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# Weeds community structure on the rice field (*Oryza sativa* L.) in bulusari village, Sayung district, Demak regency

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**Abstract.** Rice weeds are disturbing plants that grow together with rice and otherwise well-controlled, it will reduce the quantity and quality of crops. The aim of this research is to analyze the community structure of weed rice in 8-week-old. Benefits of this research are expected to provide information about the types of rice weeds and their characteristics. Research was conducted in June 2018 in Bulusari Village, Sayung District, Demak Regency; and Ecology and Biosystematics Laboratory, Biology Departement, Diponegoro University. Method of this research is a random sampling method used a plot sized 1 m x 1 m as many as 18 plots. Results of the research were the highest Important Value Index is *Echinochloa colonum* (L) Link species and rice weed diversity index is low.

## 1. Introduction

Rice (*O. sativa* L.) is the main food crop in Asia, especially Indonesia, because the majority of its population consume rice as a staple food. Rice production must be increased to meet food demand due to population growth. One of the important things to increase rice production is minimizing crop losses caused by weeds. Yield loss caused by weeds were exceeds than yield loss caused by plant pests and diseases. In addition, competition with weeds also decreases the quality of rice grains [1].

Rice weeds are disturbing plants that grow with rice and otherwise well-controlled, it will reduce the quantity and quality of crops [2]. Rice weeds are associated and will fight each other for the nutrients needed by rice, especially if the amount of nutrients is very limited. Potential competition for rice weeds are increasingly supported by breeding both vegetatively and generatively [3].

According to research conducted by Fitri *et al* [4] in Nagari Singkarak, Solok Regency, West Sumatra, there were 10 types of rice weeds : *Eclipta prostrata* (L.), *Lindernia ciliata* (Colsm.) Pennell, *Ludwigia hyssopifolia* (G. Don) Exell, *Hedyotis diffusa* Willd, *Echinochloa colonum* (L.) Link, *Echinochloa crus-galli* (L.) Beauv, *Leptochloa chinensis* (L.) Nees, *Cyperus difformis* L., *Cyperus iria* L., *Fimbristylis miliacea* (L.) Vahl. The highest Important Value Index was (IVI) owned by *Fimbristylis miliacea* (L.) Vahl which was 108.50% and the lowest was *Hedyotis diffusa* Willd of 1.61%. This shows that *Fimbristylis miliacea* (L.) Vahl have an important role in maintaining the balance of weed communities in these fields. The diversity index is 1.6 which means the diversity of weeds in the rice field is moderate. Rice weeds always in the fields, one of which is the rice fields in Demak.

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Demak is the third largest rice production center in Central Java with a production of 632.751 ton in 2015. The wide of rice field area is 94,877 hectares in 14 existing districts [5]. But rice cultivation activities in Demak still rely on rainwater. So, the farmer will only plant rice when the rainy season arrives [6].

The aims of this research is to determine the structure of rice weed communities in Bulusari Village, Sayung District, Demak Regency by calculating the Important Value Index (IVI) and Shannon-Wiener Diversity Index (H'). The expected benefits from this research are it can be used by farmers as a guide in weed management to increase rice productivity.

## 2. Material and Methods

### *2.1 Time and Place of Research*

Reserach was conducted in June 2018 on 700 $m^2$ of inorganic rice field in Bulusari Village, Sayung District, Demak Regency. Identification of the rice weeds at the Ecology and Biosystematics Laboratory, Department of Biology, Faculty of Science and Mathematics, Diponegoro University.

### *2.2 Tools and materials*

Tools used were camera, meters, ropes, pegs, scissors, plastic bags, stationery and rice weed identification book "Weed of Rice in Indonesia" (1987) by Mohamad Soerjani, Achmad Jahja G.H. Kostermans, Gembong Tjitrosoepomo. The materials used are labels, envelopes and rice weed samples.

### *2.3 Method*

Rice weed sampling used a random method. Rice weeds were allowed to grow with rice plants until the age of 8 weeks. Size plot used for the research is 1 mx 1 m, 18 plots. Recorded on the types of rice weeds that grow and counted the number of individuals of each type of rice weed. The types of rice weeds were brought to the Ecology and Biosystematics laboratory to be identified. Identification of rice weed samples using the "Weed of Rice in Indonesia" book by Soerjani *et al*. [7].

Environmental factors were measured including light intensity with lux meter, pH and soil moisture with soil tester, air temperature with thermometer, humidity with hygrometer and altitude with altimeter.

### *2.4 Data analysis*

The data obtained were analyzed by calculating type dominance, Important Value Index (IVI) and Shannon-Wiener Diversity Index

$$\text{Dominance of Plant Types} = \frac{\text{Number of individuals in a family}}{\text{Number of individuals in all families}} \times 100\%$$

Dominant families if they have a percentage of > 20% total individuals, codominant 10% - 20%, and not dominant <10% [8].

Important Value Index

Species density [9],

$$\text{Absolute density (AD)} = \frac{\text{Number of Individuals of a Type}}{\text{Area of observation plot}}$$

$$\text{Relative Density (RD)} = \frac{\text{Absolute density of a type}}{\sum \text{Total absolute density of all types}} \times 100\%$$

Frequence [10],

$$\text{Absolute Frequence (AF)} = \frac{\text{The number of plots occupied by a type}}{\text{The total number of observation plots}}$$

$$\text{Relative Frequence (RF)} = \frac{\text{Absolute frequence of a Type}}{\text{Absolute Frequence of All Types}} \times 100\%$$

$$IVI = RD + RF$$

Information :
IVI = Important Value Index
RD = Relative Density
RF = Relative Frequence

Shannon-Wiener Diversity Index [12]:

$$H' = - \sum (ni / N) \ln (ni / N)$$

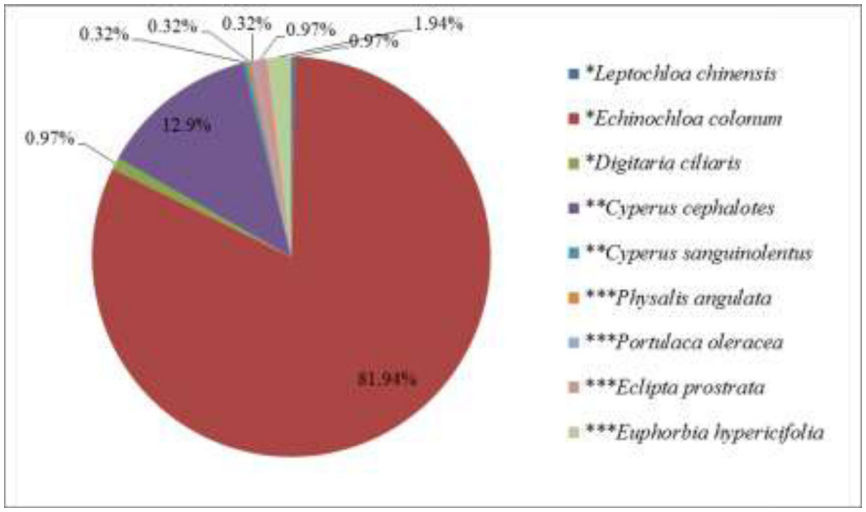
Information :
H' = Shannon-Wiener diversity index
ni = Number of i-type individuals
N = Total number of individuals of all types

The level of species diversity uses the Fachrul criteria [13] :
a. H 'value > 3 : species diversity is high.
b. $1 \leq H \leq \leq 3$ value: species diversity is moderate.
c. H '<1 value : species diversity is low or small.

## 3. Results and discussion

*3.1 Weed Composition*

The results showed that at 8 weeks of age, Rice weeds were consisting of 6 families, 10 species, and 310 individuals. There are 5 types of grasses with 258 individuals, there are 2 types of sedges with 41 individuals, and 4 broad-leaves groups with 11 individuals.




Remarks: * Grasses, ** Sedges, *** Broad-leaves

**Figure 1.** Percentage of Rice Weed Types in Bulusari Village, Sayung Districts, Demak Regency

In Figure 1, The dominant plant types of the rice weed were *Echinochloa colonum* (L) Link. It caused by its ability to produce large amounts of seedlings and seeds. Tanasale [14] stated that weeds which can survive were weeds that can reproduce vegetatively and generatively whereas the non-dominant families were Portulacaceae and Solanaceae. It because Portulacaceae and Solanaceae need wider growth space, of course, it will be difficult because there is not available enough space. Sravani [15] describes *Portulaca oleracea* L. including broadleaf weeds which have many branches with a height of up to 1 m. The dominating nature of a particular species can cause adverse effects on the ecosystem occupied by the species. Dominance is closely related to invasion. Tjitrosoedirdjo [16], states invasion is a trait that describes the performance of a plant species that becomes dominant and threatens ecosystems, habitats and other species found in a location.

*3.2. Important Value Index (IVI)*

Based on Table 1, species with the highest Important Value Index (IVI) was *Echinochloa colonum* (L) Link and the lowest were *Leptochloa chinensis* (L.) Nees, *Cyperus sanguinolentus* Vahl, *Portulaca oleracea* L and *Physalis angulata* L. *Echinochloa colonum* (L) Link has the highest Important Value Index (IVI) because it has the most number and it found in almost all plots. It shows the important effect of the *Echinochloa colonum* (L) Link on these fields [17]. whereas *Leptochloa chinensis* (L.) Nees, *Cyperus sanguinolentus* Vahl, *Portulaca oleracea* L., and *Physalis angulata* L. have the lowest Important Value Index (IVI) because they least found among other types of weeds. Solfiyeni [18] stated that the low relative density value of a species indicates that the species has fewer individuals than other weed types, while the relatively low-frequency value of a species is an indication that this type have a narrow distribution.

**Table 1.** Structure of Rice Weed in Bulusari Village, Sayung Districts, Demak Regency

| No. | Type | Famili | Nama spesies | IVI (%) |
|---|---|---|---|---|
| 1 | Grasses | Poaceae | *Digitaria ciliaris* (Retz.) Koel | 12.08 |
| 2 | | | *Echinochloa colonum* (L) Link | 105.16 |
| 3 | | | *Leptochloa chinensis* (L.) Nees | 5.88 |
| 5 | Sedge | Cyperaceae | *Cyperus sanguinolentus* Vahl | 5.88 |

| | | | | |
|---|---|---|---|---|
| 6 | weed | | *Cyperus cephalotes* Vahl | 29.57 |
| 7 | Broad-leaved | Asteraceae | *Eclipta prostrata* (L.) L | 12.08 |
| 8 | | Portulacaceae | *Portulaca oleracea* L. | 5.88 |
| 9 | | Solanaceae | *Physalis angulata* L. | 5.88 |
| 10 | | Euphorbiaceae | *Euphorbia hypericifolia L.* | 18.60 |
| | Total Number of Individuals of all Types | | | 310 |
| | Total number of all types (S) | | | 10 |
| | Species Diversity Index (H') | | | 0.69 |

*3.3 Species Diversity Index*

Weed species diversity index in 8 weeks old rice was 0.69. This value shows that weed species diversity in 8 weeks old rice was low. This value indicates that the rice field ecosystem has low weed diversity. This condition indicates that the ecosystem is less balanced. Suryatini [19] stated that the value of H' would increase if the number of species in the community increased and the distribution was evener. Species diversity has a close relationship with environmental conditions

*3.4 Environmental factor*

Based on the measurement of environmental factors conducted at the research location, the results can be seen in table 2 below

**Table 2.** Measurement of Environmental Factors on Rice Field in Bulusari Village, Sayung Districts, Demak Regency

| No. | Environmental Factors | Average |
|---|---|---|
| 1. | Light intensity | 11,562 lux |
| 2. | Air temperature | 27 $^{o}$f |
| 3. | Humidity | 86 % |
| 4. | Soil pH | 7.2 |
| 5. | Altitude | 9 m fsl |

Environmental factors are the factor which has influenced the diversity of the rice weeds from the outside. Based on Table 2, the light intensity at the research site was 11,562 lux. Utami [20] stated that high light intensity has an impact on growth and yield of good rice plants. Air temperature at the research site is 27$^{o}$C. According to Balitan [21], the optimum temperature for rice plants to grow is 24-28 $^{o}$C. Air humidity at the research site was 86%. Uluputty [22], stating that high air humidity is needed by weeds to germinate the soil pH at the location of this research is 7.2. Suryatini [19], stated that the soil pH that is best for growth and availability of nutrients is close to neutral (6.5-7.5). Soil pH determines whether or not nutrients can be absorbed easily by plants. The height of the research area is 9 meters above sea level. Suryatini [19], stated that the height of the place is not a limiting factor for the spread of weeds, because weeds can grow well to a height above 500 m above sea level.

## 4. Conclusion

From this present research, we conclude that *Echinochloa colonum* (L) Link was commonly found on the rice field in Bulusari Village, Sayung Districts, Demak Regency. It needs advance research to know

fluctuating community structure of the rice weeds in Field in Bulusari Village, Sayung Districts, Demak Regency

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