GROWTH PERFORMANCE OF INBRED RICE IN DIFFERENT WATER LEVELS

College of Agriculture and Natural Resources
BOHOL ISLAND STATE UNIVERSITY
Zamora, Bilar, Bohol

ERVIN P. ECAT

June 2022

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A Thesis
Presented to the Faculty of the
College of Agriculture and Natural Resources
BOHOL ISLAND STATE UNVERSITY
Zamora, Bilar, Bohol

In Partial Fulfillment
Of the Requirements for the Degree in
Bachelor of Science in Agricultural and Biosystems Engineering

Ervin P. Ecat

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APPROVAL SHEET

This thesis entitled **"GROWTH PERFORMANCE OF INBRED RICE IN DIFFERENT WATER LEVELS"** prepared and submitted by **Ervin P. Ecat,** in partial fulfillment of the requirements for the degree in *Bachelor of Science in* Agricultural and Biosystems Engineering has been examined and recommended for acceptance for oral defense.

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"ERVIN"

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ABSTRACT

Water is the single most important component for sustainable rice production, especially in the traditional rice growing areas of the region. Reducing investments in irrigation infrastructure, increased competition for water and large water withdrawals from underground water lower the sustainability of rice production. The study was conducted to determine the growth performance of inbred rice in different water levels. They use an inbred rice which is RC 18 and they use Complete Randomized Design (CRD) as a research design of the study. Specifically, it aimed to determine the plant height, number of leaves and length of root. Based on the analysis of variance showed that there is no significant difference on the plant height, number of leaves and length of root. The researcher accepts the null hypothesis since there is no significant difference among the treatments in terms of plant height, number of leaves, and length of root. Based on the conclusions made from the result of the study, the following recommendations are formulated; conduct the same research but have longer time in order to observe the optimum results. Conduct similar study through in site to validate the results, using other variety to compare the results. Conduct similar study including the yield performance to determine and observe the result of different water levels.

Chapter 1

THE PROBLEM AND ITS SCOPE

Rationale

Climate variability is a threat to food production. Typhoons, floods, and droughts caused 82.4% of the total Philippine rice losses from 1970 to 1990. In 1990 alone, domestic losses due to climatic constraints amounted to US$ 39.2 million. Weather aberrations, climatic fluctuations such as El Niño, and the growing concern for their effects on agriculture have stimulated academic, public and policy-level interests on the analysis of the impacts of climate variability on agricultural production systems.

This paper is presented to discuss the agronomic impacts of climate variability on rice production in the Philippines. Long-term climate variability influences sowing date, crop duration, crop yield, and the management practices adapted in rice production. Short-term weather episodes can also affect yield by inducing changes in temperature, potential evapotranspiration, and moisture availability.

The degree of vulnerability of crops to climate variability depends mainly on the development stage of the crops at the time of weather aberration. The vulnerability and risk of crop production due to weather fluctuations and climate variability can be minimized if future weather variation can be adequately predicted and a suitable process-based Eco physiological crop yield forecasting model can be identified to produce real-time yield forecasts. Scientists and farmers must join efforts to further understand crop–climate relationships and formulate viable, locally adapted production technologies that will address critical issues such as climate variability (Lansigan et al., 2000)

Traditional lowland rice production in Asia requires much water: it consumes more than 50% of all irrigation water used in the region. Water resources are, however, increasingly getting scarce and expensive. There is a need to develop alternative rice production systems that require less water and increase water productivity. In the last decade(s), researchers have studied and developed a number of water-saving irrigation technologies. Although these technologies have been demonstrated to save water and increase water productivity, their adoption by farmers is low because of a lack of extension. Compared with the heavy investments needed to develop new water resources, the adoption of water-saving technologies by farmers is low-cost and has great potential to save water.

Therefore, in 2001, a project was initiated to transfer and promote water saving technologies among farmers in the Philippines called the "Technology Transfer for Water Savings (TTWS)" project. The first two years of the project were designed as a participatory learning phase with project partners. Controlled irrigation or alternate wetting and drying was the first matured water-saving technology included in the first phase of the project while the aerobic rice trials-cum-research were also integrated in the project. This paper documents the activities of the TTWS project, describes the results and implications of the first two-year implementation, and explores a future course of action including widespread training and extension of water-saving technologies in the Philippines (Lampayan et al., 2004)

Rice production in Asia needs to increase to feed a growing population. Though a complete assessment of the level of water scarcity in Asian rice production is still lacking, there are signs that declining quality of water and declining availability of water resources are threatening the sustainability of the irrigated rice-based production system. Drought is one of the main constraints for high yield in rain-fed rice. Exploring ways to produce more rice with less water is essential for food security and sustaining environmental health in Asia (Toung et al., 2003)

Rice is the largest user of water in Asia, probably accounting for more than half of irrigation water withdrawals. Two key trends in the Asian rice economy that may be affecting water productivity are the rapid spread of pump irrigation and direct seeding. The number of pumps has grown exponentially in Bangladesh and Vietnam, and pump irrigation now dominates gravity irrigation in many countries.

Direct seeding accounts for about one-fifth of the rice area in Asia, but this share is increasing. Comparing water productivity values is difficult across space and time; in general, it is more relevant across time. Water productivity has increased over time in several selected systems, primarily due to increased yields of modern varieties and improved management of large-scale water flows. There is less evidence that improved field-level water management has led to increased water productivity, although this may have also contributed. The extent to which agricultural water scarcity will affect poverty in Asia depends crucially on how well societies will be able to create incentives for users to save scarce water, thus facilitating the adoption of new technologies. Because of the rapid spread of pumps, incentives to save water in rice cultivation are growing. Even for gravity-flow surface water, new institutions are developing in China that promise to improve incentives. International trade in agricultural products, or trade in "virtual water," may also have a role to play and should be encouraged (Dave, 2005).

LITERATURE BACKGROUND

Legal Basis

As enacted through Republic Act 8435, better known as the Agriculture and Fisheries Modernization Act (AFMA) of 1997, the modernization of the agriculture and fisheries sectors promotes the use of appropriate technologies that would protect the environment, reduce production cost, and increase the global competitiveness of farmers. Hence, the adoptation of soil and water conservation and other farming technologies is critical to the success of AFMA. Previous studies suggest that the socioeconomic circumstances of the farmers either facilitate or constrain their adoption or rejection of soil and water conservation technologies.

The Philippine Clean Water Act of 2004 (Republic Act No. 9275) aims to protect the country's water bodies from pollution from land-based sources (industries and commercial establishment, agriculture and community/household activities). It provides for a comprehensive and integrated strategy to prevent and minimize pollution through a multi-sectoral and participatory approach involving all the stakeholders.

Related Literature

Rice production in Asia must increase to feed a growing population, while irrigation water is becoming scarce. Water input can be reduced by lowering ponded water depth to soil saturation or alternate wetting/drying, putting increased soil water loss, increased water requirements, and decreased water productivity at risk. Water productivity and yield at the field level can only be increased concurrently by improving total factor productivity or increasing yield potential. Water saved in one location can be used to irrigate new land in another, increasing total rice production.

Rice is the staple food for nearly half the world's population, and its continued increased production to meet the enhanced demand due to ever-increasing population faces many challenges. Per capita availability of land and water is increasing at a fast rate, and there is worldwide mass rural-to-urban movement of youth in search of better livelihood reducing the availability of farm labor. Rice is going to suffer the most due to these changes, because of its high water and labor requirements. The development of high-yielding varieties/hybrids of rice and concomitant use of high levels of fertilizer, specially nitrogen, have been the two major drivers of increased rice production in the last four decades, but overuse of fertilizer nitrogen has created environmental problems of greenhouse warming, depletion of ozone layer, and eutrophication of surface and groundwaters, and there is global concern about it. Nitrogen application rates to rice have therefore to be reduced and it may affect production. Nitrogen use efficiency in rice is lowest among the cereals. There is therefore an urgent need for developing more nitrogen use-efficient varieties and rice production technologies demanding lesser water, labor, nitrogen, and pesticides. Achieving these is going to be a Herculean task for agricultural scientists.

Water resources: The large range of climates encountered in the Region generates a variety of hydrological regimes. The region has some of the most humid climates in the world, giving rise to major, while other parts have arid climates with closed hydrologic systems. As a result, the regions water resources and water use conditions are very unevenly distributed. Water management concerns in humid areas have been dominated by flood control consideration. The hydrology of the Region is dominated by the typical monsoon climate which induces large inter-seasonal variations of river flows. Republic Act. No.7990 Shall state effect an efficient use of land and other productive resources with due regards to ecological balance and environment protection, rural development, equity consideration, mobilization of human resources, and increased agro-industrial production for the alleviation of poverty and sustainable growth objectives.

Alternate Wetting and Drying (AWD) is a well-known low-cost water-saving and climate change adaptation and mitigation technique for irrigated rice. However, its adoption rate has been low despite the decade of dissemination in Asia, especially in the Philippines. Using cross-sectional farm-level survey data, this study empirically explored factors shaping AWD adoption in a gravity surface irrigation system. We used regression-based approaches to examine the factors influencing farmers' adoption of AWD and its impact on yield. Results showed that the majority of the AWD adopters were farmers who practiced enforced rotational irrigation (RI) scheduling within their irrigators' association (IA). With the current irrigation management system, the probability of AWD implementation increases when farmers do not interfere with the irrigation schedule (otherwise they opt to go with flooding). Interestingly, the awareness factor did not play a significant role in the farmers' adoption due to the RI setup. However, the perception of water management as an effective weed control method was positively significant, suggesting that farmers are likely to adopt AWD if weeds are not a major issue in their field. Furthermore, the impact on grain yields did not differ with AWD. Thus, given the RI scheduling already in place within the IA, we recommend fine-tuning this setup following the recommended safe AWD at the IA scale (Pascual et al., 2021)

Related Studies

Study was to evaluate the effect of water levels on rice yield and its effect on Cu and Zn concentration. There were five treatments simulating different water depths and durations namely: W1, W2, W3, W4 and W5. At harvest, the number of tillers and panicles were counted. Grain yield, number of grains per panicle and weights of 1000 seeds were determined. In addition, the weight of straw also obtained. The effect of water level was not significant for tiller number, panicle number, grain yield (t ha^{-1}), straw weight (t ha^{-1}), grain/panicle and 1000 seeds weight (g). The different flooding levels had no significant effects on Cu and Zn concentration analyzed in soil solution at weekly intervals. Overall, this study showed that yields and yield components and nutrients concentration were not affected by different water levels. In addition, this study clearly shows that it is highly possible to produce rice under low water input, which is capable of saving between 25-30% of water without any effect on nutrient concentration (Sarwar and Khanif, 2005)

THE PROBLEM

Statement of the Problem

This study aimed to find out the growth performance of inbred rice in different water irrigation level.

Specifically, it sought to answer the following questions:

1. Which treatment in different level of water affects the growth performance in terms of the following,
    a) Plant height
    b) Number of leaves
    c) Length of roots
2. Is there a significant difference in the height, number of leaves and length of roots among treatments?

Null Hypothesis

There is no significant difference in the growth performance of inbred rice in different water levels among treatments.

Significance of the Study

The results of the study contribute information about the water management of rice cultivation. The success of this study beneficial to the following individual and groups or sector.

Farmers. This give information regarding to the growth of performance inbred rice grown in different water irrigation level.

Students. The scope of this study stimulates younger students to follow and do into a deeper research.

Economic Impact: If one of the treatments used this study be applicable and adoptable to farmers, this will contribute economically through lower cost of water irrigated into field.

Environmental Impact: The highest rate of water usage is the agricultural sector. Thus, this technology contributes in conserving water resources by mitigating the amount of water irrigated into rice paddies.

Scope and limitation of the study

This study covered only the observation on the effects of water irrigation management through lesser amount than conventional rice cultivation within 21 days only. Experimental methods were limited in a small-scale modeling through potting plots.

The variety of rice used in this study was inbred for higher resistance to diseases and other factors that may abrupt the experiment.

RESEARCH METHODOLOGY

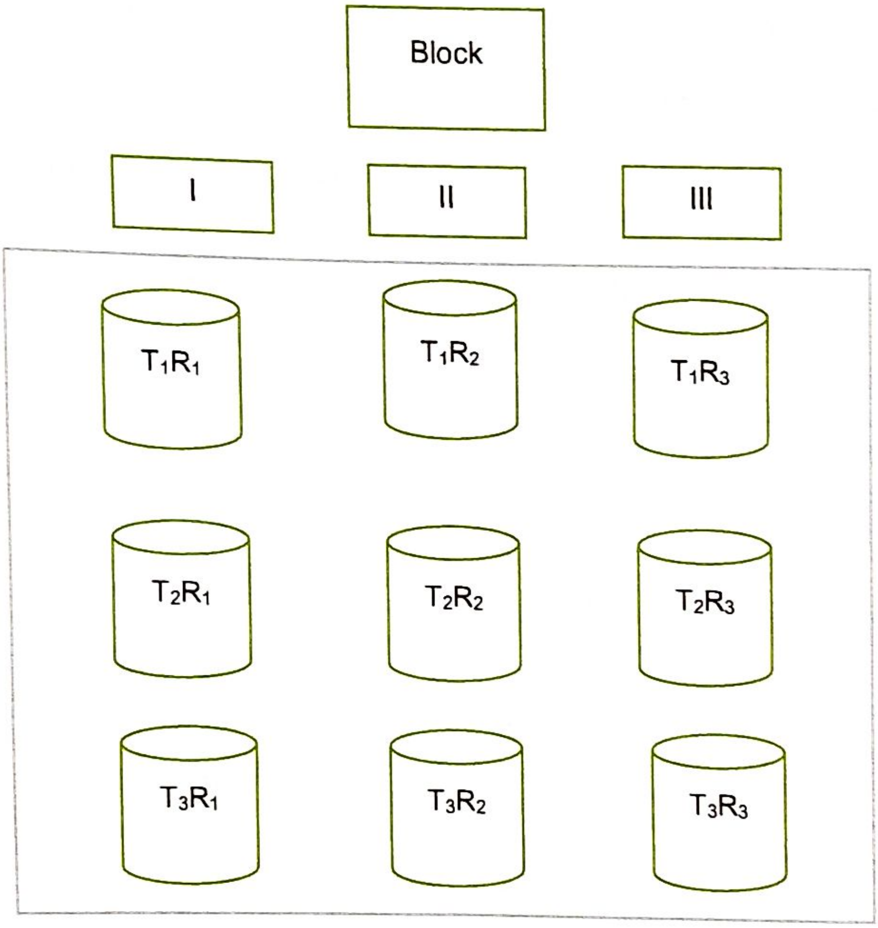
Research Environment

This study was conducted at the greenhouse facility (Figure1) in BISU Bilar Campus to prevent the crop used in the experiment from pest and severe weather conditions.

Figure 1. Experimental set up of pots for the three treatments

Research Design

This study used Randomized Complete Block Design (RCBD). There were three treatments with four replications each as shown in Figure 2.



Legend:

T_1 = 0 cm
T_2 = -5 (below ground surface)
T_3 = -10 (below ground surface)

Figure 2. Experimental lay-out of the study using Randomized Complete Block Design (RCBD)

Research Procedure

Inbred Seed Preparation. Seeds of inbred rice variety was collected at San Miguel, Dagohoy, Bohol then then dried under the sun for half day. Dried rice seeds were put inside the clean empty sack and soaked within 24 hours and covered with rice straw to maintain moisture and temperature to germinate the seeds. Germinated seeds (Figure 3) were spread in a seedbed allowing those to completely sprout within 3 weeks.

Figure 3. Germinated seeds of rice

Pot preparation. Upper part of 10-liter plastic bottle was cut as potting container. A transparent hose was inserted to the lower side of the pot for water level monitoring. Dried soil collected from rice field was filled into the pots with 7.5 kg of soil amount in each pot. There were 9 pots prepared for the 3 replications of 3 treatments. Figure 4 presents the preparation of experimental pots.

Figure 4. Preparation of experimental pots

Transplanting. Seedlings were transplanted into the appropriate containers after three weeks. Two hundred (200) ml of the liquid fertilizer solution was applied (Figure 5) to each pot after dissolving two tablespoons of 14-14-14 complete synthetic fertilizer in ten liters of water.

Figure 5. Fertilizer application

Irrigation of water. The different level of water 0, -5, -10 cm in corresponding containers and treatments were monitored through the attached observation tubing twice daily.

Figure 6. Application of water level using improvise water distributer

Collection of Data. Data collected include the parameters plant height (cm), number of leaves, and length of roots (cm). The processes in the data collection are the following:

1. **Height of the plant (cm)**. The data for plant height (cm) was collected (Figure 7) through measuring from the base of the plant up to the top of the leaves using ruler within 21 days only.

Figure 7. Collecting of plant height

2. **Number of Leaves.** The data for the number of leaves were collected (Figure 8) through counting of leaves within 21 days only.

Figure 8. Collecting of number of leaves

3. **Length of roots (cm)**. The data for the length of root (cm) were gathered (Figure 9) through measuring by pull out the plant from the base to the end of root within 21 days old only.

Figure 9. Measuring the length of roots

Statistical Treatment

The Growth Performance of inbred rice in different water levels indicate in the different treatments was using Analysis of Variance (ANOVA) in Complete Randomized Design (CRD).

DEFINITION OF TERMS

Analysis of Variance. Is a collection of statistical models and their associated estimation procedures used to analyze the differences among means.

Complete Randomized Design. Is one where the treatments are assigned completely at random so that each experimental unit has the same chance of receiving any one treatment.

Inbred Rice. A variety of pure line. It is the result of cross between two or more different varieties and subsequent selection through several cycles of self-pollination or breeding.

Treatment. The conditions applied to one or more groups that are expected to cause change in some outcome or dependent variable.

Wet seeded Rice. Is normally pre-germinated prior to broadcasting onto recently drained, well-puddled seedbeds or into pre-standing water in the fields.

Transparent hose. Is a simple device that is use in water level monitoring in the study.

Germinated Seeds. Is defined as the sum of events that begin with hydration of the seed and culminate in emergence of the embryonic axis (usually the radicle) from the seed coat.

Greenhouse. Building designed for the protection of tender or out-of-season plants against excessive cold or heat.

Water source. Is refers to bodies of water such as rivers, streams, lakes, and reservoirs that provide water to public drinking-water supplies and private wells.

Chapter 2

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

This chapter presents with the presentation, analysis and interpretation of the growth performance of inbred rice with different water levels.

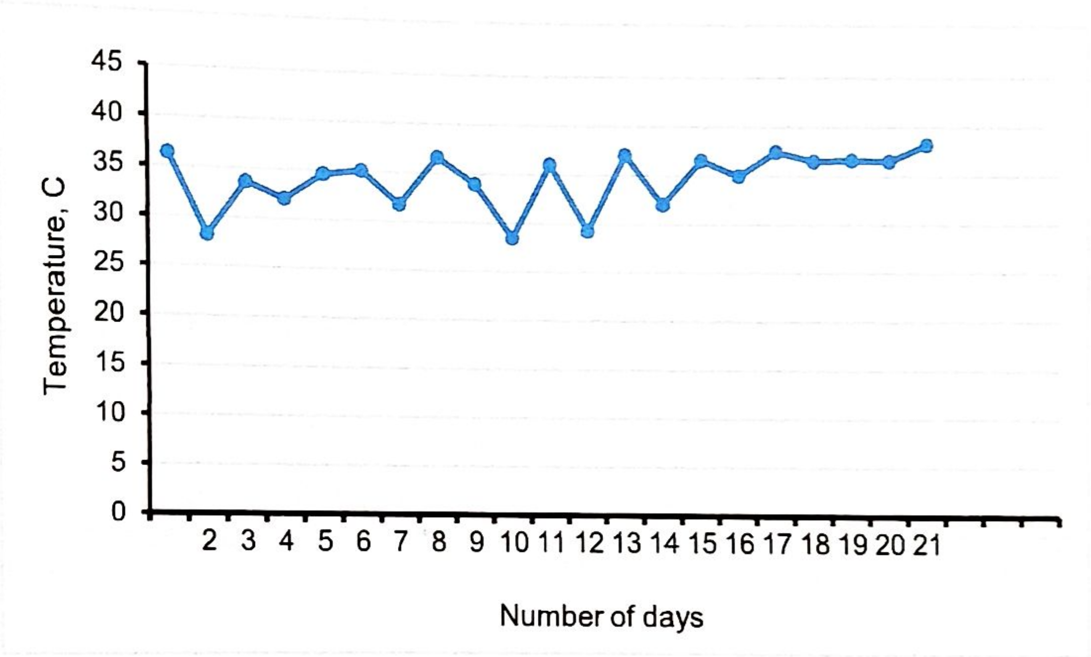


Figure 10. Average temperature inside the greenhouse

The data in the growth performance must be gathered are plant height(cm), number of leaves and length of root (cm).

Plant Height. Figure 11 shows the plant height of rice in different water levels. Based on the results, it was observed that T3 got the lowest plant height having a mean of 23.67, while T1 and T2 having a comparable result of 30.17 and 30 respectively.

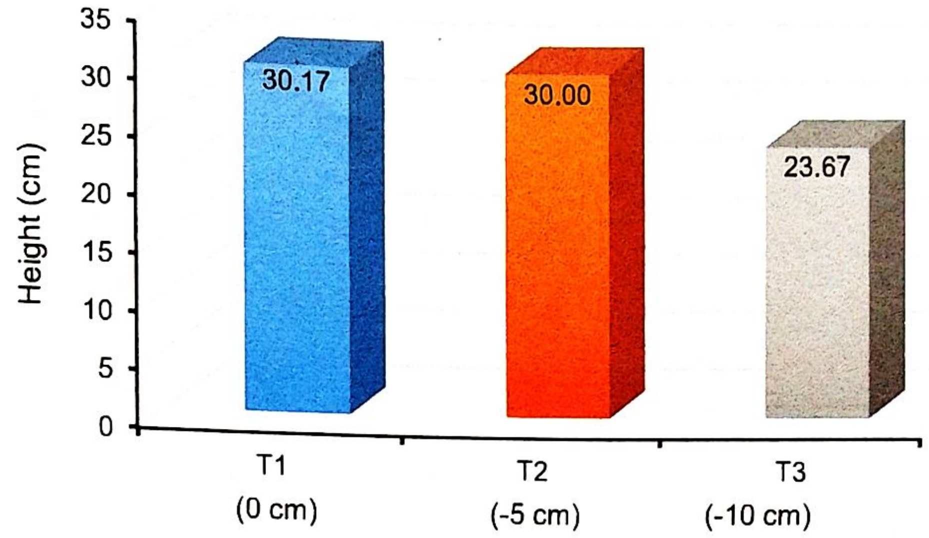


Figure 11. Plant height of rice in three different levels of water

Table 1

Analysis of Variance of the Plant Height of Rice

Source	Df	Sum of square	Mean square	F value	Pr (> F)
i.. treatment	2	82.3889	41.19944	1.63	0.2715
Error	6	151.3333	25.2222		
Total	8	233.7222			

No significant difference

Table 1 shows on the analysis of variance of the plant height (cm) applied with different water levels. Based on the statistical analysis showed that there is no significant different on the plant height of rice. This means that the different water levels not affected the plant height.

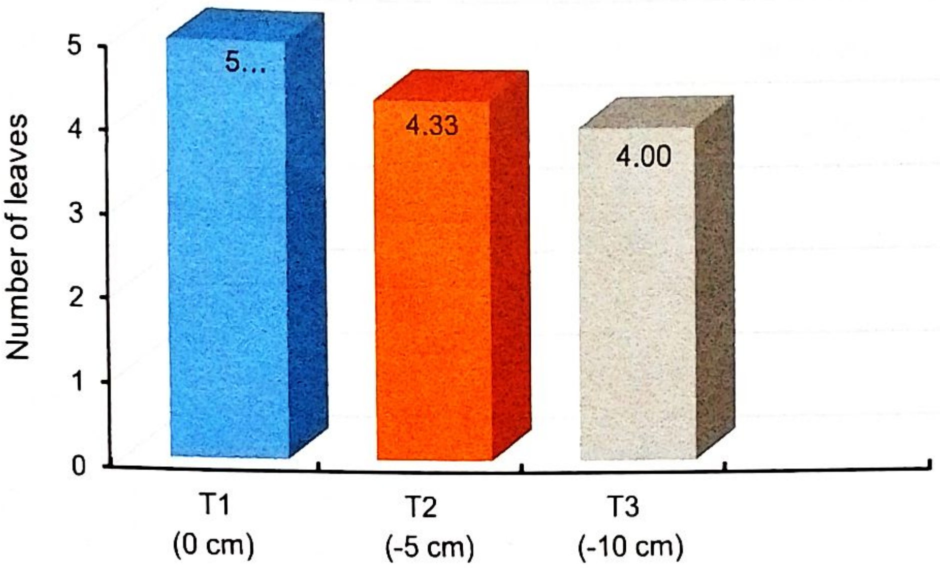


Figure 12. Number of leaves of rice in three different levels of water

Number of leaves. Shows the number of leaves of rice in different water levels. Based on the result, it was observed that T1 got the highest number of leaves having a mean of 5 leaves, T2 having a mean of 4.33 leaves and T3 having a mean of 4 leaves.

Table 2

Analysis of variance on the number of leaves

Source	Df	Sum of square	Mean square	F value	Pr (> F)
i.. treatment	2	82.3889	0.7778	1.75	0.2519
Error	6	151.3333	0.4444		
Total	8	233.7222			

No significant difference

Table 2 shows on the analysis of variance of the number of leaves applied with different water levels. Based on the statistical analysis showed that there is no significant different on the number of leaves of rice. This means that the different water levels not affected the number of leaves.

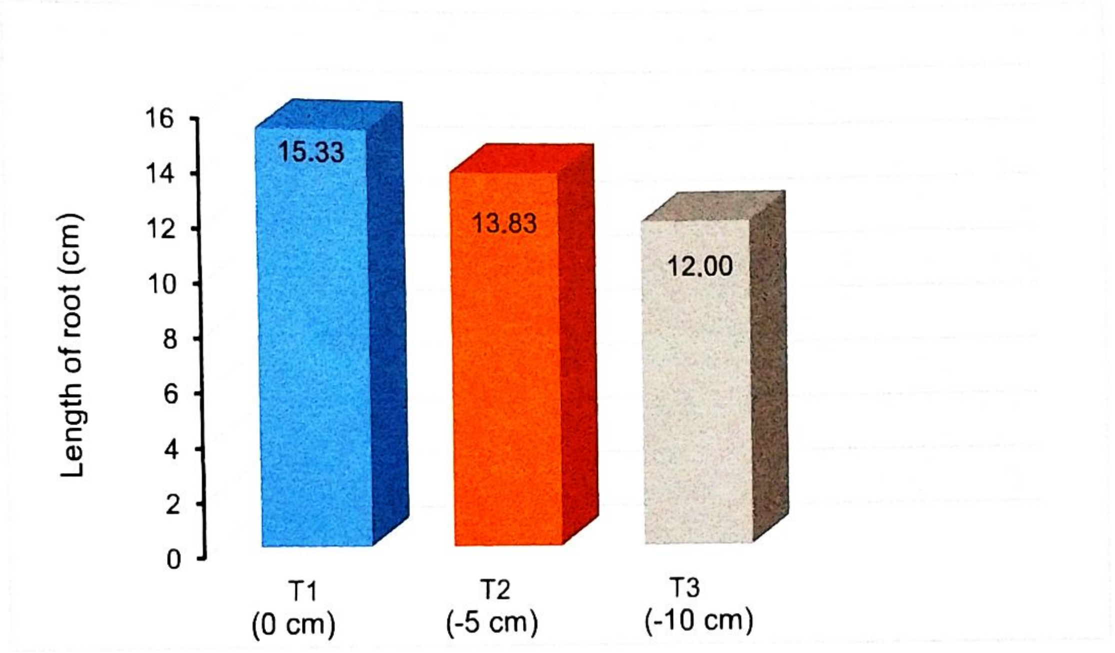


Figure 13. Length of roots of rice in three different levels of water

Length of Root. Shows the length of roots (cm) of rice in different water levels. Based on the results, it observed that T1 got the highest length of root having a mean of 15.33 cm, T2 having a mean of 13.83 cm and T3 having a mean of 12 cm.

Table 3 shows on the analysis of variance of the length of roots applied with different water levels. Based on the statistical analysis showed that there is no significant different on the length of roots of rice. This means that the different water levels not affected the length of roots.

Table 3

Analysis of variance on the length of roots

Source	Df	Sum of square	Mean square	F value	Pr (> F)
i.. treatment	2	16.7222	8.3611	0.29	0.7568
Error	6	171.8333	28.6389		
Total	8	188.5556			

No significant difference

Chapter 3

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of findings, conclusions and recommendations drawn from the findings.

Summary of Findings

Growth Performance of Rice

Height of the plant (cm). On the plant height of rice, there was no significant difference between treatments. This indicates that different water levels had no effect on rice plant height. It was also discovered that T1 had the highest mean and T3 had the lowest mean.

Number of leaves. On the number of rice leaves, there is no significant difference between treatments. This indicates that the number of leaves was unaffected by different water levels. It was discovered that T1 had the highest mean.

The Root's Length (cm). On the length of the rice root, there is no significant difference between treatments. This indicates that different water levels had no effect on the root length. It was discovered that T1 had the highest mean and T3 had the lowest mean.

Conclusions

The researcher reached his conclusions based on statistical analysis; however, the analysis of variance reveals that there is no significant difference between treatments in terms of plant height, number of leaves, and root length, but there is a possibility that we can see a difference if they have a longer time. The researcher accepts the null hypothesis because there is no significant difference between treatments in terms of plant height, number of leaves, and root length.

Recommendation

The following recommendations are formulated based on the study's findings;

1. Conduct the same research but have longer time in order to observe the optimum results.
2. Conduct similar study through in site to validate the results, using other variety to compare the results.
3. Conduct similar study including the yield performance to determine and observe the result of different water levels.

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Legal Basis

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Republic Act 9275. 2004. The Philippine Clean Water Act of 2004. Official Gazette. Congress of the Philippines.

APPENDICES

APPENDIX A

Letter

Republic of the Philippines
Bohol Island State University
BILAR Campus, Zamora, Bilar, Bohol

Vision: A premiere Science and Technology University for the formation of a world class and virtuous human resource for the sustainable development of Bohol and the country.
Mission: BISU is committed to provide quality higher education in the arts and sciences as well as in the professional and technological fields; undertake research and development and extension services for the sustainable development in Bohol and the country.

Dr. Marietta C. Macalolot
Campus Director
BISU Bilar Campus
Zamora, Bilar, Bohol

Ma'am:

Greetings!

As a requirement for graduation, we are currently conducting our individual thesis entitled "GROWTH PERFORMANCE OF INBREED RICE IN DIFFERENT WATER LEVELS" and "QUALITY OF COMPOST FROM VEGETABLE RESIDUES BY MILLIPEDES".

In this connection, we would like to request from your good office to allow us to **use the Greenhouse** as a venue, during weekdays. We are hoping for your approval with this request. Your usual support is of great help to realize our dream.

Thank you so much and GOD bless.

Respectfully yours,

ERVIN P. ECAT
BSABE Student

HILBETH JEAN T. MELENCION
BSABE Student

Noted by:

ENGR. ERWIN G. LUDEVESE
DABE Chairperson

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LAB. TECH

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Thesis Adviser

Approved by:

DR. MARIETTA C. MACALOLOT
Campus Director

APPENDIX B

RAW COLLECTION OF DATA

Treatment	Plant height(cm)			Number of leaves			Root length		
	R1	R2	R3	R1	R2	R3	R1	R2	R3
T1	24	29.5	37	5	5	5	9	18	19
T2	29.5	33	27.5	4	4	5	11	14.5	16
T3	19	23	29	3	5	4	5	19	12

TEMPERATURE INSIDE THE GREENHOUSE

DAY	AM	PM
1	36	36.7
2	27.4	29
3	35.6	31.7
4	27.3	36.7
5	38.5	30.8
6	36.7	33.5
7	32.7	30.8
8	36.8	36.5
9	36.4	31.5
10	27	30
11	36.1	36
12	30.1	28.5
13	37.7	36.5

14	35.5	28.5
15	36.7	36.5
16	34	36
17	36.7	38.3
18	36	37
19	36.5	36.8
20	36.5	36.5
21	38.5	38

APPENDIX D

Facts about Rice

Scientific Name: Oryza sativa L.

Genus: Oryza

Family : Gramine

Description:

Oryza sativa, commonly known as Asian rice, is the plant species most commonly referred to in English as rice. It is the type of farmed rice whose cultivars are most common globally, and was first domesticated in the Yangtze River basin in China 13,500 to 8,200 years ago. *Oryza sativa* is a grass with a genome consisting of 430Mb across 12 chromosomes. It is renowned for being easy to genetically modify and is a model organism for the botany of cereals. Rice (Oryza sativa L.) the staple food of about 70 million Filipinos and it is the most important crop in Asia., which contains over half the world's still expanding populations.

APPENDIX E

Facts about Water Sources

Water resources: The large range of climates encountered in the Region generates a variety of hydrological regimes. The Region is host to some of the most humid climates giving rise to major rivers, while in other parts it has a very arid climate, with closed hydrologic systems. As a result, the Region shows a very uneven distribution of its water resources and of its water use conditions. In the humid areas, water management concerns have mostly been dominated by considerations related to flood control. The hydrology of the Region is dominated by the typical monsoon climate which induces large inter-seasonal variations of river flows. Source water refers to bodies of water (such as **rivers, streams, lakes, reservoirs, springs, and ground water**) that provide water to public drinking-water supplies and private wells. Water sources can include: Surface water (for example, a lake, river, or reservoir).