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Proceedings of The 1th Almuslim International Conference on Science, Technology and Society (AICSTS) 2015 November 7-8, 2015, Bireuen, Indonesia 164 Root Characther of Drought Tolerant Rice In Lowland System 1Maisura, 2Muhamad Achmad Chozin, 2Iskandar Lubis, 2Ahmad Junaedi, 3Hiroshi Ehara 1Study Program of Agroecotechnology, Faculty of Agriculture, Malikussaleh University, Jl.

Cot Teungku Nie Reuleut, Aceh Utara, Indonesia 2Department of Agronomy and Horticulture, Faculty of Agriculture, Bogor Agricultural University, Jl. Meranti, Kampus IPB Dramaga 16680, Indonesia 3Graduate School of Bioresources, Mie University,1577 Kurimanchiya-cho,Tsu 514-8507, Japan *Corresponding author: maisuraali@ymail.com 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, Bog(24m SL). hrearh ed slit ot iwtrlicnswith 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 achived 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 rasio. Total root dry weight, root depth, shoot root rasio 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; Proceedings of The 1th Almuslim International Conference on Science, Technology and Society (AICSTS) 2015 November 7-8, 2015, Bireuen, Indonesia 165 Ba˜nocet l., 000; oseal., 0). hesadapionsare erced be siw 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, Menthik 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, Menthik 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), Proceedings of The 1th Almuslim International Conference on Science, Technology and Society (AICSTS) 2015 November 7-8, 2015, Bireuen, Indonesia 166 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 sevent 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 tlev of a 0.05ig Duncn’sanas . 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 achievment.

Drought stress treatment caused decreased in root weight and development of roots vertically and horizontally (Table 1, 2, 3 and 4). 10 cm 40 cm Proceedings of The 1th Almuslim International Conference on Science, Technology and Society (AICSTS) 2015 November 7-8, 2015, Bireuen, Indonesia 167 Table 1.

The average weight of the root eight varieties at a depth of 0- 10 c (A’)n drughtrs treatment Note: Values followed by the same letter in the same column are not significantly different according to Dunc’s analysis at P<5% Table 2. The average weight of the root of eight varieties at a depth 10- 20m (B, he ht stress treatment Note: Values followed by the same letter in the same column are not significantly different according to Dunc’s analysis at P<5% Table 3.

The average weight of the root of eight varieties at a depth of, 20- 30 cC, C’)n drughtrs treatment Note: Values followed by the same letter in the same column are not significantly different according to Dunc’s analysis at P<5% Proceedings of The 1th Almuslim International Conference on Science, Technology and Society (AICSTS) 2015 November 7-8, 2015, Bireuen, Indonesia 168 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 Note: Values followed by the same letter in the same column are not significantly different according to Dunc’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 Menthik 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.

Proceedings of The 1th Almuslim International Conference on Science, Technology and Society (AICSTS) 2015 November 7-8, 2015, Bireuen, Indonesia 169 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 Control Drought Relative Decrease 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 acordingunc'sals 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 Proceedings of The 1th Almuslim International Conference on Science, Technology and Society (AICSTS) 2015 November 7-8, 2015, Bireuen, Indonesia 170 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 achievment, 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.
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