



## The effect of soil treatment technology and watering technology on soil organisms in rice culture (*Oryza sativa* L.) m70d

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### Abstract

Soil organisms or commonly referred to as soil biota are all living things, which all or part of their life phases are in the soil or ecosystem. An ecosystem requires a balance between organisms that live in that place so that the mutualism symbiosis goes well, if there is no balance, various problems will arise such as pests and diseases that have a detrimental impact on the rice cultivation process. The purpose of this study was to determine the effect of tillage technology, and irrigation and their combination on the number and diversity of macro-organisms at a depth of 20 and 30 cm. This research was carried out in rice fields on Jalan Tondano Eris, East Tondana District, Minahasa Regency, North Sulawesi Province, using a randomized block design (RAK) as an environmental design and a split-plot design as a treatment design. Treatment of tillage (T) as the main plot with two factors: T1 = Perfect Soil Tilling (OTS), T2 = Minimum Tillage (OTM). Irrigation as a sub-plot (A) with three factors: A1 = Flooded irrigation  $\pm$  5 cm, A2 = Beselang irrigation and A3 = Macak-macak irrigation. Thus there were 6 treatments and each treatment was repeated three times so that there were 18 experimental units. The parameters observed were the number and diversity of species of macro organisms at a depth of 20 cm and 30 cm. The results showed that intermittent irrigation technology had a significant effect on species diversity and the number of macro organisms at 14 WAP and 34 WAP at a depth of 20 cm but had no significant effect on observations at 21, 42 WAP and on all parameters at a depth of 30 cm. influenced the diversity of species of macro organisms at 42 WAP observations and had no significant effect at 14, 21 and 34 WAP and all parameters at a depth of 30 cm, tillage technology and the combination of tillage technology and irrigation technology did not have a significant effect on all parameters both in the soil 20 cm and in the soil 30 cm.

**Keywords:** tillage technology, irrigation, macro soil organisms

### Introduction

Rice as the main commodity has a strategic meaning that gets priority in agricultural development because rice is the staple food for most Indonesian people, both in rural and urban areas. In the ecosystem, a balance is needed between organisms that live in that place, if there is no balance, various problems will arise, such as pests and diseases that have a detrimental impact on the rice cultivation process, so that inevitably farmers are forced to control with pesticides, Fitriani, (2016). While the use of pesticides causes organisms such as beneficial insects such as natural enemies to die, while through their role as natural enemies these organisms greatly assist humans in pest control and help in maintaining the stability of food webs in an agricultural ecosystem. Praddana *et al*, (2016)

Based on the results of interviews with several farmers and direct observations made in the rice fields owned by Tondano farmers on Jalan Eris in September 2020, information was obtained that the process of tillage for paddy fields which is generally applied in Tondano rice fields is a minimum tillage process where the processing of paddy fields is carried out starting from after harvesting the rice fields will continue to be irrigated to prevent the growth or expansion of weeds until before the land preparation for the next rice planting process, the rice fields will then be plowed or reprocessed with a tractor and will continue to be irrigated again until two or one day before the rice seed planting process This is done when the rice fields will be

dried or in a state of disorganization.

In addition, the process of sweeping or leveling the soil before the seed sowing process is generally not carried out optimally or even not carried out so that the irrigation process is uneven because the surface of the rice fields is uneven. so that the irrigation process is often a problem during the dry season and floods during the rainy season, the Tondano rice field area is a rainfed rice field area so that when the dry season the irrigation process is hampered or the rice field is dry due to a lack of water supply, generally the irrigation process applied by farmers in East Tondano is the irrigation pattern. flooded where the rice fields after a few days after planting will continue to be irrigated or flooded until a few days before harvest. The irrigation will certainly have a big impact on rice plants when the dry season approaches, especially in rainfed rice fields such as in South Tondano District. Previously, Gerungan and Pandelaki, (2019) <sup>[2]</sup> also conducted research in the South Tondano District area saying that continuous irrigation will be less than optimal and when the rice field area lacks water, coupled with reduced groundwater sources due to the transfer of forest functions.

Water management in lowland rice, of course, not only has an important effect on plant vegetative growth such as root growth which will encourage the number of tillers that will be produced by the clump (Harjani 2016) <sup>[4]</sup> but also affects the availability of organisms in the soil, Turmuktini and Simarmata (2016) <sup>[9]</sup> said that providing adequate water

controlled or controlled in a state that is not flooded or mack-macak (aerobic) will activate and increase the abundance (biodiversity) of soil organisms. With an abundance of organisms, it can improve soil structure by making channels or holes in the soil for example wormholes, and helping to stir and mix soil particles, so that aeration or soil air flow is better due to infiltration. and the movement of water in the soil and drainage can be improved.

Soil organisms in addition to forming soil texture as well as regulators of soil friability and soil structure. Soil structure is an arrangement of soil particles that are bound to each other to form lumps, besides that, soil organisms are also able to create soil pores that can loosen the soil so as to allow air to enter the soil or commonly called soil aeration. Soil pores can be formed due to the movement of soil organisms such as earthworms. These soil pores can help absorb water. Soil that has aeration and sufficient amount of water is very good for supporting plant growth (Granaststein (1998).

Given the importance of the role and existence of soil organisms, it is necessary to maintain their sustainability, soil organisms are able to encourage improvements in soil fertility through physical, chemical and biological improvements in soil according to plant needs, which will improve plant growth and production. Soil organisms, also known as soil biota, are all living things, both animals and plants, which are all or part of their life in the soil. Soil organisms are generally located in the upper soil layer, approximately 10 cm below the soil surface. With the presence of various soil organisms such as worms and plant roots, the formation of the soil texture can take place quickly because it can accelerate the breakdown of soil particles such as sand, clay, and dust (Susilawati, 2018) <sup>[11]</sup>.

Paddy land is land that is used to grow lowland rice, either continuously throughout the year or alternately with secondary crops. The term rice fields is not a taxonomic term, but is a general term such as forest land, plantation land, agricultural land and so on. All kinds of soil can be cultivated as long as sufficient water is available. Rice fields are also found in a variety of climates that are far more diverse than other types of crops. Therefore, it is not surprising that the nature of paddy fields is very diverse according to the nature of the original soil Hardjowigeno *et al* (2017).

Rice fields can come from dry land which is irrigated and then paddy, or from swamp land which is drained by making drainage channels. Rice fields whose water comes from irrigation water are called irrigated rice fields, while those that receive water directly from rain are called rain land rice fields. In the tidal areas, tidal rice fields are found, while those developed in the swampy areas of Lebak are called Lebak rice fields. Inundation during rice growth and tillage on dry paddy soils can cause various changes in soil properties, both morphological, physical, chemical, microbiological and other properties, so that soil properties can be very different from the properties of the original soil. Yartiwi *et al*, (2015) <sup>[12]</sup>.

## Materials and Methods

Processing aims to change the physical properties of the soil so that the originally hard layer becomes flat and muddy. That way weeds will die and rot into humus, better aeration of the soil, the subsoil becomes saturated with water so that

it can save water. In this paddy field cultivation, repairs and arrangements of rice fields and ditches are also carried out. Pematang (galengan) rice fields are strived to remain good to facilitate irrigation arrangements so as not to waste water and facilitate plant maintenance. According to Rachman *et al*. (2004), the action of tillage will produce good soil loose conditions for root growth, thus forming a structure and better soil aeration than without tillage. Minimum tillage can increase the efficiency of water use in the root area, protect the soil from rainwater and runoff and save time, cost, and energy (Lal, 1979). However, intensive tillage can reduce soil quality due to high soil porosity and decreased aggregate stability resulting in high evaporation.

Before planting, the soil must be processed first with the aim of: a) Creating better physical, chemical and biological soil conditions. b) Kills weeds and unwanted plants. c) Reducing the rate of erosion, d) Leveling and mixing mounds of soil to facilitate work. e) Mixing and leveling the fertilizer with the soil. f) Prepare irrigation and drainage arrangements. g) Killing insects, larvae and seeds of other pests and diseases by changing environmental conditions and sunlight. h) To make the ground muddy. i) Placing plant remains in appropriate places Mulyani, (2016).

Water management in rice cultivation is very important because it can affect the growth and production of rice. Biologically, water is very important for plant metabolic processes and soil biota can also act as a donor of oxygen dissolved in water for plants or soil biota when water conditions are saturated. Astuti (2010). Rice that lacks water will cause general symptoms such as leaf curling, leaf scorching, reduced rice tillers, stunted planting, delayed flowering, and empty seeds. decreased Subagyono *et al* (2008). Given this, the availability of water in the dry season will be an obstacle, especially in rainfed rice fields, of course, it will decrease. Therefore, irrigation technologies such as stagnant irrigation, intermittent irrigation and macak-macak irrigation are important to do in order to find out how to keep rice plants produced continuously. further need abundant water, Naharia *et all*, (2005) <sup>[6]</sup> said that excess water from irrigation water management can be used for other purposes such as increasing cropping intensity, expanding planting area, and reducing soil fallow, especially in the dry season, so irrigation technology needs to be carried out to overcome problems related to the irrigation process in rice fields during the dry season.

Rice historically came from India or Indochina and entered Indonesia brought by ancestors who migrated from mainland Asia around 1500 BC. Rice is one of the most important cultivated plants in civilization. Although it mainly refers to a type of cultivated plant, padi can also be used to refer to several species of the same genus (genus), commonly referred to as wild rice. World rice production has ranked third of all cereals, after maize and wheat. However, rice is the main source of carbohydrates for the majority of the world's population Ardianto *et al*, (2016) Rice is the most important cultivated plant in human civilization to meet basic needs, for this reason, in reality, rice ranks third of all cereals, after corn and wheat. According to Purnamawati and Purwono, (2002) rice is an ancient agricultural plant originating from two continents, namely Asia and West Africa. Historical evidence can show that rice cultivation in Zheziang (China) began in 3000 BC. Fossil grains of rice and grain were found in Hastinapur Uttar Pradesa (India) around 100 to 800 BC. AKK (1980)

According to him, rice is one type of food ingredient where the food contains nutrients and is also capable of being a sufficient booster for the human body, because rice itself contains ingredients that are easily converted into energy. Therefore, rice is also known as energy food. The nutritional value required by each adult is 1,821 calories. If these needs can be equated with rice, then 0.88 kg of rice is needed every day.

Each rice flower has six anthers and a two-branched stigma (stigma) in the shape of a bottle brush. Both sexual organs are generally ready for reproduction at the same time. The anthers sometimes come out of the palea and lemma when they are ripe.

Soil is a medium where plants grow. Soil is also a habitat for various organisms that live in it. Between plants and organisms in the soil there is a very close interdependence relationship. Therefore the population of soil organisms is determined by the quality of the vegetation on it. On the other hand, the activity of organisms in the soil will also affect plant growth, which in turn will determine the productivity of the land in which they live. (According to BIS 2010) organisms that inhabit soil ecosystems are estimated to account for a quarter of all organisms on earth. It is illustrated that in a teaspoon of fertile soil can be found thousands of species, billions of individual bacteria and hundreds of meters of fungal hyphal tissue.

Biomass of soil organisms is an index of soil fertility. Soil which contains many kinds of organisms, in general it can be said that the soil has good physical and chemical properties, Susilawati *et al.*, (2018)<sup>[11]</sup>. The high population of organisms and the diversity of organisms is only possible in soils with properties that allow these organisms to be active and thrive, such as the availability of sufficient nutrients, suitable soil pH, good aeration and drainage, sufficient air and sufficient sources of energy (organic matter). There are several factors that must be met so that the soil can grow and develop Iswandi (2015)<sup>[5]</sup>.

The formation of organismal biomass is also influenced by a number of other factors, namely temperature, humidity, and the presence of clay minerals (Joergensen *et al.*, 2013). In addition, climate, crops, and soil management practices such as crop rotation, use of fertilizers, plant waste treatment and soil management also influence the formation of organismal biomass by Hendro and Robertson (1994). Meanwhile, according to Granatstein *et al.*, (1998)<sup>[3]</sup> stated that the biomass of organisms was significantly higher in the untreated surface layer because it had more plant residues, because the input of organic matter was higher in that layer.

This research was carried out from October 2020 to January 2021 in rice fields on Jalan Tondano Eris, East Tondano District, Minahasa Regency, North Sulawesi Province. The tools used in this research are; trektors, hoes, machetes, bamboo for stakes, rapia ropes, rulers, pens, books, and sample rings measuring 40cm X 40cm, while the materials used are M70D rice varieties and fertilizer

This research was carried out using a randomized block design (RAK) as an environmental design and a split-plot design as a treatment design. Treatment of tillage (T) as the main plot with two factors: T1 = Perfect Soil Tilling (OTS), T2 = Minimum Tillage (OTM). Irrigation as a sub-plot (A) with three factors: A1 = Flooded irrigation  $\pm$  5 cm, A2 = Beselang irrigation and A3 = Macak-macak irrigation. Thus there were 6 treatments and each treatment was repeated three times so that there were 18 experimental units. One

experimental plot measuring 4 x 6 m, and the placement of all treatments in the experimental plot was done randomly.

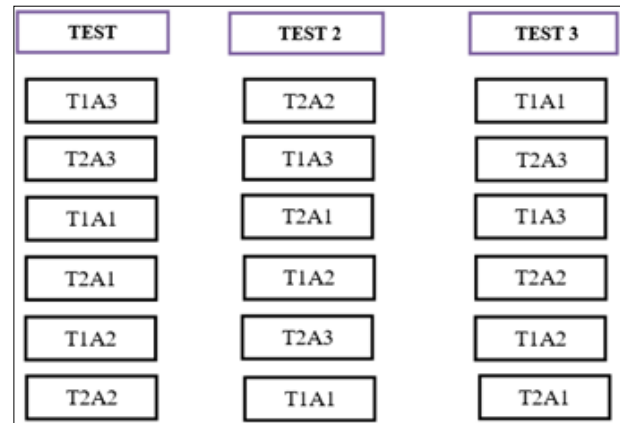


Fig 1: Rice Field Trial Test

The replicated rice fields were carried out 3 times, thus the number of experimental units was  $2 \times 3 \times 3 = 18$  units.

### Research Procedure

The research procedure was carried out in five stages, namely: 1. Land Preparation. Starting with the determination of the land and then measuring it, then making 3 replications of the blog with each replicated blog consisting of 6 replicated subplots. Between the replicated blogs, a distance of 1 meter was given as a water channel as well as the subplots for each experimental plot measuring 4 m x 6 m, between the replicates a 30 cm wide irrigation channel was made. 2. Soil Processing Consists of: a) Perfect Tillage (T1) Complete tillage, the process of tillage is carried out by dismantling the soil or rice fields twice and then leveling them and then irrigating or T1 treatment, tillage is carried out in two stages on macak macak soil conditions, then leveled and flooded for several days before planting. b) Minimum Tillage (T2). Minimum tillage, the processing is done by removing the soil only once, namely the soil is dismantled and then leveled, then watered a few days before planting the land has been processed. Irrigation Consists of: a) Flooded Irrigation (A1) The irrigation treatment for sub-plots was flooded, namely the experimental plots were flooded continuously with a maximum water level of 5 cm during the growth period until two weeks before harvest. b) Intermittent Watering (A2) The irrigation treatment for intermittent plots was experimental plot A2/intermittent inundated with water as high as approximately 5 cm at 02-07 days after planting, 08-15 DAP experimental plot A2/intermittent in a dry/drying state, then 16-28 days after planting. After planting, the plot A2/intermittent was again flooded with water as high as 5 cm, on the 29-35th day after planting, the experimental plot was re-dried, then at 36 DAP the irrigation of the experimental plot A2/intermittent was again carried out until two weeks before harvest, the experimental plot was dried again. c) Watering Macaks The irrigation treatment for macak-macak subplots was that the experimental plots were kept in a muddy state, not dry or inundated (saturated with water).

Seeding and Planting. Before sowing, the M70D rice seeds are soaked for 24 hours and then ripened for three days after which the germinated seeds are sown in the paddy fields that have been prepared as nurseries. Seedling is carried out

for a maximum of 19 days, then transferred to plots that have been prepared in macak-macak conditions. Rice is planted with a spacing of 20-25 cm x 20-25 cm, three seeds are planted in each planting hole. For each 4 x 6 experimental plot consisting of six hundred (600) planting holes or six hundred planting holes.

The maintenance of experimental rice plants was carried out by maintaining plants such as giving fertilizer twice. Before the fertilization process is carried out, the weeding / grass maintenance process is carried out manually (pulling). After the experimental plot was clean, the fertilization process was carried out.

**Observed Parameters**

**Macro Organisms**

Data collection or observation of the type and population of macro organisms is carried out before land processing is carried out as initial data into the soil 20 cm and 30 cm using a tool or sample ring and three times after rice is planted, namely at 14 days after planting / DAP 21 DAP and 42 post-planting period (DAT) but only the type and population of macro organisms were observed. Observations of the organism were carried out for each child of the experimental replicate plot.

**Data Analysis**

Observational data were analyzed using Univariate analysis of variance (ANOVA), namely the General Linear Model (GLM) and the results of the analysis were further tested using the LSD test using the SPSS statistical program version 23.0

In this study the hypothesis is symbolized by

Ho:  $\mu_1 = \mu_2$

H1:  $\mu_1 \neq \mu_2$

Significant value,  $\alpha = 0.05$

The significance of the analyzed data is based on the following

1. If the significant value is  $> 0.05$  then the null hypothesis is accepted, and the research hypothesis is rejected
2. If the significant value is  $< 0.05$ , the null hypothesis is rejected and the research hypothesis is accepted.

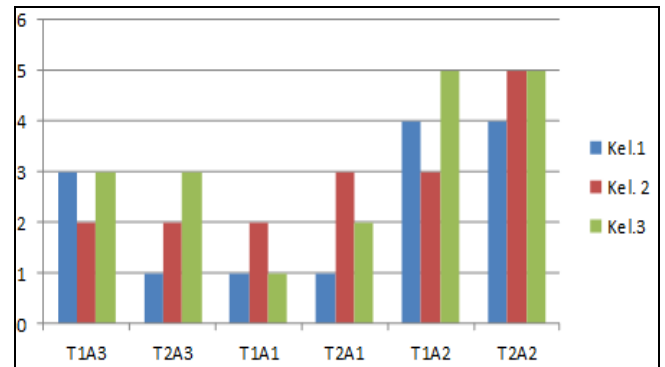
**Results and Discussion**

The data of this study were taken from 18 experimental units where there were 6 treatments, each treatment was repeated 3 times. Data for the diversity and types of soil macro organisms were obtained through observations at a depth of 20 cm and 30 cm for four observations using a sample ring.

**1. Data on Species Diversity and Number of Macro Organisms 14 DAP**

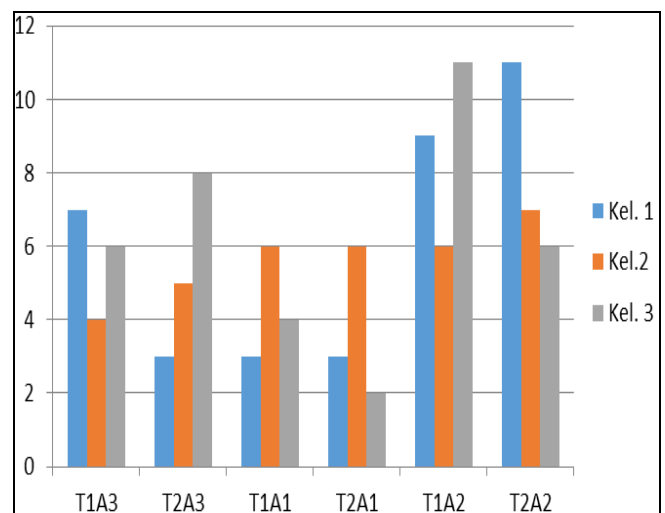
The following is a data regarding the number of macro organisms in each replication at the first observation 14 HST at a depth of 20 CM. The data obtained for the diversity of species of organisms within 20 cm at 14 days after planting (DAP) showed that the significance value of tillage technology was 0.553 or  $T > 0.05$ , the significance value of irrigation technology was 0.000  $< 0.05$ , and the significance value of the combination of tillage technology, soil and irrigation technology is 0.267 or  $T^*A > 0.05$ , so tillage technology and the combination of tillage technology and irrigation technology have no significant effect on the

number of species diversity of organisms at 14 days after planting, while tillage technology significantly affects the amount of species diversity. Organisms at 14 days after planting, and based on the results of statistical analysis of the number of macro-organisms diversity at 14 days after planting, there was no significant difference for the number of macro-organisms diversity at a depth of 20 cm where tillage technology, and the combination of tillage technology and irrigation technology had a Fh value.  $< F_t$  i.e. technology of soil  $ah\ 0.377 < 6.49$ , a combination of tillage and irrigation technology  $1.509 < 6.49$  and irrigation technology  $19.623 > 4.10$ .



**Fig 2:** Percentage of species diversity three replicates at 14 DAP

In general, the percentage of sepsis strain when replicates were carried out at 14 days after planting can be seen in fig 2 where the most varied treatment in the number of sepsis lies in the perfect tillage technology (OTS) treatment in the study, symbolized by T2 combined with intermittent irrigation. (A2) where at the time of sampling the land was dry, then the minimum tillage technology (OTM) or T1 treatment was combined with intermittent irrigation/A2 and the most dominant organisms in both treatments were ants and small caterpillars, while the percentage of diversity the least species were in the T1A1 treatment or minimum tillage combined with alternating irrigation/A1 and generally dominated by organisms such as snails and water beetles, these two organisms also dominated the macak-macak or A3 irrigation treatment in the first observation and even subsequent observations.



**Fig 3:** Total Number of organisms at 14 (DAP)

The data obtained for the number of macro organisms at 14

days after planting (DAT) showed that the significant value of tillage technology was 0.631 or  $T > 0.05$ , the significant value of irrigation technology was 0.029 or  $A < 0.05$ , the combined value of tillage technology and irrigation technology was 0.0990 or  $N^*A > 0.05$ . So that tillage technology, and the combination of tillage technology and irrigation technology did not significantly affect the diversity, number and types of soil macro organisms at 14 days after planting, while irrigation technology significantly affected the diversity, number and types of soil macro organisms at 14 days after planting. plant. This is also proven based on the results of statistical analysis of the number of organisms at 14 days after planting where tillage technology, irrigation technology, and a combination of tillage and irrigation technology have a value of  $F_h < F_t$ , namely tillage technology  $0.246 < 4.96$  irrigation technology  $5.138 > 4.10$  a combination of technology tillage and irrigation technology  $0.010 < 4.96$ .

2. Data on Species Diversity and Number of Macro Organisms 21 DAP

The diversity of organisms within 20 cm at 21 days after planting (MST) indicates that the probability value of the significance of tillage technology is 0.777 or  $T > 0.05$ , the significance value of irrigation technology is 0.571  $> 0.05$ , and the significance value of the combination of tillage technology and irrigation technology of 0.919 or  $T^*A > 0.05$ , so that tillage technology, irrigation technology, and the combination of tillage technology and irrigation technology did not significantly affect the amount of diversity of organisms at 21 days after planting, as well as evidenced by the results of statistical analysis of the number of species diversity. macro organisms at 21 days after planting were not significantly different for the number of macro organisms diversity at a depth of 20 cm where tillage technology, irrigation technology and a combination of tillage technology and irrigation technology had  $F_h < F_t$  values, namely tillage technology  $0.085 < 6.49$ , irrigation technology  $0.593 < 4.10$ . combination of tillage and irrigation technology  $0.085 < 6.49$ .

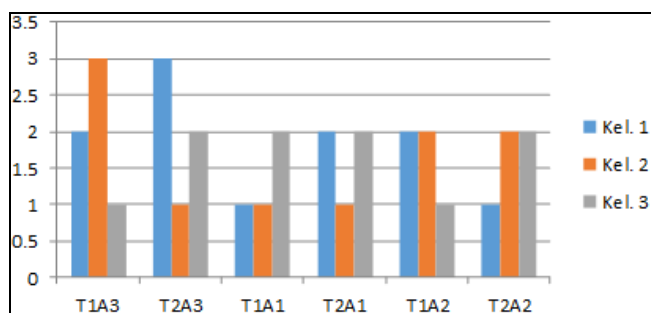


Fig 4: Percentage of species diversity three replicates at 21 DAP

The second observation made obtained the percentage of species diversity as shown in graph 4.3, where none of the treatments in this observation had a significant effect on the amount of diversity in the type of macro organism sepsis in the treatment and replications carried out, seen from the graph it can be concluded that in general the most organisms are in the T1A3 and T2A3 treatments or minimum tillage technology (OTM/T1) combined with macak-macak irrigation technology (A3) and perfect tillage technology (OTS/T2) treatment combined with macak-macak irrigation technology (A3), and the dominant organisms in both

treatments were small snails and water beetles, not much different from the other four treatments, the dominant organisms were also dominated by mussels and water beetles. The intermittent irrigation treatment at the time of the second observation was carried out in an irrigated or stagnant state so that the number of organisms in the sepsis species in the treatment was approximately the same as the organisms in the flooded irrigation treatment, both in number and diversity of organisms.

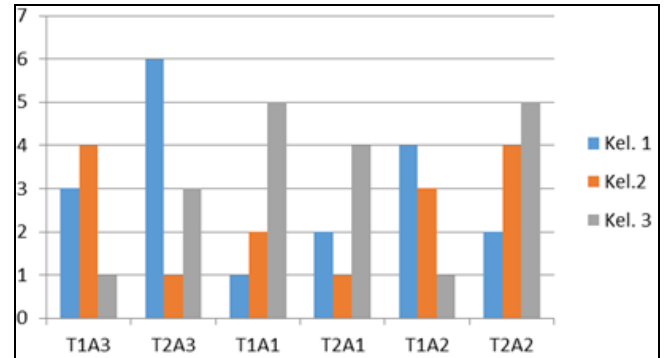


Fig 5: Number of organisms at 21 (DAP)

The number of macro organisms at 21 days after planting (DAP) showed that the probability value of tillage technology was 0.641 or  $T > 0.05$ , the probability value of irrigation technology was 0.832 or  $A < 0.05$ , the probability value of the combination of tillage technology and irrigation technology was 0.832 or  $T^*A > 0.05$ . So that tillage technology, irrigation technology, and the combination of tillage technology and irrigation technology did not significantly affect the diversity, number and types of soil macro organisms at 21 days after planting, and based on statistical analysis results the number of organisms at 21 days after planting had no significant effect. for diversity, number and types of macro organisms where tillage technology, irrigation technology, and a combination of tillage and irrigation technology have a value of  $F_h < F_t$ , namely tillage technology of  $0.231 < 4.96$ , irrigation technology of  $0.187 < 4.10$ , and a combination of tillage technology. soil and irrigation technology of  $0.231 < 4.10$ .

3. Data on Species Diversity and Number of Macro Organisms 34 DAP

The diversity of organisms within 20 cm at 34 days after planting (DAP) indicates that the probability value of the significance of tillage technology is 0.308 or  $T > 0.05$ , the significance value of irrigation technology is  $0.002 < 0.05$ , and the significance value of the combination of tillage technology and irrigation technology of 0.690 or  $T^*A > 0.05$ , so that tillage technology and the combination of tillage technology and irrigation technology did not significantly affect the number, diversity of organisms within 20 cm at 34 days after planting, while tillage technology significantly affected the amount of diversity types of organisms at 34 days after planting, and based on the results of statistical analysis of the diversity of macro-organisms at 34 days after planting. Tillage technology and the combination of tillage technology and irrigation technology were not significantly different for the number of macro-organisms diversity at a depth of 20 cm where tillage technology, and the combination of tillage technology and irrigation technology had a value of  $F_h < F_t$ ,

i.e. tillage technology  $1.154 < 6.49$ , the combination of tillage and irrigation technology  $0.385 < 6.49$  and irrigation technology which had a significant effect on the number, diversity of macro organisms at 34 DAP had a value of  $11.923 > 4.10$ .

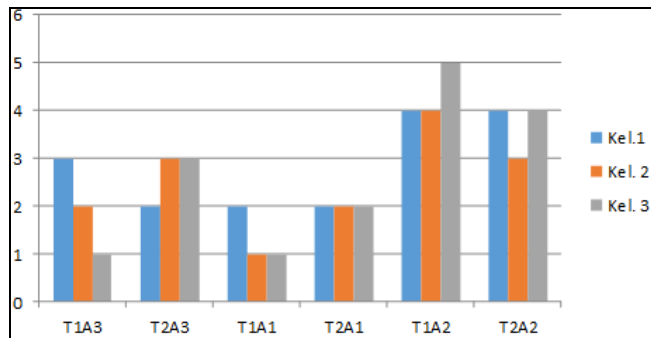


Fig 6: Percentage of species diversity three replicates at 34 DAP

The third observation was when the treatment pattern of tillage technology was combined with intermittent irrigation technology in a state of drying treatment pattern so that both the number and diversity of species of macro organisms in the intermittent irrigation treatment as well as the flooded and macak-macak irrigation treatments were more or less the same as those that existed. In the first observation, the dominant organisms in the second irrigation treatment were small caterpillars and ants, while in the macak-macak and inundated water treatment organisms were dominated by organisms such as snails and water beetles. For more details, see fig 7. and the diversity of types of macro sepsis in the third safety test 1, 2 and 3.

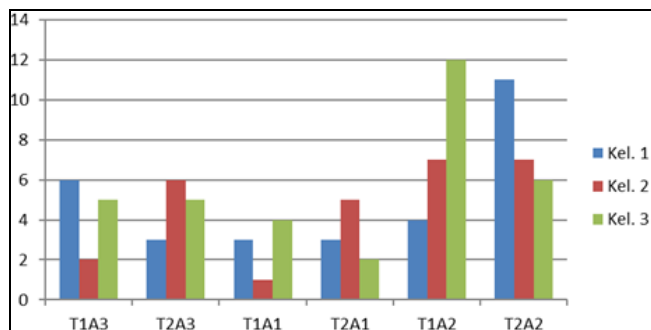


Fig 7: Number of organisms at 34 (DAP)

The number of macro organisms at 34 days after planting (DAT) showed that the significant value of the probability of tillage technology was  $0.722$  or  $T > 0.05$ , the significant value of the probability of irrigation technology was  $0.024$  or  $A < 0.05$ , the combined value of tillage technology and irrigation technology was  $0.992$  or  $T^* A > 0.05$ . So that tillage technology, and the combination of tillage technology and irrigation technology did not significantly affect the diversity, number and types of soil macro organisms at 34 days after planting, while irrigation technology significantly affected the diversity, number and types of soil macro organisms at 34 days after planting. Plant. This is also proven based on the results of statistical analysis of the number of organisms at 34 days after planting where tillage technology, irrigation technology, and

a combination of tillage and irrigation technology have a value of  $F_h < F_t$ , namely tillage technology  $0.134 < 4.96$  irrigation technology  $5.545 > 4.10$  a combination of technology tillage and irrigation technology  $0.008 < 4.96$ .

4. Data on Species Diversity and Number of Macro Organisms 42 DAP

The amount of diversity of organisms within 20 cm at 42 days after planting (MST) shows that the probability value of the significance of tillage technology is  $0.599$  or  $T > 0.05$ , the significance value of irrigation technology is  $0.023 < 0.05$ , and the significance value of the combination of tillage technology and technology irrigation is  $0.178$  or  $T^* A > 0.05$ , so that tillage technology and the combination of tillage technology and irrigation technology have no significant effect on the number, diversity of organisms within 20 cm at 34 days after planting, while tillage technology has a significant effect on the number of diversity of organisms at 42 days after planting, and based on the results of statistical analysis of the diversity of macro organisms at 42 days after planting. Tillage technology and the combination of tillage technology and irrigation technology were not significantly different for the number of macro-organisms diversity at a depth of 20 cm where tillage technology, and the combination of tillage technology and irrigation technology had a value of  $F_h < F_t$ , i.e. tillage technology  $0.294 < 6.49$ , a combination of tillage and irrigation technology  $2.059 < 6.49$  and irrigation technology that has a value of  $F_h < F_t$  of  $5.588 > 4.10$ . so it was concluded that irrigation technology had a significant effect on the number and diversity of macro organisms at 42 days after planting.

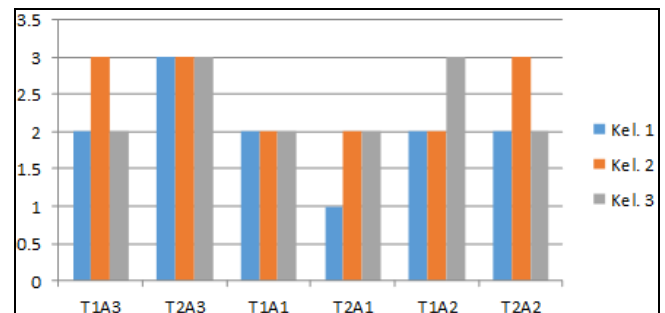


Fig 8: Percentage of species diversity three replicates at 42 (DAP)

Unlike in the second observation, in the fourth observation, irrigation technology has a real effect on the diversity of macro organisms. In this observation the diversity of the number of sepsis was in the treatment of perfect tillage technology combined with macak-macak irrigation technology or T2A3 and the organisms were still dominated by snails, while in the second treatment the tillage technology combined with the pattern of intermittent irrigation technology was in a flooded state but the organisms that were The dominant in both treatments were small caterpillars, while in the treatment of tillage technology combined with the pattern of treatment of stagnant watering technology, snail organisms were dominated by the same as in the macak-macak irrigation treatment.

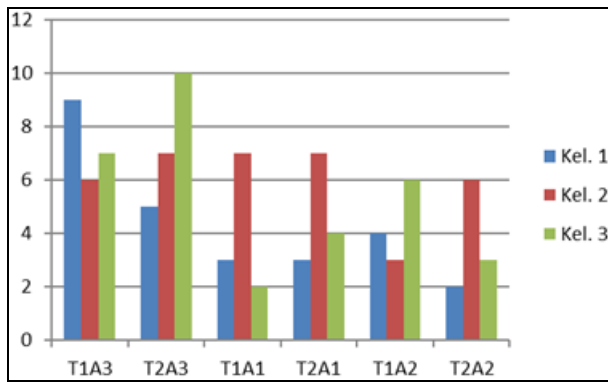


Fig 9: Number of organisms at 42 (DAP)

The number of macro organisms at 42 days after planting (DAP) showed that the significant value of the probability of tillage technology was 1,000 or  $T > 0.05$ , the significant value of the probability of irrigation technology was 0.040 or  $A < 0.05$ , the combined value of tillage technology and irrigation technology was 0.864 or  $T^* A > 0.05$ . So that tillage technology, and the combination of tillage technology and irrigation technology did not significantly affect the diversity, number and types of soil macro organisms at 42 days after planting, while irrigation technology significantly affected the diversity, number and types of soil macro organisms at 42 days after planting. This is also proven based on the results of statistical analysis of the number of organisms at 42 days after planting where tillage technology, irrigation technology, and a combination of tillage and irrigation technology have a value of  $F_h < F_t$ , namely tillage technology  $0.000 < 4.96$  irrigation technology  $4.505 > 4.10$  a combination of technology tillage and irrigation technology  $0.149 < 4.96$ .

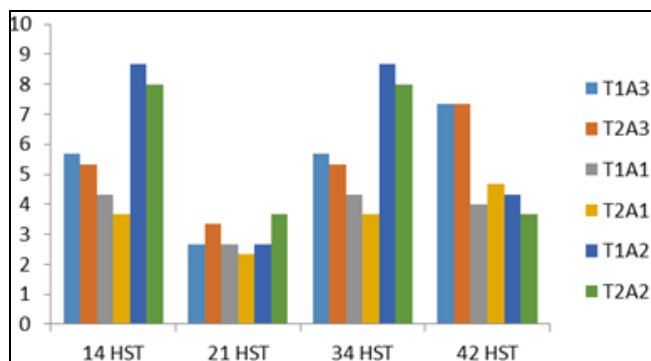


Fig 10: Total number of organisms in the four HST observations

Overall the percentage of the total number of organisms in the four observations can be seen in graph 4.9. where the graph shows that the total number of organisms is highest in the first and third observations, and the least is in the second observation.

Tillage technology, irrigation technology and a combination of tillage technology and irrigation technology did not significantly affect the number of organisms on the fourth observation 42 days after planting, but irrigation technology had a significant effect on the diversity of macro species at 20 cm deep soil. Flooded irrigation technology and macak-macak irrigation technology affect the diversity of species of macro organisms. Although the amount of species diversity in the treatment of drinking tillage technology combined with macak-macak irrigation technology and the

amount of species diversity in the minimum tillage technology treatment combined with flooded irrigation technology, each treatment had only three types of organisms. different organisms, but the total number of organisms differed quite a lot, namely in the T1A3 treatment there were a total of 22 organisms, while in the T1A1 treatment there were only 12 organisms. This is thought to occur because in the macak-macak irrigation treatment oxygen is more likely to enter the soil because the water level is not too high, while in the T1A1 treatment it is difficult for oxygen to enter the soil due to continuous waterlogging of the land or rice fields as a result the activities of aerobic organisms are disrupted., the same thing was also expressed by Regazzoni., *et al* (2016) [8] said that conventional irrigation is a technique of continuous inundation of water, puddles of water on the plot will cause nutrients to drift along with water and land inundation also causes the activities of aerobic organisms to be disturbed because they do not the presence of oxygen in the soil.

Macro organisms that are commonly found in the soil 20 cm have not been found at a depth of 30 cm in all observations made so that it can be concluded that tillage technology, irrigation technology and the combination of tillage technology and irrigation technology have no significant effect on the number and diversity species of macro organisms at a depth of 30 cm, this is presumably due to the availability of nutrients and frequent land management. According to Granatstein *et al*, (1998) [3] stated that the biomass of organisms was significantly higher in the untreated surface layer because it had more plant residues, because the input of organic matter was higher in that layer.

**Conclusions**

Based on the results of research and discussion, it can be concluded that:

1. Tillage technology gives the soil an effect that is not significantly different on all parameters of the number and diversity of species of macro organisms at a soil depth of 20 cm or within 30 cm
2. Irrigation technology had a significant effect on the parameters of the number and diversity of species of macro organisms in the soil 20 cm at 14 WAP, 34 WAP and 42 WAP, but had no significant effect at 21 WAP and did not have a significant effect on all parameters at a depth of 30 WAP. cm
3. The combination of tillage technology and irrigation technology has no significant effect on all parameters of the number and diversity of species of macro organisms at a soil depth of 20 cm or at a depth of 30 cm.

**References**

1. Adrianto J, Harianto dan Hutagaol MP. Peningkatan Produksi Padi Melalui Penerapan Sri (System Of Rice Intensification) di Kabupaten Solok Selatan. Jurnal Agribisnis Indonesia halaman Program Studi Ilmu Ekonomi Pertanian, Sekolah Pascasarjana: Institut Pertanian Bogor,2016:4(2):107-122.
2. Gerungan R.A.dan Pandelaki M.C.T. Pengaruh Rekayasa Pengairan Terhadap Produktivata Budidaya Padi (Oryzasativa) Sawah. Proqram Studi Agribisnis. Universitas Sariputra Indonesia Terbuka Tomohon, 2019.
3. Granatstein DM, Bezdicek DF, Cohran LF, Hammel J. Long Term Tillage and Ratation Effects On Soil

- Microbial Biomassa Carbon and Nitrogen Biol.Fertil.Soil, 1998.
4. Harjani RA. Sistem Pengairan Intermitten (SRI) Terhadap Pertumbuhan dan Hasil Padi. Makalah Seminar Umum (PNB4080) Semester 1 Tahun Akademik 2016/2017. Fakultas Pertanian UGM, 2016.
  5. Iswandi ADA, Santoso Widyastuti R. Penggunaan Ciri Mikroorganisme dalam Mengevaluasi Degradasi Tanah. Kongres Nasional VI HITI, 2015.
  6. Naharia Orbanus, Saeni MS, Sabihan S, dan Burhan H, Teknologi Pengairan dan Pengolahan Tanah pada Budidaya Padi Sawah untuk Mitigasi Gas Metana (CH<sub>4</sub>). Disetasi. Pengelolaan Sumber Daya Alam dan Lingkungan. Institut Pertanian Bogor, 2005.
  7. Pradhana RAI, Mudjiono G, dan Karinda S. Keanekaragaman Serangga dan Laba-laba pada Pertanaman Padi Organik dan Konvensional. Jurnal HPT 2(2). ISSN 2338-4336, 2016.
  8. Regazzoni OY, Sugito dan A Suryanto. Sistem Irigasi Berselang (Intermittent Irrigation) pada Budidaya Padi (Oryza sativa L.) Varietas Inpari-13 dalam Pola Sri (System Of Rice Intensification). Jurnal Produksi Tanaman MEI 2016 ISSN: 2338-3976. Jurusan Budidaya Pertanian, Fakultas Pertanian, Universitas Brawijaya, 2016, 1(2).
  9. Simarmata T, dan Turmuktini T. Peran Kelimpahan Mikroba Tanah dalam Sistem dalam Budidaya Intensifikasi Padi Aerob Terkendali Berbasis Organik (IPAT-BO) untuk Peningkatan Pertumbuhan dan Produktivitas Padi di Indonesia. Fakultas Pertanian Prodi Agrotek: Universitas Winaya Mukti, 2016.
  10. Suddin S, Mokosuli YS, Marcelina W, Orbanus N, Ardi K, Molecular barcoding based 16S rRNA gene of Thermophilic bacteria from vulcanic sites, Linow Lake, Tomohon. In Materials Science Forum Trans Tech Publications Ltd,2019:967:83-92.
  11. Susilawati, Mustoyo, Budhisurya E, Anggono RCW, Simanjuntak BH. Analisis Kesuburan Tanah dengan Indikator Organisme Tanah pada Berbagai Sistem Penggunaan Lahan Plateau Dieng. Jurnal AGRIC. Fakultas Pertanian dan Bisnis UKSW: Salatiga, 2018, 25(1).
  12. Yartiwi Romeida A, Utama SP. Uji Adaptasi Varietas Unggul Baru padi Sawah untuk Optimasi Lahan Tadah Hujan Berwawasan Lingkungan di Kabupaten Seluma Provinsi Bengkulu. Jurnal Penelitian Pengelolaan Sumberdaya Alam dan Lingkungan ISSN: 2302- 6715: Jurusan Agroekoteknologi Fakultas Pertanian UNIB, 2015.