THE 3rd ANNUAL INTERNATIONAL CONFERENCE SYIAH KUALA UNIVERSITY
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IN CONJUNCTION WITH
THE 2nd INTERNATIONAL CONFERENCE ON MULTIDISCIPLINARY RESEARCH
(ICMR)

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MESSAGE FROM THE RECTOR

Assalamualaikum wr wb

On behalf of Syiah Kuala University, I would like to extend my warmest welcome to all participants to the 3rd Annual International Conference of Syiah Kuala University 2013 (AIC- UNSYIAH 2013).

Syiah Kuala University is the largest and the oldest national university in Aceh Province, Indonesia. The university was established on June 21st, 1961. Establishment of UNSYIAH was driven by a spirit to form an institution to bring the Acehnese to become educated, knowledgeable and pious to God Almighty. UNSYIAH has a vision to establish itself as an innovative, independent, and outstanding university in term of the development of science, technology, humanities, sport and arts, in order to produce qualified graduates who highly honour moral and ethical values. Currently, there are more than 1,500 staffs and 2800 students both under graduate and post graduate programs.

This year, Syiah Kuala University has been hosted a series of events commemorating the 52th anniversary. As part of that celebration, the university has been held an interdisciplinary academic conference on October 2-4, 2013. The conference has a plenary address, oral & poster parallel sessions, and other social programs. It is gratifying to note that the agenda of the conference covers a wide range of very interesting items relating to the Social Sciences, Life Sciences, and Engineering.

In fact, this is the third annual international conference held by Syiah Kuala University, and we are very happy, because this year Syiah Kuala University became a host for 2nd International Conference of Multidisciplinary Research (ICMR) 2013. Last year, a total of 185 papers have presented by participants from at least 16 countries. According to chairman of this conference, this year the committee has received a total of 210 papers from 17 countries, however due to limitation of time only 173 papers were accepted to be presented in oral and poster sessions.

I would like to take this opportunity to thank our keynote speakers Professor. Dr. Siti Azizah M. Nor from Universiti Sains Malaysia, Professor. Dr. Bradley Pusey from University of Western Australia, Associate Professor Dr. Ahmad Fauzi from Universiti Sains Malaysia, Professor Dr. Kiyohiko Toyoda from Kobe University, Japan, Associate Professor. Dr. Abdul Malek from Universiti Sains Malaysia and also my appreciation to representative of steering committee Prof Madya Dr Mustafa Fadzil Farid Wajid, Prof. Dr. Nurhayati and Ms. Sojiah Likin.

Lastly, I would like to thank the chairman of the conference and his very good team for their hard work in making this event successful. To all participants, I wish you to have fruitful interactions with your peers, and to our foreign friends, an enjoyable stay in Banda Aceh.

Thank you
Assalamualaikum wr wb

Prof. Dr. Samsul Rizal, M.Eng
Rector of Syiah Kuala University
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Editor Board</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notice of Disclaimer</td>
</tr>
<tr>
<td>Message from the Rector</td>
</tr>
<tr>
<td>Message from the Chairman</td>
</tr>
<tr>
<td>Table of Contents</td>
</tr>
</tbody>
</table>

| 1. Factor Affecting Student of Environmental Conservation Concern | 1 |
| Nur Aidar (Indonesia), Rahmayani (Indonesia) |
| Effect of Seedling Number per Hill and Seedling Age on Plant Growth and Grain Yield Ciherang Rice | 9 |
| Yenni Asbur (Indonesia) |
| Analysis on the quality of test items on disaster management block | 16 |
| Rosaria Indah (Indonesia), Mulyadi (Indonesia), Reza Maulana (Indonesia) |
| Oil Palm Frond Fibers Pulp From Kraft Pulping Process– Effect of Beating | 27 |
| Nasrullah R.C.L.(Indonesia), Wan Rosli Wan Daud (Malaysia), Pinalty (Malaysia), Adisalamun (Indonesia) |
| Ocean-Atmosphere Analysis of Super Typhoon Songda 2011 over Western North Pacific Ocean | 37 |
| Yopi Ilhamsyah (Indonesia), Ahmad Bey (Indonesia), Edvin Aldrian (Indonesia), Junaidi M. Affan (Indonesia) |
| Preparation And Characterization Edible Film Packaging From Carrageenan | 44 |
| Saiful (Indonesia), Siti Saleha (Indonesia), Salman (Indonesia) |
| Social Interaction within the village migrant circular pins twon of Bandar Aceh, Indonesia | 51 |
| Rusli Yusuf (Indonesia) |
| Salinity Stress Simulation on Acehnese Local Rice (Oryza sativa L. with NaCl in The Method of In vitro Germination | 59 |
| Efendi (Indonesia), Elly Kesumawati (Indonesia), Sabaruddin Zakaria (Indonesia), Syafruddin, (Indonesia), Syamsuddin (Indonesia), and Hasanuddin (Indonesia) |
| The effect of ethanol extracts of pegagan (centela asiatica [I.] Urban) in inhibiting the growth of staphylococcus aureus and klebsiella pneumoniae that caused pneumonia | 66 |
| Zinaatul Hayati (Indonesia), Noratul Hafdhah (Indonesia), Junaidi (Indonesia) |
| Effect of Host Diets on Host Preference and Host Suitability in Telenomus Parasitoid (Hymenoptera: Scelionidae) | 72 |
| Husni (Indonesia), Jauharrina (Indonesia), Karmisah (Indonesia) |
Salinity stress simulation on Acehnese local rice (*Oryza sativa* L.) with NaCl in the method of *in vitro* germination

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Abstract

Agricultural yield was negatively impacted by salt stress throughout around the world affecting production whether it is for economic gain or subsistence. The tolerance of Acehnese local rice on salinity stress was studied with using osmotic condition in the method of *in vitro* germination. NaCl was applied on medium MS for the salinity stress simulation for studying the capability of the various osmotic conditions in selection of some Acehnese local rice for the tolerance of salinity stress. The objective of this research was to simulate with *in vitro* method the tolerance of some varieties of Acehnese local rice on salinity stress during seed germination. Sixteen varieties of Acehnese local rice was sterilized and germinated *in vitro* for tens days in 250 ml bottle containing 25 ml of medium MS with applying NaCl as concentration 0, 0.5, 1.0, 1.5 and 2.0 g/liter. The varieties of Acehnese local rice that used in this research are Ciherang as control variety, and Acong, Padi Mas, Aweuh, Rom Mokot, Bo Santeut, Sigudang, Bo 100, Sanbei, Sigupai, Manggeng, Sapirok, Padi Berselona, Salah Mayang Ru, Pandrah, dan Sikuneng. The results of this study showed that the tolerance of Acehnese local rice different significantly on observed viability of the seeds: seed growth rate, germination capacity, growth velocity, growth unity, and seedling fresh weight. The osmotic condition of NaCl resulted an effective method to simulate the tolerance of salinity stress for Acehnese local rice using NaCl in the method of *in vitro* cultivation. The solution with 2.0 g/l of NaCl that used to study the responds of Acehnese local rice to the tolerance of salinity stress was obtained as the best concentration. Thus, simulation of salinity stress condition on Acehnese local rice will become an alternative method for selection of genotype traits related to the tolerance of salinity stress for local rice in the future.

Key words: rice, salinity, *in vitro*, NaCl

Introduction

Recently, development of agriculture production, including rice was limited by global climate change and salinity stress. Rice is one of the most important crops as major staple food in the world. However, rice is considered as a sensitive plant if exposed to salinity stress (Maas and Hoffman, 1977; Shannon *et al.*,1998). Rice is also widely grown crops in coastal areas frequently inundated with sea water affecting by high tidal period or tsunami wave.

Grattan *et al.* (2002) reported that sea water level was increased in some area of Indonesia and it will be dilapidated by the effect of global
warming continuously. This condition will increase soil salinity and threat agriculture production in Indonesia, especially in coastal agriculture area. Nowadays, salt stress is the second most widespread soil problem in rice growing countries (Gregorio, 1997). Some study showed that physiological activities and productivity of rice plant decrease linearly by the increasing of soil salinity (Lutts et al., 1995; Grattan et al., 2002; Ibraheem et al., 2011). Indonesia known as archipelago countries that have huge costal belt and is easy to be disturbed by tsunami waves.

Rice plant adapting to salinity stress need to develop for ensuring food security in future. In vitro method of seed germinating in an osmotic condition of NaCl provides a promising approach to develop salinity-tolerant rice plant. Reveendar et al. (2008) studied the delayed germination of rice seed that indicated sea water tolerance of two genotypes of rice. Therefore, the soil salinity problems should be raised by adaptation effort to create more resilient approach to avoid food crisis around in the future. Resistance to salinity stress will become more important in the coming decades as farmers around the world have to cope with the effects of global warming and extreme events.

Development for new varieties for adaptation to salinity stress must be studied for development of adaptive plants in future. Selection of rice germplasm through salinity stress simulation on Acehnese local rice with NaCl in the method of in vitro germination is very important to exploit the genetic diversity within available rice germplasm. Manneh et al. (2011) stated that diversity of rice germplasm should be exploited for new genes for adaptation to produce new varieties plants. Saleem et al. (2005) produced rice plant by in vitro selection using osmotic solution of NaCl in high concentration. So, the objective of this research was to simulate with in vitro method the tolerance of some varieties of Acehnese local rice on salinity stress during seed germination.

Material and Methods

The study of salinity stress simulation on Acehnese local rice with NaCl in the method of in vitro germination was carried out at the Laboratory of Plant Tissue Culture and Seed Science Laboratory, Faculty of Agriculture, University of Syiah Kuala since March to September, 2013. Material used in this research are Ciherang as Control and fifteen varieties of local (Acong, Padi Mas, Aweuh, Rom Mokot, Bo Santet, Sigudang, Bo 100, Sanbei, Sigupai, Manggeng, Sipirok, Padi Bercelona, Salah Mayang Ru, Pandrah, dan Sikuneng). The seeds were germinated on MS solid standard medium that contained NaCl with pH 5.8. The media contained macro and micro nutrients (NH₄NO₃, KNO₃, KH₂PO₄, H₃BO₃, NA₂MoO₄.2H₂O, COCl₂.H₂O, KI, CaCl₂.2H₂O, MgSO₄.7H₂O, MnSO₄.4H₂O, ZnSO₄.7H₂O, CuSO₄, NaEDTA, dan FeSO₄.7H₂O). The Media solidified with bacto agar 7.5%.

The selected seeds soaked in alcohol 75% during two minutes and were air dried on filter paper during two minutes. Then, seeds were remove
from husks and sterilized with 10% NaOCl and betadin. After sterilization, the seeds without husk were cultured on 25 ml MS medium in 250 ml bottles. Salinity factor and and rice variety were designed in Completely Randomized Design with three replication. The salinity condition consist of five level $S_0$=without or 0 g/l NaCl, $S_1$ = 5 gram NaCl, $S_2$ = 10 gram NaCl, $S_3$ = 15 gram NaCl, and $S_4$ = 20 gram NaCl. The rice seed consist of sixteen varieties, they are: V1 Acong, V2 Aweuh, V3 Bo Santet, V4 Bo 100, V5 Ciherang, V6 Manggeng, V7 Padi Bercelona, V8 Pandrah, V9 Padi Mas, V10 Rom Mokot, V11 Sigudang, V12 Sanbei, V13 Sigupaip, V14 Sipirok, V15 Salah Mayang Ru, and V16 Sikuneng.

Seed viability and vigor were observed every day after planting. The observation carried out to study germination process to produce a normal seedling. The parameters observed in this study are potential growth of seeds, germination capacity, unity of germination, germination velocity, and biomass weigh of the normal seedling during ten days germination. Data of the seed viability and vigor were tested statistically with the method of ANOVA and HSD test.

**Result and Discussion**

**Effect of Salinity on Seed Viability and Vigor**

The ANOVA test showed that NaCl affected significantly on seed viability and vigor (Table 1). The average of seed germination rate, germination capacity, growth unity of germination, germination velocity, and biomass weigh of the normal seedling during ten days germination were showed in Table 1. The results of study showed the highest potential growth of seeds, germination capacity, unity of germination, germination velocity, and biomass weigh of the normal seedling found at 0.0 g/l NaCl ($S_0$) or control. In other hand, the lowest seed vigor found at the highest concentration of NaCl (20 g/l).

Table 1. Effect of NaCl on potential growth of seeds, germination capacity, unity of germination, germination velocity, and biomass weigh of the normal seedling during ten days germination.

<table>
<thead>
<tr>
<th>NaCl</th>
<th>Germination rate (%)</th>
<th>Germination capacity (%)</th>
<th>Germination velocity (%/etmal)</th>
<th>Unity of growth (%)</th>
<th>Biomass weigh (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 g/l</td>
<td>94,27 c</td>
<td>82,15 d</td>
<td>16,54 e</td>
<td>76,28 e</td>
<td>0,11 b</td>
</tr>
<tr>
<td>5 g/l</td>
<td>92,81 c</td>
<td>79,88 d</td>
<td>15,30 d</td>
<td>71,71 d</td>
<td>0,10 b</td>
</tr>
<tr>
<td>10 g/l</td>
<td>91,46 c</td>
<td>75,36 c</td>
<td>14,20 c</td>
<td>65,98 c</td>
<td>0,10 b</td>
</tr>
<tr>
<td>15 g/l</td>
<td>85,94 b</td>
<td>23,54 b</td>
<td>5,38 b</td>
<td>11,04 b</td>
<td>0,09 a</td>
</tr>
<tr>
<td>20 g/l</td>
<td>80,52 a</td>
<td>21,05 a</td>
<td>4,39 a</td>
<td>5,28 a</td>
<td>0,09 a</td>
</tr>
</tbody>
</table>
Effect of Rice Variety on Seed Viability and Vigor

The analysis of variance for means of potential growth of seeds, germination capacity, unity of germination, germination velocity, and biomass weigh of the normal seedling during showed that were significantly affected by the variety of rice. The average of potential growth of seeds, germination capacity, unity of germination, germination velocity, and biomass weigh of the normal seedling during ten days germination were showed in Table 2.

Tabel 2. Effect of variety on germination rate of seeds, germination capacity, unity of germination, germination velocity, and biomass weigh of the normal seedling during ten days germination.

<table>
<thead>
<tr>
<th>Rice varieties</th>
<th>Germination rate (%)</th>
<th>Germination capacity (%)</th>
<th>Germination velocity (%/etmal)</th>
<th>Unity of growth (%)</th>
<th>Biomass weigh (gram)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciherang</td>
<td>82.00 a</td>
<td>68.02 f</td>
<td>12.30 d</td>
<td>42.19 b</td>
<td>0,11 bc</td>
</tr>
<tr>
<td>Acong</td>
<td>89.67 de</td>
<td>54.33 cde</td>
<td>10.47 c</td>
<td>51.89 e</td>
<td>0,10 ab</td>
</tr>
<tr>
<td>Aweuh</td>
<td>91.33 efg</td>
<td>59.16 cde</td>
<td>11.02 c</td>
<td>41.00 b</td>
<td>0,09 a</td>
</tr>
<tr>
<td>Bo Santet</td>
<td>90.00 ef</td>
<td>44.40 a</td>
<td>9.58 b</td>
<td>44.43 c</td>
<td>0,10 ab</td>
</tr>
<tr>
<td>Bo 100</td>
<td>85.33 ab</td>
<td>43.24 a</td>
<td>8.41 a</td>
<td>33.96 a</td>
<td>0,10 ab</td>
</tr>
<tr>
<td>Manggeng</td>
<td>88.33 cde</td>
<td>43.42 a</td>
<td>8.59 a</td>
<td>37.72 c</td>
<td>0,10 ab</td>
</tr>
<tr>
<td>Berselona</td>
<td>85.33 bc</td>
<td>44.51 b</td>
<td>9.30 c</td>
<td>41.34 b</td>
<td>0,09 a</td>
</tr>
<tr>
<td>Rom Mokot</td>
<td>90.67 ef</td>
<td>63.41 ef</td>
<td>12.16 d</td>
<td>43.46 c</td>
<td>0,10 ab</td>
</tr>
<tr>
<td>Padi Mas</td>
<td>91.00 fg</td>
<td>50.63 cd</td>
<td>9.18 b</td>
<td>40.77 b</td>
<td>0,11 bc</td>
</tr>
<tr>
<td>Pandrah</td>
<td>85.33 bc</td>
<td>62.92 e</td>
<td>12.89 d</td>
<td>47.06 d</td>
<td>0,11 bc</td>
</tr>
<tr>
<td>Sigudang</td>
<td>93.33 fg</td>
<td>71.62 f</td>
<td>14.95 f</td>
<td>61.56 g</td>
<td>0,11 bc</td>
</tr>
<tr>
<td>Sanbei</td>
<td>95.00 h</td>
<td>77.26 g</td>
<td>14.87 f</td>
<td>72.33 h</td>
<td>0,17 d</td>
</tr>
<tr>
<td>Sigupai</td>
<td>90.67 ef</td>
<td>47.15 b</td>
<td>9.36 b</td>
<td>41.66 c</td>
<td>0,11 bc</td>
</tr>
<tr>
<td>Sipirok</td>
<td>87.00 bcd</td>
<td>53.87 cd</td>
<td>11.08 d</td>
<td>42.49 c</td>
<td>0,10 ab</td>
</tr>
<tr>
<td>S. Mayang Ru</td>
<td>91.33 efg</td>
<td>56.47 cde</td>
<td>10.76 c</td>
<td>41.68 c</td>
<td>0,10 ab</td>
</tr>
<tr>
<td>Sikuneng</td>
<td>87.67 def</td>
<td>65.97 f</td>
<td>13.67 e</td>
<td>53.40 f</td>
<td>0,11 bc</td>
</tr>
</tbody>
</table>

Note: The number followed by the same letter, the same column is not significantly different at potential 5% (Tukey's HSD, P<0.05)

The results of this study (Table 2) showed that the tolerance of Acehnese local rice different significantly on observed viability of the seeds: seed germination rate, germination capacity, growth velocity, growth unity, and seedling fresh weight. The highest seed viability and vigor tested on the highest concentration of NaCl (20.0 g/l) found on variety of Sanbei. This results showed that the osmotic condition of NaCl resulted an effective
method to simulate the tolerance of salinity stress for Acehnese local rice using NaCl in the method of \textit{in vitro} cultivation. The MS medium with 2.0 g/l of NaCl that used to study the responds of Acehnese local rice to the tolerance of salinity stress was obtained as the most effective concentration.

Scardaci \textit{et al.} (1996) stated that salinity is one of the major obstacles to increasing production in rice growing areas worldwide. Nowadays, the use of recirculating water systems in rice production and the requirement for water holding in the fields without recirculating water systems have increased because of environmental concerns related to the problems caused by drainage into receiving rivers after pesticide applications. Zeng and Shannon (2000) reported that knowledge of salinity effects on rice seedling growth and yield components would improve management practices in fields and increase our understanding of salt tolerance mechanisms in rice. Seedling growth was significantly reduced by salinity and significant reduction of seedling growth occurred at longer cumulative thermal than at higher salt levels.

Maas and Hoffman (1977) and Shannon \textit{et al.} (1998) showed that rice is sensitive crop if exposed to salinity stress. The response of rice to salinity varies with growth stage. Young seedlings were very sensitive to salinity in the most commonly cultivated rice cultivars (Pearson and Bernstein, 1959; Kaddah, 1963; Flowers and Yeo, 1981; Heenan et al., 1988; Lutts et al., 1995). Respectively, Sajjad (1984), Heenan \textit{et al.} (1988), Cui \textit{et al.} (1995), and Khatun \textit{et al.} (1995) reported that salinity also severely affected final grain yield of rice. Continuously, salt treatments also significantly reduced panicle length, spikelet number per panicle, and grain yield of rice. The emergence of panicle and flowering also delayed by salinity stress (Khatun \textit{et al.}, 1995). Khatun and Flowers (1995) and Khatun \textit{et al.} (1995) also reported that seed set decreased through reduction of pollen viability due to salinity stress.

\textbf{Conclusions}

The tolerance of Acehnese local rice different significantly on observed viability of the seeds: seed growth rate, germination capacity, growth velocity, growth unity, and seedling fresh weight. The osmotic condition of NaCl resulted an effective method to simulate the tolerance of salinity stress for Acehnese local rice using NaCl in the method of \textit{in vitro} cul germination. The MS medium with 2.0 g/l of NaCl that used to study the responds of Acehnese local rice to the tolerance of salinity stress was obtained as the best concentration. Thus, simulation of salinity stress condition on Acehnese local rice will become an alternative method for selection of genotype traits related to the tolerance of salinity stress for local rices in the future.

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References


