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GROWTH RESPONSE OF TWO LOCAL UPLAND RICE CULTIVARS (*ORYZA SATIVA* L.) ON SALINITY

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ABSTRACT

Increasing the number of inhabitants in Indonesia led to the limited agricultural land so that the paddy fields become narrow and limited, the limited paddy fields caused agricultural production in Indonesia to decline while demand increased. Tidal land cultivation is still rarely performed due to the high salt content (NaCl). The purpose of this study is to obtain upland rice cultivars that are tolerant of salinity stress. The study was conducted in November to December 2019 at the Seed and Science Technology Laboratory of the Faculty of Agriculture, University of Tadulako. The study was arranged using a completely randomized design (CRD) of two factors where the first factor consisted of two levels, namely Logi, and Tako, while the second factor consisted of five levels, namely 0.5%, 0.6%, 0.7%, 0.8%, and 0.9% were repeated three times. The results showed that tako cultivars have a good tolerance to salinity stress compared to logi cultivars, tako cultivars have the fastest germination time and germination capacity above 80%. At a concentration of 0.5% can not inhibit the growth of upland rice, but at a concentration of 0.9% can inhibit the growth of upland rice.

Keywords: Cultivar**,** Rice Gogo, and Salinity.

INTRODUCTION

The increase of population in Indonesia causes limited agricultural land so that rice fields become narrow and limited. Limited rice fields cause Indonesian rice production to decrease while demand increases (Mulyani, et al., 2017).

One way that can be done to increase rice production in Indonesia is to use dry land and marginal land such as tidal swamp land to become agricultural land (Sahara and Kushartanti, 2019). However, basically saline land has problems, namely that it can reduce water uptake by plants so that disrupts the metabolic process in seeds, so rice is needed that is tolerant to salinity (Nafisah, et al., 2017).

Rice that can be cultivated on saline land is upland rice, but upland rice has problems. The problems faced by farmers in cultivating upland rice are the lack of availability of superior seed varieties and the cultivation takes quite a long time compared to lowland rice (Fitria and Ali, 2014). Test methods for selecting varieties that are tolerant to salinity can be carried out in the field or in the laboratory. Plants that are tolerant to salinity can adapt to sub-optimal environments. Seeds that are able to maintain life under optimal conditions can be said to be vigor seeds (Arzie, et al., 2015)

The test can be carried out using a NaCl solution, because NaCl indicates dry conditions with high osmotic pressure. The properties that can cause stress are the high osmotic pressure of the solution and the toxicity of Na+ and Cl- ions (Jasmi, 2018). Seed testing is very important because by conducting seed testing we can find out which cultivars are tolerant to salinity stress, besides that we can carry out a fast and efficient selection method in determining the level of tolerance of a genotype to salinity (Arzie, et al., 2015).

Based on the description above, the growth of two local upland rice cultivars was tested for salinity.The aim of this research is to obtain upland rice cultivars that are tolerant to salinity stress using NaCl

RESEARCH METHODS

This research was carried out from November to December 2019 at the Seed Science Technology Laboratory, Faculty of Agriculture, Tadulako University, Palu.

The tools used in this research were, petridish dishes, straw paper, ruler, stationery, label paper, measuring cups, analytical scales, aqua cups, tweezers, scissors, tubs and germination baskets. The materials used are rice seeds (Tako and Logi cultivars), NaCl and distilled water.

This research was carried out using a Completely Randomized Design (CRD) with two factors, the first factor was cultivar namely: logi cultivar, and tako cultivar while the second factor was the concentration of 0.5% NaCl (N1), 0.6% NaCl (N2), NaCl 0.7% (N3), NaCl 0.8% (N4), and NaCl 0.9% (N5). Thus, there are 10 treatment combinations and each treatment combination is repeated three times to obtain 30 experimental units and each unit is filled with 50 seeds so the seeds required are 1500 seeds.

Observation Variables

Time to Germination was calculated from the first day to the fourteenth day. The time to germination is calculated based on the formula (Sadjad, 1993);

WB=(N1.T1+N2.T2+⋯+Ni.Ti)/(Total Germinated Seeds)

Note:

WB = Average days to germination
Ni = Number of seeds that germinate at time Ti
Ti = Observation Time (days)

Germination capability is calculated from the first day to the fourteenth day. According to (Sadjad, 1993) germination capacity is calculated using the formula;

DB=(Number of normal sprouts)/(Number of seeds germinated) x 100%

Note:

DB = Germination Capability

Growth potential is calculated by adding up all the seeds germinated and then multiplying by 100%. According to (Sadjad, 1993) maximum growth potential is calculated using the formula.

PTM = (Number of germinated seeds) /(Number of germinated seeds) x 100%

Note:

PTM = Maximum g Growth potential

Plumule Length Measurement of plumule length was carried out at the end of the observation, namely by measuring the base of the plumule to the growing point, measurements were made using a ruler.

Radicle Length measurement was carried out at the end of the observation, namely by measuring the base of the radicle to the tip of the radicle, the measurement was carried out using a ruler.

The wet weight of the sprouts was carried out at the end of the observation, namely by weighing the sprouts using an analytical balance.

Dry weight of sprouts was carried out by weighing the sprouts dry after being baked in the oven for 18 hours at a temperature of 105^{0}C.

Time to Germination

The results of diversity analysis showed that cultivar and NaCl concentration had an effect, while the interaction had no effect on the observed parameters of germination time. The average germination time is presented in table 1.

Education is one of measurements that determines the quality of human resource. Education is closely related to economic growth, where the level of education determines the work done by a person. Furthermore, individual mindset affects the behavior in running a farming business from farmers, where formal education is one that influences and determines that mindset (Maulidah, Fadliah and Soejoto, 2015).

The HSD test results (Table 1) show that the tako cultivar germinates faster than the logi cultivar. A NaCl concentration of 0.5% provided faster germination in contrast to a concentration of 0.9% except for concentrations of 0.6, 0.7 and 0.8%.

Germination Ability

The results of diversity analysis showed that cultivar had an effect, while NaCl concentration and interactions had no effect on the observed parameters of germination. Average germination is presented in table 2.

Table 1. Average Germination Time (Days) of Two Upland Rice Cultivars at Various NaCl Concentrations.

	Concentration of NaCl						HSD 5%
Cultivar	0,5%	0,6%	0,7%	0,8%	0,9%	Rata –rata	
Logi	3,71	3,97	3,72	4,80	6,19	4,48 ^{b}	0,83
Tako	2,29	2,93	2,88	3,29	4,13	3,10 ^{a}	
Average	3,00 ^{a}	3,45 ^{a}	3,30 ^{a}	4,05 ^{ab}	5,16 ^{b}		1,18

Note: Numbers followed by the same letter in rows or columns do not differ at the 5% HSD test level.

Table 2. Average Germination Capacity of Two Upland Rice Cultivars at Various NaCl Concentrations.

	Concebtration of NaCl					Rata-rata	HSD 5%
Cultivar	0.5	0.6	0.7	0.8	0.9		
Logi	77.33	88.67	81.33	80.00	74.67	80.40**a**	4.68
Tako	100.00	100.00	98.67	100.00	100.00	99.73**b**	
Rata-rata	88.67	94.34	90.00	90.00	87.34		

Note: Numbers followed by the same letter in the same column do not differ at the 0.05 HSD test level

Table 3. Average growth potential of two upland rice cultivars at various NaCl concentrations

Kultivar	Konsentrasi					Rata-rata	HSD 5%
	0.5	0.6	0.7	0.8	0.9		
Logi	88.00	94.67	93.33	92.00	92.00	92.00	2.92
Tako	100.00	100.00	98.67	100.00	100.00	99.73	
Rata-rata	94.00	97.34	96.00	96.00	96.00		

Note: Numbers followed by the same letter in the same column do not differ at the 0.05 HSD test level

Table 4. Average plumule length (cm) of two upland rice cultivars at various NaCl concentrations.

NaCl / Cultivar	Consentration NaCl					HSD 5%
	0,5%	0,6%	0,7%	0,8%	0,9%	
Logi	$^{p}25,67_{c}$	$^{p}30,13_{d}$	$^{p}24,67_{c}$	$^{p}19,4_{b}$	$^{p}15,5_{a}$	3,93
Tako	$^{q}31,5_{d}$	$^{p}26,8_{c}$	$^{p}23,87_{bc}$	$^{p}19,97_{b}$	$^{p}15,6_{a}$	
HSD 5%			5,62			

Note: Numbers followed by the same letter in the same row (a, b) or column do not differ at the 0.05 or 5% HSD test level.

The results of the 5% HSD test (Table 2) show that the Tako cultivar has the highest germination capacity compared to the Logi cultivar.

Maximum Growth Potential.

The results of diversity analysis showed that cultivar had an effect, while NaCl concentration and interactions had no effect on the parameters observed for growth potential. The average maximum growth potential is presented in table 3.
The HSD test results (Table 3) show that the tako cultivar has a higher growth potential value and is different from the logi cultivar.

Plumule Length

The results of diversity analysis showed that the interaction between cultivar and NaCl concentration had an effect on the parameters observed for plumule length. Average plumule length is presented in table 4.

The HSD test results (Table 4) show that the effect of NaCl concentration is different for each cultivar. In each cultivar, the higher the NaCl concentration, the shorter the plumules produced. Table 4 also shows that the effect of cultivar is different at a concentration of 0.5% but not different at other concentrations. At a concentration of 0.5%, the Tako cultivar produced longer plumules, in contrast to the Logi cultivar.

Radicle Length

The results of diversity analysis showed that NaCl concentration had an effect, while cultivar and its interactions had no effect on the parameters observed for radicle length. Average radicle length is presented in table 5.

HSD test results in table 5 show that the 0.5% concentration produces longer radicles and is significantly different from other concentrations except the 0.7% concentration. A concentration of 0.9% produces shorter radicles and is no different from a concentration of 0.8%.

Fresh Weight of Sprouts

The results of the diversity analysis showed that cultivar, NaCl concentration and their interactions had an effect on the parameters observed for the wet weight of the sprouts. The average wet weight is presented in table 6.

The HSD test results (Table 6) show that the effect of NaCl concentration is different for each cultivar. Table 6 also shows that the effect of cultivar is different at concentrations of 0.5, 0.7 and 0.9% but not different at concentrations of 0.6 and 0.8%. At a concentration of 0.5%, the Tako cultivar produced a heavier weight and was different from the Logi cultivar.

Table 5. Average radicle length (cm) of two upland rice cultivars at various NaCl concentrations.

Cultivar	Consentration NaCl					Rata-rata	HSD 5%
	0.5	0.6	0.7	0.8	0.9		
Logi	49.07	30.13	44.03	28.67	22.73	34.93	5.90
Tako	52.57	40.87	41.53	25.20	25.00	37.03	
Rata-rata	50.82^{c}	35.50^{b}	42.78^{bc}	26.93^{a}	23.87^{a}		8.46

Note: Numbers followed by the same letter in the same column are not significantly different at the 5% HSD test level.

Table 6. Average wet weight of sprouts (g) of two upland rice cultivars at various NaCl concentrations.

Cultivar \ NaCl	Consentration NaCl					HSD 5%
	0,5%	0,6%	0,7%	0,8%	0,9%	
Logi	$^{P}3{,}27_{b}$	$^{P}4{,}17_{c}$	$^{P}2{,}70_{ab}$	$^{P}2{,}67_{ab}$	$^{P}2{,}53_{a}$	0,47
Tako	$^{q}5{,}03_{d}$	$^{P}3{,}97_{c}$	$^{q}3{,}27_{b}$	$^{P}2{,}40_{a}$	$^{q}3{,}27_{b}$	
HSD 5%			0,67			

Note: Numbers followed by the same letter in the same row (a, b) or column do not differ at the HSD test level of 0.05

DISCUSSION

The interaction between plumule length and fresh weight of sprouts is caused by genetic factors in the seeds so that they can respond to the cultivar and concentration given (Muttaqien and Rahmawati, 2019). This result in the activation of enzymes needed for the germination process, the seeds are able to withstand the accumulation of salt in the vacuole so that it does not interfere with enzyme activity in the cells which plays a role in the emergence of plumules (Amartani, 2019).

The tako cultivar is the best cultivar and is more resistant to salinity stress compared to the logi cultivar because it can provide higher germination and growth potential, and germinate faster, the tako and logi cultivars have good genetic factors for salinity stress resulting in a germination capacity of more than 80 % seeds are said to be vigor if the seeds produce a germination capacity of at least 80% (Elfiani and Jakoni, 2015).

Vigor is the ability of seeds to grow normally in sub-optimal conditions (Hasanuddin, 2015). The high level of vigor can be seen from the appearance of the sprouts which are resistant to various limiting factors (Tustiyani, et all., 2016).

A NaCl concentration of 0.5% produces longer plumule and radicle lengths than a concentration of 0.9%. So, it can be said that the higher the NaCl concentration, the shorter the plumule and radicle produced. germinate (Junandi et al., 2019).

High concentrations of NaCl can increase osmotic pressure, thereby reducing the water potential in the seeds which causes reduced water absorption by the seeds and reduced water content in the seeds, the metabolic process in the seeds is also hampered (Jasmi, 2018).
The function of water is to soften the seed coat so that the embryo and endosperm expand and tear the seed coat. Water also functions to get oxygen into the seed so that the seed can imbibition (Suhendra, 2019).

The metabolic process of food reserves and respiration which will produce energy to stimulate the germination process forms the plumule which is the stem and leaf bud and the radicle which is the root bud, these two parts will enlarge, causing the seed to germinate (Juhanda, et al., 2013).

The amount of water that enters the seeds can influence the metabolism in the seeds so that the seeds can germinate. If the amount of water entering the seed is unhindered then the seed can speed up the metabolic process and vice versa, if the water entering the seed is blocked then the metabolic process in the seed is also hampered so that the germination process in the seed becomes slow (Mustakim, et al., 2017)

Increasing the NaCl concentration gave an insignificant decrease and the growth rate of rice seeds was not uniform. This is because the seeds used are still in cultivar form where the cultivar consists of a collection of several lines or has many lines and each line has different properties (Wahdah et al., 2017).

CONCLUSION

1. Interaction of tako cultivar and NaCl concentration on plumule length and fresh weight of sprouts
2. Tako cultivars have a higher response to salinity because they produce the highest germination and growth potential as well as faster germination times
3. The salinity tolerance limit for upland rice is at a concentration of 0.8%.

Suggestion

In developing upland rice in saline land conditions, further research is needed on upland rice that is tolerant to salinity stress. So the information obtained can be useful, especially in the agricultural sector.

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