 after planting, while the Inpara 8 and Inpara 9 varieties at 100% soil moisture content were harvested on 99 day after planting. The difference in harvesting age was because in the generative phase of rice plants, water needs must be fulfilled because at this phase rice plants were very sensitive to drought/lack of water. Drought stress could have caused plants to experience stress. This was in line with the research of Gardner (1991), it was said that the age of harvest was two to 7 days faster due to lack of water in the generative phase.

CHAPTER 5
CONCLUSION AND SUGGESTION

5.1. Conclusion

The results showed that from the 14 rice varieties that had been tested, the sequence of varieties that were more tolerant to drought stress in the generative phase were Inpago 5, Inpago Unsoed 1, Inpara 8, Inpago 12, Inpago 9, Inpago 8, Situ Patenggang, Inpago 4, Inpago 10, Inpara 9, Towuti, Batu tegi, Rindang 1, and Rindang 2. The best varieties were seen based on the parameters number of tillers, number of panicles per clump, number of grain per panicle, number of grain per clump, weight of grain per clump, weight of filled grain per clump and flowering age of rice plant.

5.2. Suggestion

Varieties that are tolerant to drought stress can be used as out crossing parental lines.

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