PAPER • **OPEN ACCESS**

The 3rd International Conference On Agricultural Technology, Engineering, and Environmental Sciences

To cite this article: 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **922** 011001

IOP Conf. Series: Earth and Environmental Science **922** (2021) 011001 doi:10.1088/1755-1315/922/1/011001

THE 3rd INTERNATIONAL CONFERENCE ON AGRICULTURAL TECHNOLOGY, ENGINEERING, AND ENVIRONMENTAL SCIENCES

(The 3rd ICATES 2021)

" Innovative Agricultural and Biosystem Engineering for Sustainable Food, Water, Energy, and Environment "

Banda Aceh, 21 September 2021

Organized by:

Department of Agricultural Engineering

Faculty of Civil Engineering and Earth Resources

POLITEKNIK ACEH SELATAN

Pusat Riset Mekanisasi dan Perbengkelan Pertanian

LPPM Universitas Winaya Mukti

IOP Conf. Series: Earth and Environmental Science **922** (2021) 011001 doi:10.1088/1755-1315/922/1/011001

Extended Preface

The ICATES is annual conference organized primary by the Department of Agricultural Engineering, Universitas Syiah Kuala. This year, in the 3rd consecutive year 2021, ICATES conducted the 3rd conference with co-hosted by University Malaysia, Pahang (UMP), Agricultural Mechanization Research Center (PUSMEPTAN) Syiah Kuala University, South Aceh Poly-technique (Poltas Aceh Selatan) and LPPM Winaya Mukti. Surely, we plan to conduct this conference physically just like previous ICATES in August 2019. However, due to the unforseen circumstances of global pandemic COVID-19, the 3rd ICATES 2021 conference was carried out virtually as same as ICATES 2020 by zoom meeting platform. We took this option because this conference was already designated and funded. Keynote and invited speakers were also scheduled for this event. Many delegations and authors requested for this conference to be performed, even virtually, since they need it to cover their publication and sharing knowledge requirements.

The conference itself was run as planned on 21st September 2021 with the support from virtual event organizer started from 8.00 am to 19.00 pm. The ICATES committee members were managed this event in a particular room as a studio along with two appointed MCs. The conference was officially opened by the Rector of Syiah Kuala University, Prof. Samsul Rizal and it is broadcast lively via YouTube platform with recorded participants reach 447 were joined. The main event was started by video presentation from the Keynote speaker Prof. Okke Batelaan from Flinders University, Australia, followed by invited speaker from UMP Malaysia Assoc. Prof. Ramadhansyah Putra Jaya. The discussion session was performed directly once the second speaker was completed his presentation. Then, the second session of keynote speaker was started after 20 minutes break with the speaker from University Technology Mara (UiTM) Dr.rer.nat Shahril Anuar Bahari, followed by the last invited speaker Dr. Joko Pitoyo from Indonesian Center for Agricultural Engineering Research and Development (ICAERD).

Moreover, parallel sessions were started after all keynote speaker session and participants were divided into 8 breakout rooms in zoom platform based on their related sub-topics. The operator acted as virtual Host and Co-host to manage and ensure all presenters and participants were put in the right place. Each participant and presenter was identified by renaming their name to room number and author full name. Presenter was given about 10 minutes for power point presentation via Screen Sharing and 5 minutes for discussion and shifted to next presenter. During the conference, video capabilities were turned on to ensure dynamic conference.

As the conference chair, I firmly believe that the success of a virtual conference like this event can be achieved by arranging a stimulating program. We sincerely hope that next forthcoming ICATES conference will be conducted lively in touch as previously ICATES event in 2019. Thus, everyone finds the conference is stimulating and enjoying.

Cordially yours,
Conference Chair

Dr. Safrizal, ST., M.Si

IOP Conf. Series: Earth and Environmental Science **922** (2021) 011001 doi:10.1088/1755-1315/922/1/011001

INTERNATIONAL SCIENTIFIC COMMITTEES

Professor Ts. Dr. Mohd Rosli Hainin, P. Tech *(Universiti Teknologi Malaysia)*
Professor Ir. Dr. Hasanan Md. Nor *(Universiti Teknologi Malaysia)*
Professor Dr. Badorul Hisham Abu Bakar *(Universiti Sains Malaysia)*
Professor Dr. Taksiah A.Majid *(Universiti Sains Malaysia)*
Professor. Ir. Zulkifli Nasution, M.Sc, Ph.D *(Universitas Sumatera Utara)*
Professor. Dr. Ir. Sigit Supadmo Arif, M.Eng *(Universitas Gadjah Mada)*
Professor. Dr. Ir. Lilik Sutiarso, M.Eng *(Universitas Gadjah Mada)*
Professor. Dr. Ir. Bambang Purwantana, M.Agr *(Universitas Gadjah Mada)*
Professor. Dr. Ir. Asep Sapei, MS *(Institut Pertanian Bogor)*
Professor. Dr. Sabaruddin, M.Agric. *(Universitas Syiah Kuala)*
Professor. Dr. Ir. Darusman, M.Sc *(Universitas Syiah Kuala)*
Professor. Dr. Elke Pawelzik *(Germany)*
Associate Professor Dr. Mohammed J.K Bashir *(Universiti Tunku Abdul Rahman)*
Associate Professor Ts. Dr. Mohd Haziman Wan Ibrahim *(Universiti Tun Hussein Onn)*
Associate Professor Dr. Tony Hadibarata *(Curtin University, Australia)*
Associate Professor Dr. Fadzli Mohamed Nazri *(Universiti Sains Malaysia)*
Associate Professor Dr. Kusmono, S.T., M.T *(Universitas Gadjah Mada)*
Associate Professor Dr. Haryati Awang *(Universiti Malaysia Pahang)*
Associate Professor Dr. Mohd Fadzil Arshad *(Universiti Teknologi MARA)*
Dr. Muhammad Zulkarnain *(University of Kuala Lumpur)*
Dr. Khairil Azman Masri *(Universiti Malaysia Pahang)*
Dr. Slameto W Lukito *(Institut Teknologi Bandung)*
Dr. Abdullahi Ali Mohamed *(University of Nottingham, UK)*
Dr. Euniza Jusli *(University College of Technology Sarawak)*
Dr. Ir. Desrial, M.Eng *(Institut Pertanian Bogor)*

STEERING COMMITTEES

Prof. Dr. Ir. Samsul Rizal, M. Eng.,IPU *(Rector of Universitas Syiah Kuala)*
Prof. Dr. Ir. Marwan *(Vice Rector I Universitas Syiah Kuala)*
Dr. Ir. Agussabti, M.Si *(Vice Rector II Universitas Syiah Kuala)*
Dr. Ir. Alfiansyah Yulianur *(Vice Rector III Universitas Syiah Kuala)*
Dr. Hizir *(Vice Rector IV Universitas Syiah Kuala)*
Prof. Dr. Taufik Fuadi Abidin, S.Si, M.Tech *(LPPM Universitas Syiah Kuala)*
Prof. Dr. Ir. Samadi, M.Sc*(Dean Faculty of Agriculture, Universitas Syiah Kuala)*
Dr. rer.hort. Indera Sakti Nasution *(Head of Agricultural Engineering Department, Universitas Syiah Kuala)*
Dr. Ir. Syahrul, M.Sc*(Universitas Syiah Kuala)*
Dr. Ing. Agus Arip Munawar, M.Sc*(Universitas Syiah Kuala)*
Dr. Muhammad Idkham, S.TP., M.Si*(Universitas Syiah Kuala)*
Dr. Muhammad Yasar, S.TP., M.Sc*(Politeknik Aceh Selatan)*
Dr. Ichwana,ST.,MP *(Universitas Syiah Kuala)*
Dr. Dodi Sukmayana (LPPM Universitas Winaya Mukti)

ORGANIZING COMMITTEES

Chairman	:	Dr. Safrizal, ST.,M.Si
Co-Chairman	:	Dr. Muhammad Dhafir, ST.,M.Si
Secretariat	:	Diswandi Nurba,S.TP.,M.Si Nur Anita Humaira, S.TP
Article Submission	:	Mustaqimah, M.Sc Dr. Darwin, S.TP.,M.Sc Dr. Ferijal, S.TP.,M.Sc Dr. Sri Hartuti, S.TP.,MT Dr. Zulfahrizal, S.TP.,M.Si Dr.Yusmanizar, ST.,MP
Treasure and Registration	:	Raida Agustina, S.TP, M. Sc
Accommodation and equipment	:	Dr. Purwana Satriyo, S.TP, MT Dr. Rita Khathir, S.TP, M.Sc Syafriandi, S.TP, M.Si
Website, publicity and promotion, book of abstract	:	Fachruddin, S.TP, M.Si Bambang Sukarno Putra, S.TP., M.Si
Meals and Souvenir	:	Dr. Devianti, S.TP, MP Dr. Ramayanty Bulan, ST, M.Si Dian Kamisna, S.TP Nurbani, A.Md
Schedule and Virtual Conference	:	Dr. Rahmat Fadhil, S.TP, M.Sc Dr. Kiman Siregar, S.TP, M.Si Ratna, S.TP, MT

IOP Conf. Series: Earth and Environmental Science **922** (2021) 011001 doi:10.1088/1755-1315/922/1/011001

KEYNOTE SPEAKER ABSTRACT

WATER-ENERGY-FOOD SECURITY NEXUS

Prof Okke Batelaan

Flinders University
Adelaide, Australia
Okke.batelaan@flinders.edu.au

Abstract

This presentation investigates the global past, current, and future relationship between food production and water use. It is shown that the water use, mainly for agriculture, in the past 60 years has been rising faster than the global population growth. This puts pressure on the sustainability of the global water resources, connected environmental assets and future food security. A positive trend is that the global average of the arable land (in hectares) per person used for our food production in the past 50 years has halved, due to the more efficient agricultural techniques, plant resistance and higher crop productivity. Next, options for meeting the future water-food demand are discussed, including efficiency gains from better quantification of individual and national water footprints and optimizing virtual water. Finally, an example study is presented to investigate how, in an agriculturally dominated area in Southern Vietnam, the profitability and sustainability of water use in groundwater-dependent smallholder farming systems can be improved. It is shown how combining water balance and groundwater models makes it possible to evaluate and rank a range of agricultural development scenarios in terms of sustainability of the groundwater resources for irrigation. It is concluded that global efforts on activating the water-energy-food security nexus are imminent to attain a sustainable future.

IOP Conf. Series: Earth and Environmental Science **922** (2021) 011001 doi:10.1088/1755-1315/922/1/011001

KEYNOTE SPEAKER ABSTRACT

WASTE PLASTIC: RECYCLE AND REUSE FOR SUSTAINABLE ROAD CONSTRUCTION

Ramadhansyah Putra Jaya, PhD

Professor (Associate)
College of Engineering, Universiti Malaysia Pahang

Abstract

Plastic disposal is one of the major problems for developing countries especially in South East Asia,at the same time all countries needs a large network of roads for its smooth economic and social development. The limited source of asphalt needs a deep thinking to ensure fast road construction. Therefore, the use of plastic waste in road construction not only can help to protect environment but also able to help the road construction industry. Road construction that uses plastic waste as one of it material is called plastic road. Plastic bag is non-biodegradable but most of it is recyclable. The recycled products are more environmentally harmful than the first time manufactured ones because every time plastic is recycled it is subject to high intensity heat. This can make it to deteriorate and lead to environmental pollution. That is why the use of plastic waste in road construction can be one of the solutions. This type of construction gives benefit to environment because it uses plastics that would otherwise be disposed through environmentally harmful means. In addition, it is not only reducing wasteplastic but also lengthens the road service life.

IOP Conf. Series: Earth and Environmental Science **922** (2021) 011001 doi:10.1088/1755-1315/922/1/011001

KEYNOTE SPEAKER ABSTRACT

BAMBOO, A GREAT PLANT FOR GREEN PLAN

Dr.rer.nat. Shahril Anuar Bahari

Senior Lecturer, Faculty of Applied Sciences,
Universiti Teknologi MARA (UiTM), 40450 Shah Alam, Selangor, Malaysia

Abstract

Bamboo is a great plant and important raw material for multiple uses since the earliest epoch. It is a promising material and mainly can be developed to become a supplement raw material in green product manufacturing; e.g.wood-based sector and bio-based industry. Bamboo has been used traditionally in most tropical countries for conventional building construction, housing materials, handicraft items, paper making, foods, and others. Nowadays, bamboo is widely used in modern applications with the great understanding of its characteristics. However, planning to improve the know-how of itsglobal resource handling, processing, manufacturing, as well as green product performance could further boost-up the uses of bamboo in modern green utilization. Industrial players nowadays sareaware about the potential of bamboo in supporting the demand of raw material for a wide variety of green products. Up to the present time, many accomplishments and findings were gained successfully through extensive research on bamboo applications. These findings are very useful in further promoting the potentials of bamboo as a great raw material for green development and consumption planning. Extra information on bamboo resources, processing, manufacturing and product output are necessary for proper utilization of bamboo in modern green industries.The data were widely documented and established; however, bamboo's contemporary applications are relatively inadequate. In comparison to other green materials, its state-of-the-art in term of operation and products' green performance, belonging to the most recent stage of technological development are relatively limited. Relationship between the available technology and futuristic potential of bamboo usage should be planned in order to elevate the function of bamboo as a green product in society. It is an important information on bamboo, before it is upgraded for green development and consumption. Understanding of these facts will enable reliable evolution of bamboo products especially for green planning purposes.

IOP Conf. Series: Earth and Environmental Science **922** (2021) 011001 doi:10.1088/1755-1315/922/1/011001

KEYNOTE SPEAKER ABSTRACT

REVIEW OF RICE TRANSPLANTER AND DIRECT SEEDER TO BE APPLIED IN INDONESIA PADDY FIELD

Dr. Ir. Joko Pitoyo, M.Si

Specialist Reserach Engineer
Indonesia Center for Agricultural Engineering Research and Development (ICAERD)
Email: jokpitoyo@yahoo.co.id

Abstract

The manual labor cost for rice cultivation year by year in some on-going develop country in Asia. The more focus in hand transplanting. There is an option in rice cultivation by direct sowing but still need improvement in order to get yield as same by transplanting method. The challenge to plant one seed or plant per hill by rice ordinary rice transplanter (RT) is still difficult to be achieved due to random in sowing seed by on rice nursery tray. In Japan it was started 1995 by Minoru company as pioneer research and develop the Pot Nursery Rice Transplanter (PNRT) which rice are sow in exact amount in pot tray by special seed sowing machine then later on transplanter by PNRT. Rice Direct Seeding (RDS) method theoretically could be as a solution in order to get precision on rice cultivation. But due to the vigority of seed after sowing in the field and also the unfavorable condition, the more number of seed are still needed and the yield lower compare transplanter method. Recently, the use of rice direct seeding has been increasing rapidly owing to rural labor shortages and continuous increases in agricultural production costs. This article reviews the research and application progress of mechanized rice direct seeding including direct seeding technologies, precision rice seeding, precision rice seed-metering devices. The other important component on succession direct seeding method is also discussed i.e. calcium gypsum coating and iron powder coating. Operating direct seeding machine also need consider about land and water management. Paddy field need to be managed since the seed drooped in order give favor condition of seed and facility the seed with optimum growing condition. In this approach, pre-germinated seeds are uniformly hill-dropped in the expected positions in puddled soil. The both technology PNRT and RDS have prospect and great potential for promoting the development of precession on rice cultivation in Asia

IOP Conference Series: Earth and Environmental Science

PAPER • **OPEN ACCESS**

Peer review declaration

To cite this article: 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **922** 011002

IOP Conf. Series: Earth and Environmental Science **922** (2021) 011002 doi:10.1088/1755-1315/922/1/011002

Peer review declaration

All papers published in this volume of IOP Conference Series: Earth and Environmental Science have been peer reviewed through processes administered by the Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

- **Type of peer review:** Double-blind

- **Conference submission management system:**
  For official information, we develop using the University platform: *http://icates.unsyiah.ac.id/* ,
  while for paper submission, We used the EasyChair conference management system:
  https://easychair.org/conferences/?conf=3rdicates2021

- **Number of submissions received:**
  In total, we received 133 submitted papers through submission system

- **Number of submissions sent for review:**
  A total of 121 papers were sent to the reviewers, while remaining 12 submission paper were rejected directly due to irrelevant topics and out of conference scopes.

- **Number of submissions accepted:**
  A total of 74 papers were accepted for presentations on The 3rd ICATES 2021

- **Acceptance Rate (Number of Submissions Accepted / Number of Submissions Received X 100):**
  Acceptance rate = 55.63%

- **Average number of reviews per paper:** *2x for major revisions and 1x for minor revisions*

- **Total number of reviewers involved:** *32 reviewers*

- **Any additional info on review process:** *The review process were carried out by assigning two potential respective reviewers by track editors. The review itself approximately took maximum 3 weeks to complete.*

- **Contact person for queries:**

Dr.-Ing. Agus Arip Munawar (aamunawar@unsyiah.ac.id)
Dr.rer.hort. Indera Sakti Nasution (i.nasution@unsyiah.ac.id)
Dept. of Agricultural Engineering, Syiah Kuala University
Jl. T Hasan Krueng Kalee No. 3 Banda Aceh – Indonesia
Email: icates@unsyiah.ac.id

IOP Conference Series: Earth and Environmental Science

PAPER • **OPEN ACCESS**

The effect of water-saving irrigation on the growth of local rice plants

To cite this article: D Yanti *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **922** 012036

IOP Conf. Series: Earth and Environmental Science **922** (2021) 012036 doi:10.1088/1755-1315/922/1/012036

The effect of water-saving irrigation on the growth of local rice plants

D Yanti[1]*, I Berd[1], Z Naspendra[2]

[1]Department of Agricultural Engineering and Biosystem, Faculty of Agricultural Technology, Andalas University, Indonesia
[2]Department Soil Science, Faculty of Agriculture, Andalas University, Indonesia

*Email: delviyanti@ae.unand.ac.id

Abstract. The decline in the function of the watershed causes the increasing scarcity of water, while the competition for water use is increasing. A conventional method of rice cultivation (continuous inundation) is very wasteful in the use of irrigation water. Water-saving irrigation by regulating the water availability in rice fields is an effort to reduce water loss due to percolation, seepage, and runoff. The study's purpose was to examine the effect of water availability in the field on the growth of local rice varieties. The study used 5 treatments of water availability in the field (GW < 50% AW, 50% AW < GW ≤ 60% AW, 60% AW< GW ≤ 70% AW, 70% AW < GW ≤ 80% AW, and saturated) with 3 replicates and the parameters observed were the height of plants and number of tillers. The results showed that the availability of water in the field did not affect the plant height but did affect the number of tillers. From the vegetative phase at the age of ±28 days after planting (DAP) to the beginning of the generative phase ±55 DAP, there was an addition of tillers. When the generative phase period from ± 55 DAP, the formation of the tillers stopped, and some of the tillers dried up or died.

1. Introduction

Climate change as the impact of environmental damage is increasing the threat of drought and flooding. There is a fluctuation in the amount of rainfall from 1% to 4% in different periods. The dry season lasts longer with decreasing rainfall. On the contrary, the rainy season lasts a short time with higher rainfall intensity. Rainfall is an important component in hydrology because it is the only source of water in a watershed. The decline in watershed function causes the scarcity of water availability, while the competition for water use is increasing. As a result, many irrigated rice fields cannot be planted due to insufficient water, especially in the downstream irrigation area.

A conventional method of rice cultivation (continuous inundation) is very wasteful in irrigation water usage. Water-saving irrigation in lowland rice is an effort to reduce water loss in rice fields to maintain or increase grain yield per unit area and volume of water. Reduction of water due to percolation, seepage, and runoff can reduce the use of irrigation water. This can be done by regulating the availability of water on the land. The results research [1] stated that the water availability at field capacity conditions on land during rice plant growth provides a higher production value for irrigation water than saturated water and 50% available water. It is in line with the opinion [2] which stated that plant growth generally would begin to be disrupted when the water content in the soil is less than 50%

of the available water. Therefore, it could reduce production. For efficient water use, irrigation does not have to be added to meet field capacity conditions of 100% of available water, it is enough to provide about 60-80% of available water.

Research on irrigation water for efficient rice cultivation has been widely done, including alternate wetting and drying (AWD), shallow water depth with wetting and drying (SWD), and semi-dry cultivation (SDC) systems [3]. A water-saving irrigation method has been developed in Madagascar in the 1980s, which is the system of rice intensification (SRI). However, irrigation of land without inundation in rice cultivation by regulating the water availability according to soil characteristics needs to be done for water-saving irrigation. This study aims to determine the effect of water-saving irrigation on the growth of rice plants.

2. Materials and methods

2.1 Location

The research was conducted in Nagari Singakarak, X Koto Singkarak Sub District, Solok Regency, West Sumatra Province. The experiment was conducted from May 2021 to August 2021.

2.2 Trial Treatment

The study used a completely randomized design (5 treatments) with 3 replications. The implementation of water administration is shown in Figure 1. Observations were made weekly on plant growth, which was plant height and number of tillers. The treatment of water availability in the land consists of:

1. P1: GW < 50% AW: groundwater is less than 50% available water
2. P2: 50% AW < GW ≤ 60% AW: groundwater is between 50% and 60% available water
3. P3: 60% AW < GW ≤ 70% AW: groundwater is between 60% and 70% available water
4. P4: 70% AW < GW ≤ 80% AW: groundwater is between 70% and 80% available water
5. P5: Saturated.

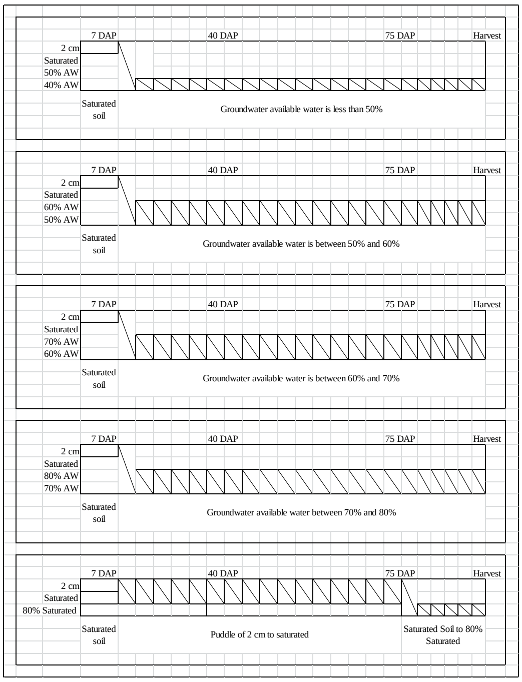

Figure 1. Treatment of Water Availability in the Land During Plant Growth
Information: DAP (Days After Planting)

2.3 Data Analysis
Data analysis was carried out by analysis of single-factor ANOVA variance at the level of α = 0.05. A P-value of less than 0.05 ($p<0.05$) was considered to have a statistically significant difference.

3. Results and discussion

3.1 Research Location Description
The ability of plants to absorb available water depends on the type of plant and the soil profile which are reached by the roots. The range of groundwater available to plants is water-bound between field capacity (pF 2.54) and permanent wilting point (pF 4.2), which varies depending on soil texture. Therefore, the finer the soil texture, the greater the range [4]. The research location has a clay texture with a percentage of 16.3% of sand, 18.58% of dust, and 65.12% of lay.

According [4], groundwater available to plants ranges from 20% to 55% for clay soils and 8% to 18% for sandy soils. The averages of soil water content for pF2.01, pF2.54, and pF4.2 were 57.56%, 49.48%, 27.46%, respectively. The water content (% of volume) at pF2.0, pF2.54, and pF 4.2 is the basis for determining the water supply or when the water condition reaches standard according to the treatment (treatment setpoint).

3.2 Plant Growth
Plant growth was observed from day 1 to day 70. Parameters observed were plant height and the tillers number. Bujang Marantau rice is a local variety in Tanah Datar Regency, West Sumatra Province, with a Plant Variety Protection registration number 160/PVL/2014 on March 23, 2015. The description of the Bujang Marantau rice plant based on the official PVP news [5] is the cere group, age 135 to 140 days after seedling (HSS), husky shape, height 100 to 110 cm, and productive tillers 25 to 32 stems. Meanwhile, the observations on the plant height of the Bujang Marantau rice on the 70th day resulted that the plant height ranged from 95 to 100 cm. Observation data of plant height and the tillers number are presented in Figures 2 and 3.

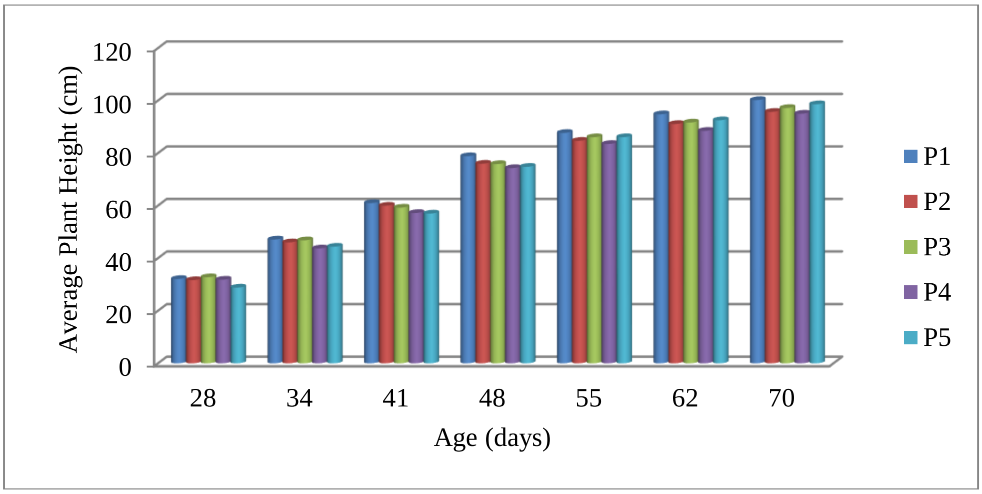

Figure 2. Average Plant Height from Early Phase to Generative Phase

Information:
P1: GW < 50% AW: groundwater is less than 50% available water
P2: 50% AW < GW ≤ 60% AW: groundwater is between 50% and 60% available water
P3: 60% AW < GW ≤ 70% AW: groundwater is between 60% and 70% available water
P4: 70% AW < GW ≤ 80% AW: groundwater is between 70% and 80% available water
P5: Saturated.

In Figure 2, the plant height from the vegetative phase (±11-50 DAP) to the beginning of the generative phase (±51-70 DAP) continues to increase. At the end of the observation, (generative phase at 70 DAP), the average plant heights were 100 cm (P1), 96 cm (P2), 97 cm (P3), 95 cm (P4), and 99 cm (P4). P5). The results of statistical analysis stated that there was no difference in plant height during the growth period, with a significance value of 0.988, ie > 0.05, meaning that there was no effect of water availability in the land on plant height.

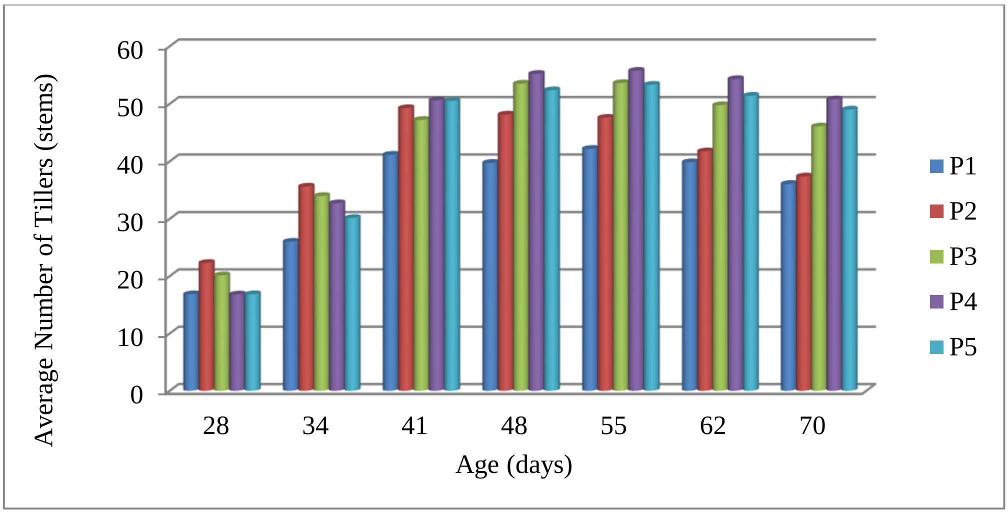

Figure 3. Average Number of Tillers from Early to Early Generative Phase

Information:
P1: GW < 50% AW: groundwater is less than 50% available water
P2: 50% AW < GW ≤ 60% AW: groundwater is between 50% and 60% available water
P3: 60% AW < GW ≤ 70% AW: groundwater is between 60% and 70% available water
P4: 70% AW < GW ≤ 80% AW: groundwater is between 70% and 80% available water
P5: Saturated.

Figure 3 shows the number of tillers from the vegetative phase (±11-50 DAP) to the generative phase (±51-70 DAP) is fluctuating. At the end of the observation (generative phase 70 DAP), the averages number of tillers respectively were 36 stems (P1), 37 stems (P2), 46 stems (P3), 51 stems (P4), and 49 stems. (P5). The results of statistical analysis stated that there was a difference in the number of rice tillers during the growth period, with a significance value of 0.047, which was <0.05. It means that there was an effect of water availability in the field on the number of rice tillers. The results of the one-way ANOVA analysis are presented in Table 1.

Table 1. Results of One Way Anova Analysis Number of Rice Tillers

Group based on Real Level 0.05	
1	2
P1	
P2	P2
	P5
	P3
	P4

Information:
P1: GW < 50% AW: groundwater is less than 50% available water
P2: 50% AW < GW ≤ 60% AW: groundwater is between 50% and 60% available water
P3: 60% AW < GW ≤ 70% AW: groundwater is between 60% and 70% available water
P4: 70% AW < GW ≤ 80% AW: groundwater is between 70% and 80% available water
P5: Saturated.

In Table 1, the number of tillers treated with water availability P1 was not significantly different from P2, but significantly different from P5, P3, and P4. The number of tillers treated with water availability P2 was not significantly different from P5, P3, and P4. The best water availability treatment was P4 with the highest average number of tillers, which is 51 stems.

The formation of tillers is influenced by genetic factors, spacing and soil fertility [6]. In this experiment, the three factors were assumed to be the same, because the experiment used seeds from the same source, the spacing was the same at the same location, and the experiment was carried out on land with adjacent beds. The treatment factor at the time of the experiment was the same, the difference was the irrigation pattern. In this case it can be concluded that the formation of tillers in rice plants is influenced by the availability of water in the soil. The optimal condition for the formation of rice tillers is the availability of water in the soil between 70% and 80% of available water. The pattern of changes in tiller formation is presented in Figure 4.

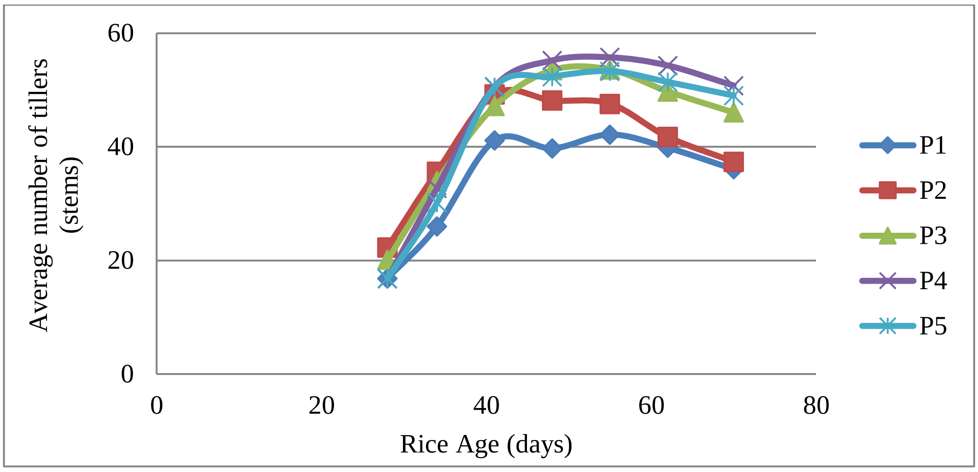

Figure 4. The average number of tillers

Information:
P1: GW < 50% AW: groundwater is less than 50% available water
P2: 50% AW < GW ≤ 60% AW: groundwater is between 50% and 60% available water
P3: 60% AW < GW ≤ 70% AW: groundwater is between 60% and 70% available water
P4: 70% AW < GW ≤ 80% AW: groundwater is between 70% and 80% available water
P5: Saturated.

Figure 4 shows that in the vegetative phase at the age of ±28 DAP to the beginning of the generative phase ±55 DAP, the line graph of the average number of tillers always increases. This indicates the addition of tillers during the vegetative phase. However, when entering the generative phase of the age of ± 55 DAP, the line graph declines because there were several rice clumps whose tillering stopped. Some of the tillers dried up or died.

The results research [7] showed that the pattern of giving water affected the number of tillers. In the vegetative phase (±1-45 DAP), rice produced tillers and then the formation of these tillers stopped in the generative phase (±46-86 DAP). The results research [8] also showed that the cultivation method affected the maximum number of tillers of the SRI and ICM cultivation methods achieved at 55 days after planting (DAP), while conventional cultivation methods were at 35 DAP.

4. Conclusions

The results showed that the water availability in the field did not affect the plant height but affected the tillers' number. From the vegetative phase at the age of ±28 DAP to the beginning of the generative phase ±55 DAP, there was an addition of tillers. In the generative phase from the age of ± 55 DAP, the formation of the tillers stopped, and some of the unproductive tillers were eliminated or dried up.

IOP Conf. Series: Earth and Environmental Science **922** (2021) 012036 doi:10.1088/1755-1315/922/1/012036

References

[1] Yanti, D. (2020). Model Pengelolaan Operasi Irigasi Intermittent pada Pengembangan Modernisasi [*Disertasi*]. Bogor (ID):IPB University. https://repository.ipb.ac.id/handle/123456789/105125

[2] Abdurachman, A., Haryati, U., & Juarsah, I. (2006). Penetapan Kadar Air Tanah dengan Metode Gravimetrik. In *Sifat Fisik Tanah dan Metode Analisanya* (pp. 131–142). Litbang Pertanian. http://balittanah.litbang.pertanian.go.id/ind/dokumentasi/buku/buku sifat fisik tanah/12gravimetrik.pdf

[3] Zhi, M. (2002). Water efficient irrigation and environmentally sustainable irrigated rice production in China. *International Commission on Irrigation and Drainage*, 1–15. http://www.zanzare-risaie.info/wat_mao.pdf

[4] Nurhayati. (2009). Pengaruh Cekaman Air pada Dua Jenis Tanah Terhadap Pertumbuhan dan Hasil Kedelai (Glycine max (L.) Merril). *J. Floratek, 4,* 55–64. http://jurnal.unsyiah.ac.id/floratek/article/view/190

[5] Kementeriaan Pertanian Republik Indonesia. (2015). *Berita Resmi PVT, Pendaftaran Varietas Lokal, No. Publikasi : 041/BR/PVL/04/2015*.

[6] Efendi, E., Halimursyadah, H., & Simajuntak, H. (2012). Respon Pertumbuhan dan Produksi Plasma Nutfah Padi Lokal Aceh Terhadap Sistem Budidaya Aerob. *Jurnal Agrista*, *16*(3), 114–121. http://jurnal.unsyiah.ac.id/agrista/article/view/655

[7] Sofiyuddin, H. A., Martief, L. M., Setiawan, B. I., & Arif, C. (2012). Evaluasi Koefisien Tanaman Padi Berdasarkan Konsumsi Air Pada Lahan Sawah. *Jurnal Irigasi*, *7*(2), 120–131. http://jurnalirigasi_pusair.pu.go.id/index.php/jurnal_irigasi/article/download/253/317

[8] Subari, Joubert, M. D., Sofiuddin, H. A., & Triyono, J. (2012). Pengaruh Perlakuan Pemberian Air Irigasi pada Budidaya Sri, PTT dan Konvensional Terhadap Produktivitas Air. *Jurnal Irigasi*, *7*(1), 28–42. http://jurnalirigasi_pusair.pu.go.id/index.php/jurnal_irigasi/article/view/99