Advances in Environmental Biology, 10(6) June 2016, Pages: 49-52

AENSI Journals

Advances in Environmental Biology

ISSN-1995-0756 EISSN-1998-1066

Journal home page: http://www.aensiweb.com/AEB/

Diversity and Agronomic Features of Indigenous of Upland Rice in Southeast Sulawesi, Indonesia

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Received 12 May 2016; Accepted 28 June 2016; Available online 28 July 2016

ABSTRACT

Exploring upland rice (*Oryza sativa* L.) cultivars from *Tolakinese* of South Konawe Regency was conducted in 2015 and collected 20 types of local cultivars based on their own farming knowledge and culture of upland rice cultivation. From these cultivars, we selected four cultivars based on characteristics of panicle, grain performance and germination test. The cultivars' names are: *pae Dai Ndongalaru*, *pae Bou*, *pae Uba* and *pae Dai Bandoeha*. This experiment was conducted in plastic house as pot culture with four levels of water application: 25 %, 50 %, 100 % and 150 % soil water holding capacity (WHC). The results indicated that lower level WHC was delayed panicle emergence and maturity stage and higher of WHC was reduced shoot and grain yield. The optimum of water application was 50 to 100 % WHC which induced growth and grain yield of tested cultivars.

KEYWORDS: Biodiversity, traditional farming, water holding capacity and upland rice.

INTRODUCTION

1. Features of upland rice farming in Southeast Sulawesi Province:

Generally upland rice production in Indonesia was not significant contribution in comparison with wetland rice production. In Southeast Sulawesi Province, upland rice production was located mainly in Konawe and South Konawe Regencies, some areas in Kabaena, Muna and Buton islands. Total production of upland rice in Southeast Sulawesi Province was 25,034 t to 32,121 t per year, which harvested from 8,175 ha to 10,243 ha per year [1]. This indicated that productivity of upland rice cultivation in Southeast Sulawesi Province was variable from 3.062 t to 3.136 t/ha (dry grain with husk). Variable of cultivated land per year is mainly due to the fluctuation of rainy season and rainfall intensity.

2. Traditional farming system on upland rice:

2.1. Land preparation:

Land preparation was slash and burning and no mechanization. Most of land preparation was done by human power by farmer group. They were moving from land to land. The chronological of land preparation done by *Tolakinese* as follows: cutting down of bush and tree in dry season (August to September) and keeping dry. In October to November they started to burn and cool-down during the start of rainy season up to December. The land was ready for rice seeding.

2.2. Seed and seeding:

The upland rice seed was produced from their own land from last year's harvest. Traditionally, they keeping of dried rice seed in can box. Rice seeding was done by famer group around twenty persons per group. That group was mixed of woman and man, ten men for making the hole and ten women for putting the seed into the hole and heaped up the hole. That group seeder moving from land to land of each member of farmer group. Seeding time was January. Upland rice cropping was monoculture and strip-mixed culture with corn and some kind of vegetables. Two weeks before rice seeding, the corn was seeding in two to three meter rows. Rice seeding was 25 cm x 40 cm between corn rows. Crop management of upland rice cultivation was only weeding by hand, no fertilizer and no pesticide treatments. They protect crops from wild pig by making fence from woods.

2.3. Harvesting and post harvesting:

Harvest time of upland rice was four to five months after seeding. Rice harvest sseason is mainly in April to May. Rice harvest was done by farmer group who was contributed in the land preparation and rice seeding. Rice harvested by hand cutting using a traditional rice cutter called *ani-ani*. Harvested rice then sun drying in their garden and stocking in the traditional rice stocking called *lumbung padi*.

MATERIALS AND METHODS

This experiment was conducted in pot culture during April to August 2015 in plastic house Faculty of Agriculture, Halu Oleo University. There are four levels of water application: 25, 50, 100 and 150 % of soil maximum water holding capacity (WHC) of 8 kg air dry soil/pot. Those WHC was equivalent to 920.0, 1,840.0, 3,680.0 and 5,520.0 ml water per pot. Pot size was 25 cm wide x 30 cm height. This water application was figured to upland rice field condition: 25 % WHC is extremely soil drying, 50 % WHC is general soil moisture condition, 100 % WHC to 150 % WHC are wetland and flooding soil conditions, respectively [2-3]. Each pot was fertilized with NPK (15:15:15) 300 kg/ha which split in two time applications: 200 kg/ha before seeding and 100 kg/ha at 40 days after seeding (DAS).

There are four local cultivars was tested: *pae Ngalaru* (V-1), *pae Uba* (V-2), *pae Bou* (V-3) and *pae Bandoeha* (V-4). Each pot was seeded by three seeds and then thinning out to two plants/pot. One plant was harvested at 70 DAS and the rest one plant at mature stage. Soil moisture was maintenance every two days by weighting pots and watering. Plant height, tiller number, flowering and mature days, root, shoot and grain yield was measured. This experiment was designed in randomized block design with three replications. The effect significant of WHC on each upland rice cultivar was evaluated by Duncan Multiple Range Test, p = 5 % [4].

RESULTS AND DISCUSSION

1. Genetical affarence on local upland rice cultivars:

In this experiment we collected twenty *Tolakinese's* cultivars from South Konawe Regency [5]. The genetically observation was based on grain characteristic, glutinous or non glutinous type, rice color, weight of 1,000 grain and germination rate as shown in Table 1.

Based on the above grain and panicle characteristic we explained that most of the *Tolakinese's* upland rice cultivar was non-glutinous type with yellowing husk, white and red-dark rice color, mostly tailed, medium to long panicle and various of 1,000 grain weights, respectively. According to local farmers test, most of these cultivars are aromatic rice. Typical of upland rice cultivation system at *Tolakinese* as shown in Fig.1.

Fig. 1: Growing of upland rice in wet and dry conditions

2. Variety responses on water level application:

Based on the genetically features, we selected four cultivars to test on water level application namely: *pae Ngalaru*, *pae Uba*, *pae Bou*, and *pae Bandoeha*. Those cultivars are non-glutinous rice, tailed and yellowing grain husk.

Table 1: Grain characteristis of *Tolakinese* upland rice cultivars

Genetical affarence	No. Cultivar	Genetical affarence	No. Cultivar
1. Group:		***4. Grain husk tail:***	
a. Glutinous	3	a. Tailed	20
b. Non-glutinous	17	b. Non-tailed	0
2. Grain husk color:		***5. Panicle lenght (cm):***	
a. Darkbrown	1	a. < 20	0
b. Yellowing	16	b. 21-25	5
c. Black	1	c. 26-30	9
d. Red-dark	2	d. > 30	6
3. Rice color:		***6. Grain wight (g/1000):***	
a. White	10	a. < 10	1
b. Reddish	7	b. 10-20	5
c. Blackish	3	c. 21-30	12
		d. > 31	2

2.1. Growing at 70 DAS:

Generally, the increasing of WHC has no significant effect on growing of upland rice at 70 DAS. The similar phenomena were observed on leave number, tiller number and shoot dry matter per plant. The increasing of WHC was increased root dry matter of all tasted cultivars as shown in Fig. 2.

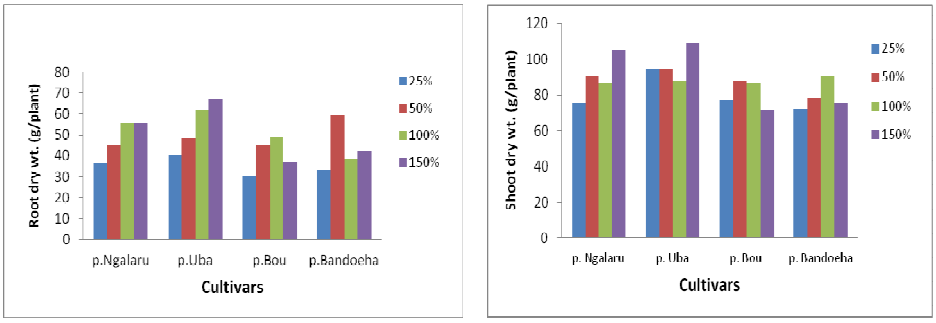

Fig. 2: Root and shoot dry weight of upland rice at 70 DAS.

Based on root and shoot dry weight it could be explained that cultivar of *p. Ngalaru* and *p. Uba* shown an increase of biomass production with an increase of WHC, however, *p. Bou* and *p. Bandoeha* biomass production was decreased at higher of WHC. This indicated that *p. Ngalaru* and *p. Uba* was tolerance to higher soil moisture level.

2.2. Growing at Mature Stage:

Generally that lower of WHC (25 %) was decreased one productive tiller of upland rice if compared with 50, 100 and 150 % WHC. Growing of upland rice cultivars at higher WHC was significantly induced panicle emergence as compared with 25 % WHC. [6]. The same effect was observed on grain maturity as indicated in Fig.3.

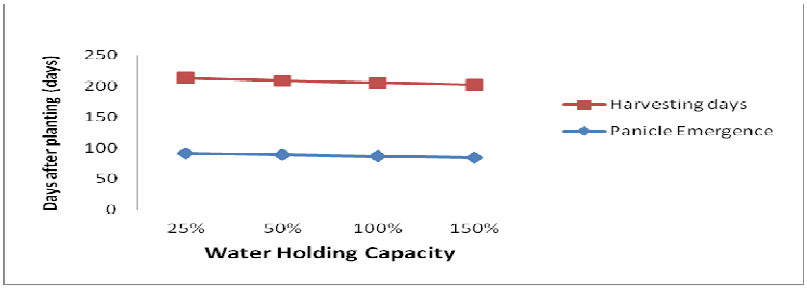

Fig. 3: Effect of WHC on panicle emergence and harvesting days of upland rice

Grain maturity was various from 114 to 124 DAS, where *P. Ngalaru* was early mature (114 dap) and the other cultivar was 120 to 124 DAS, respectively. The number of filling-grain was not significantly affected by

WHC, however, empty-grain was reduced by the increase of WHC as shown in Fig. 4.

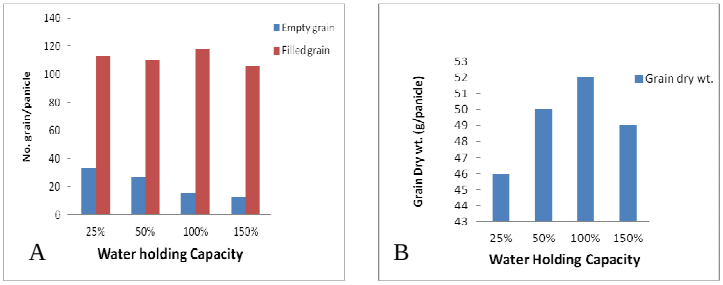

Fig. 4: Effect of WHC on grain number (A) and grain dry weight (B) of upland rice.

This indicated that water stressing at 25 % WHC was reduced grain quality and increasing of WHC up to 100 % was induced grain quality as indicated by the increased of grain dry weight. Water flooding at 150 % WHC on upland rice was significantly reduced grain dry weight. This effect may be related to the reduction of nutrient availability and root activity of some varieties at submerging condition [2,7,8]. This finding clarified that the lower of upland rice production in farmer land may be mainly due to water shortage especially in the sloping and mountain areas. This finding also indicated that upland rice is quietly susceptible to water flooding. The same phenomenon was reported by some reports [9-10]. The optimum of soil water condition on upland rice cultivation was 100 % WHC as indicated by the higher of grain dry weight (Fig. 4).

Conclusion:

Based on the above results it could be concluded that *Tolakinese* upland rice cultivars was dominated by *non-glutinous* type, long panicle, grain-tailed, yellowing husk, white to reddish rice color and aromatic taste. The higher of shoot and grain dry weight was obtained at 50 to 100 % WHC. This indicated that *Tolakines*'s upland rice cultivars could be adapted to moisture and wet land conditions.

Acknowledgement:

Moizes D.R. Borromeu gratitude to Universitas Halu Oleo for partly supported of this experiment and scholarship.

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