

ISSN: 2477-1899

# Proceeding

The 1<sup>st</sup> Almuslim International Conference  
on Science, Technology, and Society



The Institute of Research and Community Services  
**ALMUSLIM UNIVERSITY BIREUEN - ACEH**



**COORDINATION OF PRIVATE HIGHER  
EDUCATION REGIONAL XIII ACEH**

**CHAPTER I**  
**LIFE SCIENCE**

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**ISSN : 2477-1899**

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**Printed November 2015**

## **Message from the Rector**

Assalamu'alaikum Wr. Wb.  
Greetings.

Ladies and gentlemen,

It is an honor indeed to open this conference, the 1<sup>st</sup> Almuslim International Conference on Science, Technology, and Society (AICSTS). On behalf of Almuslim University (Umuslim), I would like to extend a warm welcome to all participants and our speakers who are with us to make this a notable and exciting event a success.

At Almuslim University, we emphasize the best possible achievements in education and research and are also committed to innovation and technology. Today, we are faced with more challenges in these spheres, and therefore, as members of the academic community, we have a duty to find innovative research solutions for them. Hence, this conference is an excellent forum for experts, professionals, researchers, and students as well, to present, share, and discuss their knowledge and experiences with all of us. In line with such idealism, it is really a privilege for us to host you, not just this year, but for years to come, to give and provide opportunities to contribute lasting and practical solutions to the challenges that confront us from time to time. This conference includes keynote speeches, oral and poster parallel sessions on topics in the field of sciences, life sciences, engineering, social sciences and humanities.

Finally, we know that in the origination of this conference there may be some shortcomings, for which we would like deeply apologize in advance to all of you. This is the University's first experience in organizing an international conference like this. With deepest sincerity hereby we would also like to thank all the keynote speakers for your contribution, time and support for this conference. Our heartfelt appreciation goes to all the authors of the selected papers for their effort and hard work. I also would like thank the organizing committee of the conference for their hard work in making this event a success. I wish to encourage them to continue organizing more events and to take other initiatives as well in future. To support and sustain important research linkages for dialogue and facilitate exchanges of ideas such as this will certainly generate more new discoveries and innovations in years to come. It is everyone's optimism that all we will learn from this first international conference in 2015 will be used as a reference for the development of research, as well as guidance for the readers in education and in academic profession.

I am sure the committee of this conference has served you in the best way they can to make your brief stay with us a lasting memory.

Thank you.

Dr. Amiruddin Idris, SE, M.Si

## Message from the Committee Chairman

Assalamu'alaikum Wr. Wb.

Greetings,

Ladies and Gentlemen,

I would like to take this occasion to cordially welcome all participants of the 1<sup>st</sup> Almuslim International Conference on Science, Technology, and Society (AICSTS). This conference is held at our beloved campus of Almuslim University (Umuslim), Bireuen, from November 7<sup>th</sup> to November 8<sup>th</sup>, 2015. Almuslim University, the home of 7 faculties, is one of the major private universities in Aceh. We are assured that the 416 scientific participants will contribute to productive discussions and exchanges of scientific experiences that will bring about success to this conference. Participants from 9 countries, Indonesia, Malaysia, Thailand, Philippines, United States, India, Taiwan, England, and Qatar, have optimally marked an international scope to the conference.

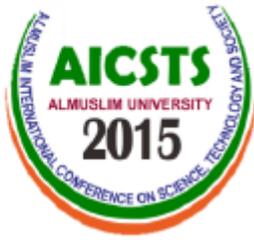
I would like to express my gratitude to the Coordination of Private Higher Education Regional XIII Aceh, the Institute of Research and Community Services of Almuslim University and the committee members for helping us in organizing the conference. The conference and proceedings are a credit to a large group of people and everyone should be proud of the outcome.

We are delighted with the vast responses of 152 submissions from researchers and practitioners. The knowledge bases that we are aiming to generate in the conferences topics are overwhelming due to the involvement of these experts from various fields of studies. Their papers will be published in the proceedings to provide permanent records of what has been presented. The proceedings are divided into four, Life Sciences, Engineering, Social Sciences and Humanities (Science Educations), and Social Sciences and Humanities (Economics, Social and Arts), and the papers published here will exhibit the current state of development in all aspects of important topics that are instrumental to all researchers in the various fields. They have succeeded in bringing together various aspects of developments and innovations in knowledge and technology that will benefit not only the academic community, but the society itself as well.

We realize that there are still many shortcomings in the implementation of the arrangements of this conference. Therefore at this opportunity we also expect criticism and constructive suggestions from all stakeholders so that the conference arrangements in future will be more successful. Finally we would like to thank you all for all the support and assistance you have contributed to making this conference and its proceedings successful.

Thank you,

Drs. Marwan Hamid, M.Pd



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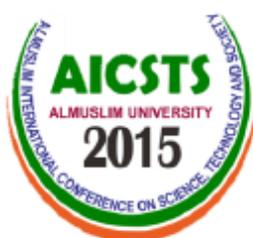
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## **Root Character of Drought Tolerant Rice In Lowland System**

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### **Abstract**

The objective of this research is to identify the characters of the root of rice that tolerance to drought stress. This research was done in the Rice Research Field, University Farm IPB, Bogor ( $\pm$  240 m ASL). The research used a split plot design with three replications with drought stress as the main plots and variety as the subplots. The main plot consisting of drought stress at 3 Weeks After Transplanting (3 WAT) until the age of 7 WAT, and control (K0), whereas the subplot consisted of rice varieties namely IR 64, Ciherang, IPB 3S, Way Apo Buru, Jatiluhur, Menthik Wangi, Silugonggo and Rokan. The results showed that drought stress inhibits root development either vertically or horizontally at 0-10 cm, 10-20 cm, 20-30 cm and 30-40 cm depth. Decreased total root weight, root depth of achievement. Decrease in total dry weight of the roots is less due to drought stress on the Jatiluhur and IPB 3S varieties (12.41%, 36.41% respectively). The highest increasing in root depth achieved by Way Apo Buru (46.05 cm) followed by IPB 3S (37.05 cm) varieties. Drought tolerance index was positively correlated with total root dry weight and relative leaf water content, and negatively correlated with the shoot root ratio. Total root dry weight, root depth, shoot root ratio during drought stress can be used as selection criteria for drought tolerant varieties.

**Keywords:** Drought stress, rootbox, root distribution

### **Introduction**

Roots play important roles by exhibiting various adapted responses specific to the prevailing soil moisture stress conditions (Yamauchi et al., 1996). For instance, one of the adaptive responses of plants to drought conditions is the development of deep and extensive root systems (Fukai and Cooper, 1995; Serraj et al., 2004), which include thick roots (Price et al., 2000) and increased root length density (Siopongco et al., 2005) as a result of the plasticity in lateral root development (Azhiri-Sigari et al., 2000;

Bañoc et al., 2000; Kamoshita et al., 2000). These adaptations are perceived to be associated with increased water extractions (Kamoshita et al., 2000, 2004; Siopongco et al., 2005).

Rooting character becomes important in drought condition in which the ability of the roots to penetrate the solid ground to improve the extraction of water in the deeper zones, osmotic adjustment and dehydration tolerance of plant leaves. Deep root system, rugged and has a high ability to form root branching and penetration, high shoot root ratio, is a component of the essential nature of the roots associated with Drought avoidance (Yamauchi et al.1996; Samson et al., 2002).

In contrast to the flooded rice root has the ability to form cells aerenchym. This is important not only for adaptation to oxygen deficiency, but also to keep the extension of the roots and also to maintain the condition of the water loss that often occurs progressively. Increased aerenchym cells may facilitate the diffusion of oxygen to the roots when the low oxygen condition (Suralta and Yamauchi 2008). Rice root system has a unique morphological and physiological responses to drought, because usually adapt to the waterlogged conditions. Character facilitate the growth of the roots in waterlogged conditions that may affect the response of rice to drought, but the characteristics of the roots the condition of drought stress on the structurally and functionally rice in paddy system has not been known. It underlies related research to understand the mechanisms of plant roots to drought stress is primarily concerned with the root system of paddy systems. The objective of this research is to identify the characters of the root of rice that tolerance to drought stress.

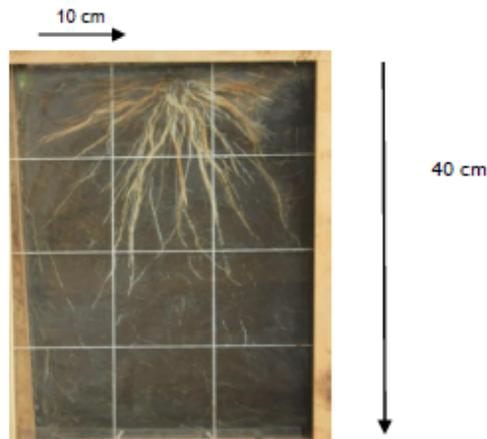
#### **Materials and Methods**

This experiment was done in a plastic house at the Rice Research Bogor Agricultural University in 2012. Plant materials that were used in this experiment are IR 64, Ciherang, IPB 3S, Way Apo Buru, Jatiluhur, Mentik Wangi, Silugonggo and Rokan rice varieties. NPK fertilizers and insecticides. The tools used include plastic containers measuring 67 cm long, 47 cm wide and 42 cm in, yells, rulers, measuring cups, oven and analytical scales, microscopes and rootbox. Rootbox used was adopted from research Kono et al. (1987) and has been modified.

The experiment was arranged in a split plot design with three replications with drought stress the main plots that consisted of control (normal irrigation) and drought stress (drought imposed at three weeks after transplanting until harvest). The sub-plot consisted of eight rice varieties which are IR 64, Ciherang, IPB 3S, Way Apo Buru, Jatiluhur, Mentik Wangi, Silugonggo and Rokan.

Observation of water samples done at age 7 MST by opening the glass portion on one side, then take a picture of the distribution of root system intact and then also take pictures using griedline (Figure 1) to determine the root zone at a depth of 0-10 cm, 10-20, 20-30 cm and 30-40 cm. The depth of the root in each treatment outcome was measured by measuring the length of the roots from the base of the longest root to root. The root dry weight was measured based based deployment depth and radius of the base of the clump-which consists of: A: The depth of 0-10 cm (vertical), a radius of 0-5 cm A': root depth of 0-10 cm (horizontal), 5-15 B: Depth of 10-20 cm (vertical), radius 0-5 B': root depth of 10-20 cm (horizontal),

radius 5-15 C: Depth of 20-30 cm (vertical), radius 0-5 C': The depth of 20-30 cm (horizontal), radius 5-15 D: The depth of 30-40 cm (vertical), radius 0-5 D': The depth of 30-40 cm (horizontal), radius 5-15.



**Figure 1.** Gridlines that are used to determine the root zone (the root depth of 0-10 cm, 10-20 cm, 20-30 cm and 30-40).

The experiment was arranged in a split plot design with three replications with drought stress the main plots that consisted of control (flooded) and drought stress (drought imposed at three weeks after transplanting until seven weeks after planting). The sub-plot consisted of eight rice varieties which are IR 64, Ciherang, IPB 3S, Way Apo Buru, Jatiluhur, Menthik Wangi, Silugonggo and Rokan.

observations conducted on root weight, the depth of the roots achievements, the total weight of the roots, shoot root ratio and relatif water content. The data were analyzed for significance by analysis of variance in the level of  $\alpha = 0.05$  using Duncan's analysis.

### Results and Discussion

Analysis of variance showed that drought stress treatment, variety and interaction significantly affect root weight at a depth of 0-10 cm, 10-20 cm, 20-30 cm, 30-40 cm (zones A, A', B, B', C, C', D and D'), total dry weight of root, shoot root ratio, depth of root achievement. Drought stress treatment caused decreased in root weight and development of roots vertically and horizontally (Table 1, 2, 3 and 4).

**Table 1.** The average weight of the root eight varieties at a depth of 0-10 cm (A, A') on drought stress treatment

Varieties	ZONE A			Relative decrease (%)	ZONE A'			Relative decrease (%)
	Drought stress		Relative decrease (%)		Drought stress		Relative decrease (%)	
	control	3 WAT			control	3 WAT		
IR 64	7.66 d	2.14 fg	72.10	2.66 a	0.85 f-i	68.00		
Ciherang	9.95 c	1.08 gh	89.10	1.54 cd	0.43 jkl	72.10		
IPB 35	3.11 f	1.77 fgh	42.90	1.11 ef	0.61 h-k	45.10		
Way Apo Baru	12.54 b	1.49 gh	88.10	0.94 e-h	0.31 kl	67.10		
Jatiluhur	6.28 e	2.28 fg	63.70	1.18 c	1.05 efg	10.60		
Mentik Wangi	6.30 e	0.48 h	92.40	0.70 i-l	0.54 g-j	22.90		
Silugonggo	7.05 de	1.93 fg	72.50	1.32 de	0.20 l	84.60		
Rokan	22.86 a	1.72 gh	92.50	2.28 b	1.04 efg	54.50		

Note: Values followed by the same letter in the same column are not significantly different according to Duncan's analysis at  $P<5\%$

**Table 2.** The average weight of the root of eight varieties at a depth 10- 20 cm (B, B') on the drought stress treatment

Varieties	ZONE B			Relative decrease (%)	ZONE B'			Relative decrease (%)
	Drought stress		Relative decrease (%)		Drought stress		Relative decrease (%)	
	control	3 WAT			control	3 WAT		
IR 64	0.27 cd	0.41 b	[33.40]	0.69 cd	0.29 fg	58.00		
Ciherang	0.20 ef	0.14 fgh	27.70	0.55 de	0.28 fg	48.00		
IPB 35	0.12 gh	0.26 cde	[50.70]	0.38 efg	0.45 ef	[16.20]		
Way Apo Baru	0.19 efg	0.07 h	59.40	1.20 a	0.38 efg	68.00		
Jatiluhur	0.28 cd	0.23 de	16.00	0.70 cd	0.71 cd	[0.28]		
Mentik Wangi	0.14 fgh	0.08 h	40.70	0.52 de	0.53 de	[1.50]		
Silugonggo	0.49 a	0.13 gh	73.60	0.81 bc	0.17 g	78.00		
Rokan	0.21 cd	0.12 h	[29.70]	0.99 b	0.33 efg	46.00		

Note: Values followed by the same letter in the same column are not significantly different according to Duncan's analysis at  $P<5\%$

**Table 3.** The average weight of the root of eight varieties at a depth of, 20-30 cm (C, C') on drought stress treatment

Varieties	ZONE C			Relative decrease (%)	ZONE C'			Relative decrease (%)
	Drought stress		Relative decrease (%)		Drought stress		Relative decrease (%)	
	control	3 WAT			control	3 WAT		
IR 64	0.14 bc	0.18 abc	[20.80]	0.52 bc	0.37 cde	27.90		
Ciherang	0.07 e	0.16 abc	[58.30]	0.39 cde	0.29 de	25.30		
IPB 35	0.04 e	0.20 ab	[77.80]	0.45 bcd	0.34 cde	25.30		
Way Apo Baru	0.08 de	0.22 a	[62.20]	0.47 bcd	0.26 e	45.10		
Jatiluhur	0.18 abc	0.22 a	[17.50]	0.77 a	0.62 a	18.80		
Mentik Wangi	0.06 e	0.05 e	10.90	0.58 b	0.33 cde	42.20		
Silugonggo	0.16 abc	0.04 e	71.10	0.61 ab	0.31 de	48.70		
Rokan	0.13 cd	0.15 bc	[14.30]	0.76 a	0.46 bcd	38.90		

Note: Values followed by the same letter in the same column are not significantly different according to Duncan's analysis at  $P<5\%$

Table 4. The average weight of the root of eight varieties at a depth 30 to 40 cm (zones D, D') on drought stress treatment

Varieties	ZONAE D			ZONE D'		
	Drought stress		Relative decrease (%)	Drought stress		Relative decrease (%)
	Control	3 WAT		Control	3 WAT	
	g			g		
IR 64	0.04 e	0.25 b	[84.10]	0.15 d-g	0.47 c	[67.20]
Ciberang	0.05 de	0.06 de	[7.00]	0.06 fg	0.17 de	[63.40]
IPB 3S	0.02 e	0.27 b	[91.30]	0.06 fg	0.74 b	[91.80]
Way Apo Bum	0.04 e	0.19 bc	[78.50]	0.05 g	0.25 d	[76.90]
Jatiluhur	0.12 cd	0.35 a	[63.50]	0.11 efg	0.99 a	[88.70]
Menthik Wangi	0.04 e	0.02 e	52.20	0.07 efg	0.15 d-g	[53.20]
Silugonggo	0.05 de	0.25 b	[77.20]	0.12 efg	0.16 def	[24.30]
Rokan	0.03 e	0.25 b	[86.50]	0.09 efg	0.56 c	[83.50]

Note: Values followed by the same letter in the same column are not significantly different according to Duncan's analysis at  $P < 5\%$

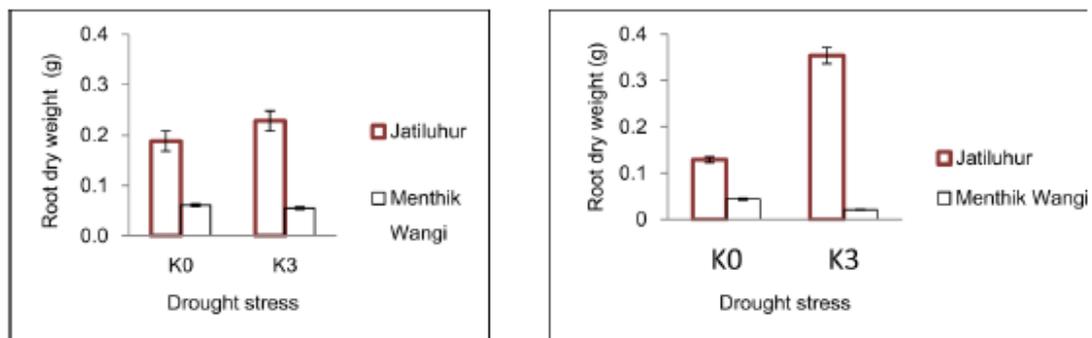


Figure 1. Root weight in zones C and D at a depth of 20-30 and 30-40 cm in Jatiluhur (tolerant varieties) and Mentihk Wangi (sensitive varieties)

Due to drought caused a reduction in total dry weight of the roots reach 12.41-81.56%. IPB 3S and Jatiluhur shows a decline in the smaller root weight (12.31% and 36.41%). This shows that IPB 3S and Jatiluhur varieties has the ability to increased root weight in the deeper part or root expansion either vertically or horizontally to reach the water in deeper soil layers. One drought adaptation is elongation and expansion of roots. Elongation and extension of roots implications of total weight of the roots that would affect the balance of shoot and root growth.

The highets increase percentage ratio of the shoot root is Rokan and IR 64 varieties of drought stress treatment. This shows that drought stress occurs on the variety IR 64 and Rokan caused increased growth of canopy and inhibited growth of roots, thus causing that of ratio shoot root value becomes higher.

Table 2. Effect of drought stress and varieties to the total root dry weight and shoot root ratio

Varieties	Total root dry weight			Shoot root ratio		
	Control	Drought	Relative Decrease (%)	Control	Drought	Relative Decrease (%)
IR 64	12.16 c	4.98 g	59.05	1.47 fg	4.12 a	[64.13]
Ciherang	12.83 c	2.63 h	79.50	1.62 efg	2.872 b	[43.28]
IPB 3S	5.32 fg	4.66 g	12.41	2.34 bcd	2.076 cde	12.72
Way Apo Buru	15.53 b	3.19 h	79.46	1.33 gh	2.818 b	[52.70]
Jatiluhur	10.19 d	6.48 f	36.41	1.87 def	2.361 bcd	[20.75]
Menthik Wangi	8.01 e	2.6 h	67.54	1.44 fg	2.403 bc	[39.70]
Silugonggo	10.64 d	3.23 h	69.64	2.59 b	1.787 efg	45.22
Rokan	27.39 a	5.05 g	81.56	0.95 h	2.67 b	[64.16]

Note: Values followed by the same letter in the same column are not significantly different according to Duncan's analysis at  $P < 5\%$

Drought stress treatment causes changes in the of root distribution on the ability of the roots to increase the depth of the roots achievement. IPB 3S and Way Apo Buru varieties has deeper depth achievement roots than other, while the Jatiluhur variety have high the depth of root achievement is also, but the depth of root of the achievements was not affected by drought stress treatment. Differences of the root distribution in the tolerant and sensitive variety can be seen in Figure 1. The depth of the roots of each variety achievement illustrates the ability to reached the water on the deeper layers by extending roots that a mechanism of drought stress. The depth of root achievement implications of the leaf relative water content. IR 64 has a most short depth of root achievements, inhibiting the ability to absorb water in the deeper layers of soil when drought stress, that make lower relative leaf water content ( not show data ).

The high ability to maintain relative water content of leaves remained is one of the mechanisms of plants to avoid drought stress, by increasing the absorption of water at deeper soil depths, or by reducing the density of stomata. IR 64 shows that drought led to a decline in the relative leaf water content in drought stress is significant. It is suspected IR 64 has a shallow root system and shortest depth of roots achievements, it can makes inhibiting the ability to absorb water in the deeper layers of soil.

The roots character become one of factors that determine plant resistance to drought. The paddy system of root have development of roots horizontally and when occur of drought, the development of

root will be inhibited both horizontally and vertically can be seen with decreased root dry weight in zone A on the Rokan, Menthik Wangi, Ciherang, IR 64 and Way Apo Buru varieties while in the zone A 'root development is inhibited on Silugonggo. Silugonggo variety although included into the type of upland rice but showed a decrease in root weight is relatively high in the zone A'. Jatiluhur (upland) showed a decrease in root weight is relatively small at a depth of 0-10 cm (A and A ') as the drought treatment. Differences in root system of upland rice and paddy system reported by Gowda et al. (2011) is in addition to the differences in water status in the paddy system, also there is a difference of root growth and adaptation to drought.

Upland rice varieties well adapted to the drought stress. But the results of this study show that upland rice varieties are also given the same level of water status with paddy. Turns at a depth of 10 cm has decreased root weight, reached 63.7%. Despite the higher paddy rice varieties ranging from 72.1% - 92.5%, but not on the type of new rice varieties that IPB 3S smallest decrease in root weight is 42.9%. A new type of rice with a good root vigor as one component of the result is expected to increase the percentage of filling grain the constraints of this type of plant. Rooting has good vigor in shallow layer of soil. Asch et al. (2005) reported tolerant variety would increase root growth was greater in drought stress conditions.

#### Conclusion

Characters of roots rice varieties have different response to drought stress. However, drought caused decreased root development either vertically or horizontally roots weight, the total weight of the root, the depth of the roots achievements, the shoot roots ratio and relative water content of leaf. Jatiluhur and Way Apo Buru is tolerant varieties that indicates different ways avoidance mechanism to drought stress. Tthe increased weight of the root zones C and D in Jatiluhur,by increasing depth of root achievement on Way Apo Buru. The increase in total root weight, depth roots achievement, shoot root ratio and relative water content during drought stress were root characters that the important role in tolerance to drought stress in paddy systems.

#### Acknowledgement

This research received funding from I-MHERE B.2.C program, Bogor Agricultural University in the year 2010-2012.

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