International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 18-05-2021, Accepted: 02-06-2021, Published: 17-06-2021
Volume 6, Issue 3, 2021, Page No. 724-729

Weed diversity in upland rice area in west Tobelo, north Halmahera, Indonesia

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Abstract
The research conducted in West Tobelo aims at examining the weed diversity in upland rice area. The vegetation were collected in 4 stations using the quadratic method. The weed species found were counted using RF, RD and IVI. The result shows that there are 21 weed species of 11 families. Weed's Importance Value Index (IVI) at station 1 are *Borreria laevis (Lamk), Brachiaria mutica (Forsk.) Stapf, Borreria latifolia* (Aubl.) K. Sch., and *Phyllanthus niruri* L., while the dominant weeds at station 2 are *Paspalum commersonii Lamk* (IVI 6.93) and *Ottochloa nodosa* (IVI 4.82), and at stations 3 and 4 the highest is *Imperata cylindrica Beauv*, (IVI 38.16 and 35.81).

Keywords: weed diversity, dominance, upland rice, west Tobelo

Introduction

Upland rice is one choice of the most popular plants on rain fed slope area, which contributes to about 11% of the worldwide rice production (Tuhina-Khatun *et al*., 2015) [18] where about 13 million ha is planted in Asia (Jaruchai, Monkham, Chankaew, Suriharn, & Sanitchon, 2018) [8]. The upland rice farming system is also important since it does not require irrigation facilities and needs lower production cost (Tuhina-Khatun *et al*., 2015) [18]. According to Tuhina-Khatun *et al*, to enhance the potential yield of upland rice, cultivar identification needs to be performed by improving the yield and other desired agronomic characters, to solve famine and global famine issues (Tuhina-Khatun *et al*., 2015) [18].

In effort to improve upland rice yield production, weed is an important plants intruding organism that needs to be dealt with, since weed may absorb nutrients and water quicker than main plants (Antralina, 2012) [3]. This conforms to the research conducted by (Reena & Samuel, 2020) [14], that weed commonly completes with the existing plant where they grow for resources including sunlight, water, minerals and other soil contents, decreasing the yield quantity and quality and causing economic loss to farmers. In general, weed causes 5% loss of agricultural production in most of developed countries and 25% loss in least developed countries. In this regard, (Beltran, 2011) [4] explains that there are 10 types of important weed which greatly influence paddy agricultural system globally.

West Tobelo area, North Halmahera Regency, is an area with most of its inhabitants farming upland rice for their livelihood. Upland rice plants in North Halmahera is planted on 5,900 ha, with harvest area of 2,806 ha and production of 6,314 ton (BPS Halmahera Utara, 2020) [5]. Upland rice is commonly known by local society of North Halmahera as "*Padi Beras Baru*", cultivated to support household food availability (Kastanja, Patty, Manikome, & Dilago, 2020) [9]. One of the problems faced by the farmers is upland rice's low production yield because of the use of local seeds from previous harvest and weed attack (Kastanja *et al*., 2020) [9]. Besides, the loss because of weed, according to (Beltran, 2011) [4], is also influenced by some factors, including: competition between weeds and paddy, species or type of weed, weed density and others.

This research aims at examining the diversity in the upland rice area in West Tobelo area, North Halmahera Regency. In addition, this research takes the opinion of Yakup, (2002) [19] explaining that weed control effort needs to pay attention to some matters, such as identification attempt, searching for weed literature, and asking weed experts, which are the first measure to explore any possible appropriate control method.

Materials and Methods

Study Area

The study on the diversity of weed on upland rice area in West Tobelo, had been conducted at 4 selected locations, namely Kusuri Village, Togoli Village, Birinoa Village and Wawongira Village. The vegetation data were collected using the quadratic method by placing 1mx1m sized quadratic plot with three repetitions at each of the selected locations (Sembodo, 2010) [16]. Each of the weed species existing in the quadratic plot was identified by species and counted.

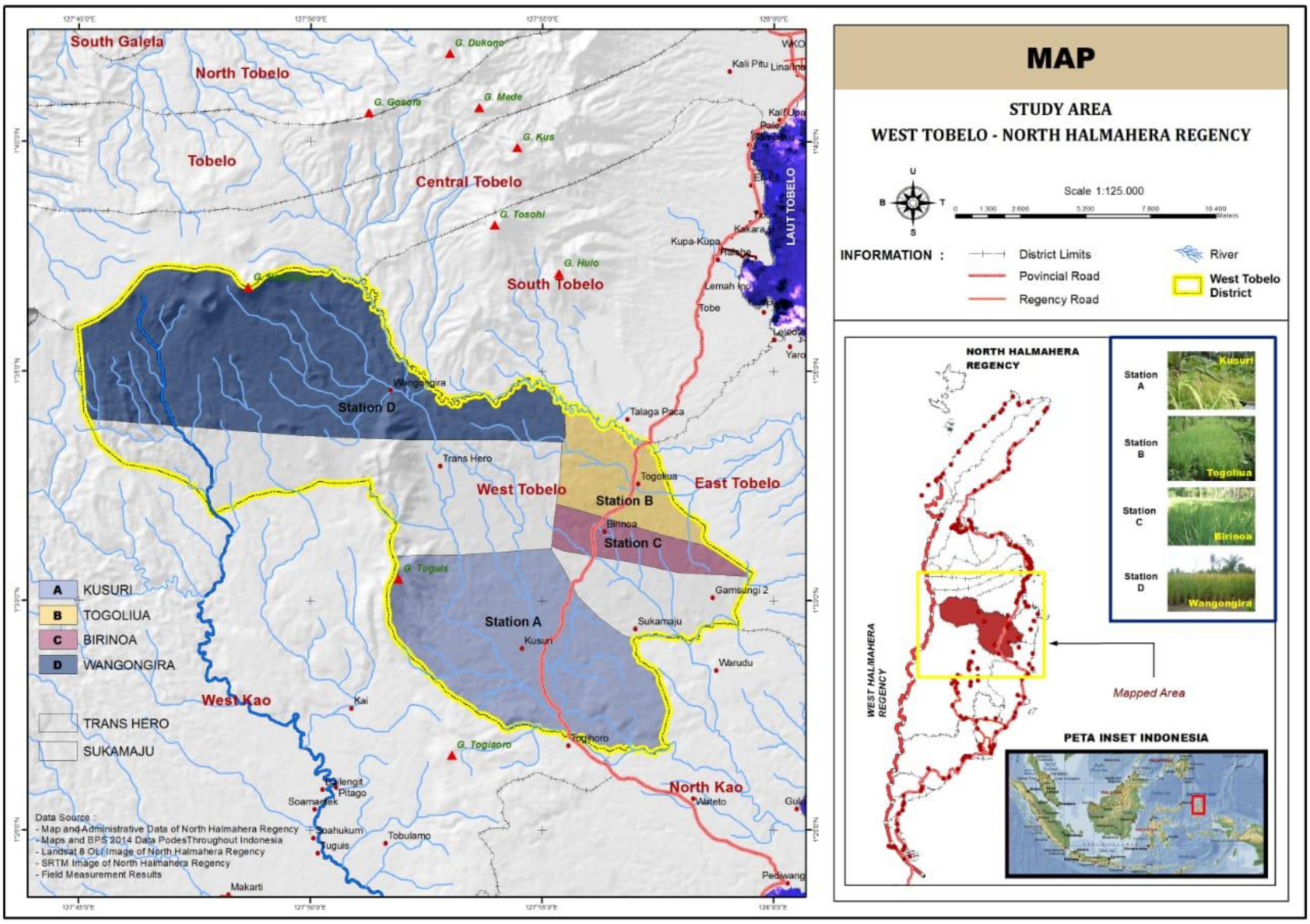

Fig 1: Map of study area

Data Analysis

The types of weeds found are presented descriptively in the form of table and graphic, while the data obtained from quadratic plot placement result were used to count the relative density, relative frequency, and importance value index (Sembodo, 2010) [16], (Nuraini & Sebayang, 2019) [11], (Saragih, Purba, & Tampubolon, 2018) [15]

Density

Absolute Density means the number of individuals of one type in a certain location, which is formulated: Absolute density (KM) = number of individuals of certain type of weed in sample plot.

Relative Density

Relative Density means the comparison of absolute density of certain type of weed with total absolute density of all types, with the following formula:

$$Relative\ Density = \frac{\text{absolute density of a type}}{\text{absolute density of all types}} x100\%$$

Frequency

Absolute Frequency means the comparison of the number of sample plots where a type is found with the sample plots made, with the formula:

$$Absolute\ Frequency = \frac{\text{number of plots where a type is found}}{\text{number of all obervation plots}} x100\%$$

Relative Frequency

Relative Frequency means the percentage of frequency of a type against the count of frequency of all types, with the formula:

$$Relative\ Frequency = \frac{\text{Frequency of a type}}{\text{Frequency of all types}} X100\%$$

Importance Value Index (INP)

This value shows the dominance of a type in a certain farming land or cultivation area, with the formula:

$$INP = Relative\ Density + Relative\ Frequency.$$

Result and Discussion.

Weeds Diversity

The research result shows that in the upland rice farm in West Tobelo area, there are 21 weed species of 11 families, which are dominated by *Poaceae*, *Passifloraceae* and *Euphorbiaceae* families. The *Poaceae* family is of grassy weed, while *Passifloraceae*, *Euphorbiaceae* and *amaranthaceae* families are of wide leaf weed.

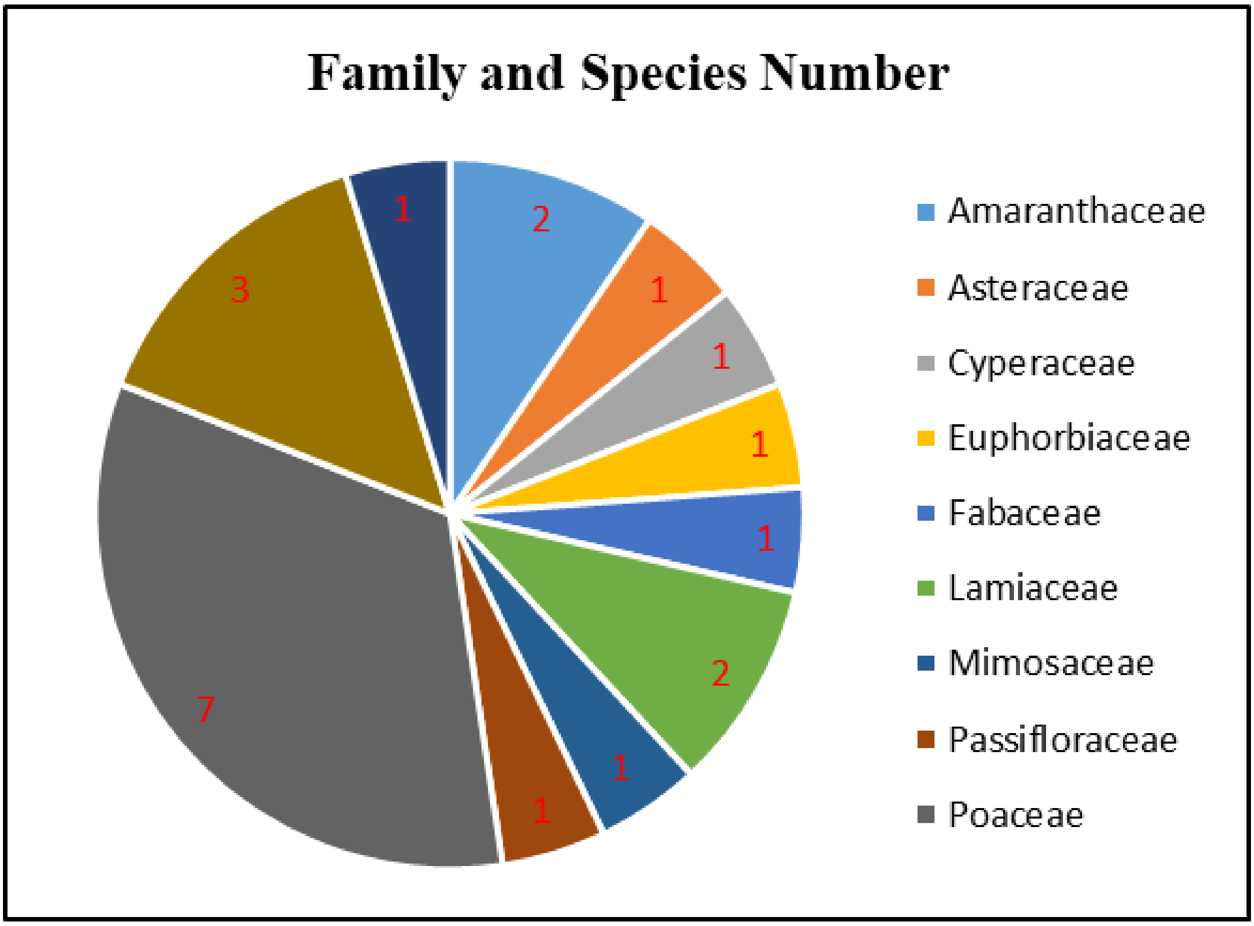

Fig 2: Weed Distribution by Family in study area

The research result also shows that some weeds, covering *Cyperus rotundus* L., *Eleusine indica* (L.) Gaertn, *Paspalum conjugatum* Berg, and *Imperata cylindrica* Beauv, existing on upland rice farm are of very malicious weeds because of their extensive distribution with high frequency of emergence. The semi-malicious weeds growing on the upland rice land include *Ageratum conyzoides* L, and *Mimosa pudica*. This conforms to the opinion of Abdi, Soejono, & Mawandha, (2018) [1] that classifies some weed species into very malicious weed, malicious weed, and semi-malicious weed. The weed families and species are presented in table 1.

Table 1: Weed Species on Upland Rice Area in West Tobelo

No	Family	Weed Species	Indonesian Name	Location			
				A	B	C	D
1	Amaranthaceae	*Amaranthus spinosus*	Bayam duri		√		
		Amaranthus gracilis	Bayam				√
2	Asteraceae	*Ageratum conyzoides L*	Babadotan	√		√	√
3	Cyperaceae	*Cyperus rotundus* Linn.	Teki		√	√	
4	Euphorbiaceae	*Phyllanthus niruri* L.	Meniran	√	√	√	√
5	Fabaceae	*Crotalaria striata* DC	Orok-orok				√
6	Lamiaceae	*Hyptis brevipes Poit*	Genggeyan				√
		Ocimum basilicum Linn	Kemangian				√
7	Mimosaceae	*Mimosa pudica*	Putri malu	√	√		
8	Passifloraceae	*Passiflora foetida* L.	Rambusa	√	√	√	√
9	Poaceae	*Paspalum commersonii Lamk*	Rumput gegenjuran	√	√	√	
		Brachiaria mutica (Forsk.) Stapf	Rumput malela	√			
		Ottochloa nodosa	Rumput kawatan/rumput sarang buaya		√		
		Eleusine indica (L.) Gaertn.	Rumput belulang		√		
		Imperata cylindrica Beauv	Alang-alang			√	√
		Paspalum conjugatum Berg.	Paitan			√	
		Digitaria ciliaris	Jalamparan	√			
10	Rubiaceae	*Borreria latifolia* (Aubl.) K. Sch.	Kentangan	√			
		Borreria laevis (Lamk)	Rumput kancing ungu	√			
		Borreria alata	Rumput setawar				√
11	Verbenaceae	*Lantana camara* L.	Tembelekan			√	

Source: Primary data √ = Type of Weed found
A = Kusuri Village; B = Togoli Village; C = Birinoa Village; D = Wawongira Village.

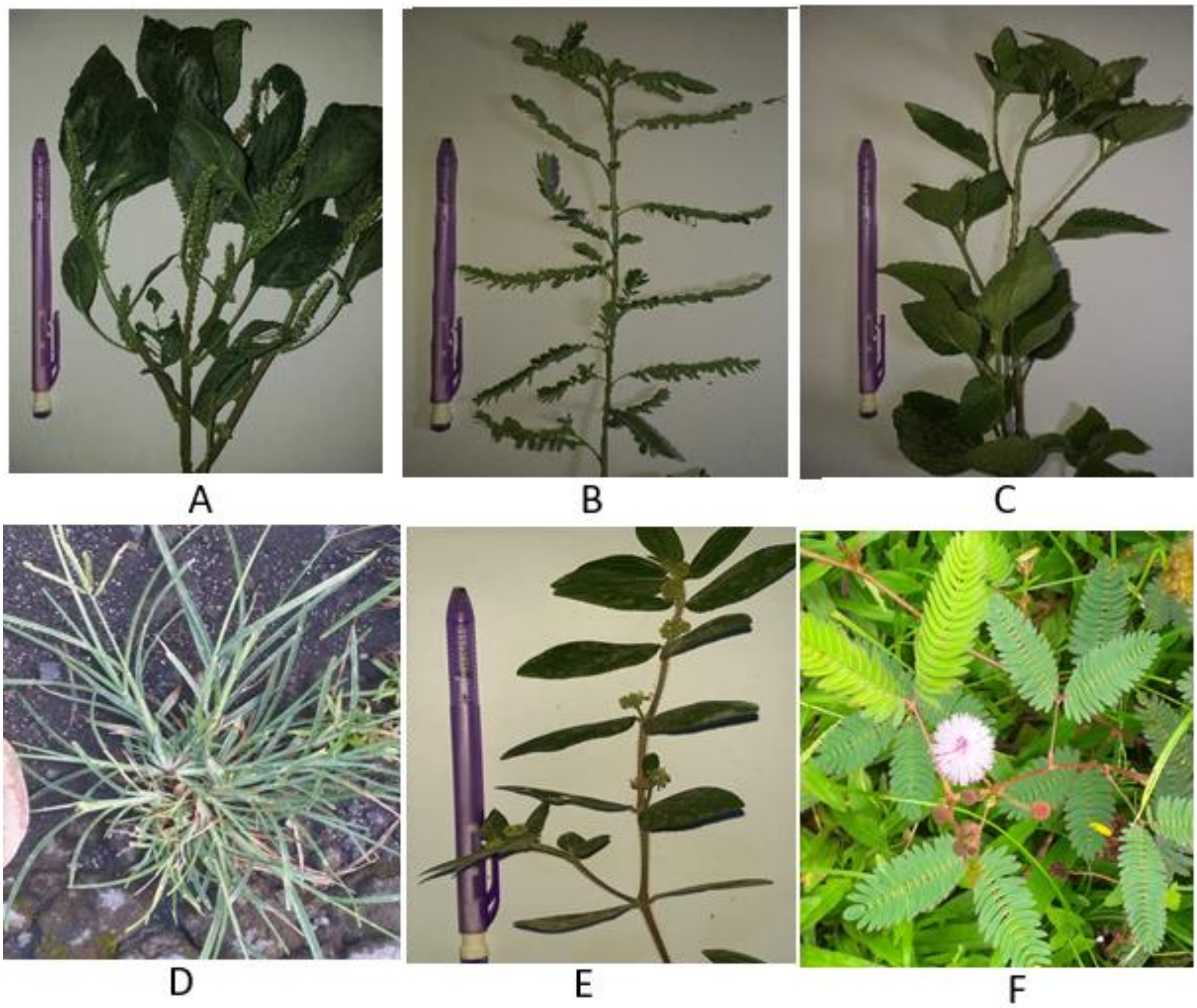

Fig 3: Weeds Species in study area

The diversity of weeds existing in the fourth locations of upland rice area is relatively the same, with some wide-leaf types of weeds found on the upland rice area, such as; *babadotan* (*Ageratum conyzoides* L.), *bayam duri* (*Amaranthus gracilis), meniran (Phyllanthus niruri* L.), *ceplukan* (*Passiflora foetida* L.), while the grassy weeds found include; *jaringan* (*Paspalum commersonii Lamk), rumput kawatan (Ottochloa nodosa), rumput belulang (Eleusine indica* (L.) Gaertn, *alang-alang* (*Imperata cylindrica* Beauv), and *paitan* (*Paspalum conjugatum* Berg). In addition, there is also *teki-tekian* (*Cyperus rotundus L.*) in the locations at Togoli Village and Birinoa Village.

The composition of weeds and coverings on the area with different types of soil in certain ecological area shows big difference. The result of previous research shows that soil type significantly influences the seed germination of *Asystasia gangetica*. In addition, the difference in sand, clay and dust content in soil causes different air and water circulation and adsorption (Andhini & Chozin, 2016) [2].

Weed Vegetation Analysis

Relative Frequency

Station A (Kusuri Village)

The highest Relative Frequency Value at station A is that of *Borreria laevis* (Lamk) of 2.73% and of *Mimosa Pudica* of 2.27%. These two types of weeds commonly grow on dry land.

Station B (Togoli Village)

The highest Relative Frequency Value at station B is that of *Paspalum commersonii Lamk* of 3.93%. The Relative Frequency Value of *Ottochloa nodosa* and *Phyllanthus niruri* L is each 3.37%. *Paspalum commersonii* is commonly known as "*gegenjuran*" and *Ottochloa nodosa* is commonly known as "*rumput sarang buaya*". The two are of *Poacae* family and classified as grassy weed, while *Phyllanthus niruri* L (*rumput meniran*) is classified as wide leaf weed. According to Suryaningsih, Joni, & Darmadi, (2013) [17], weeds of *Poaceae* family have high adaptability and strong rhizome, and are able to grow through seed and tuber.

Station C (Birinoa Village)

The highest Relative Frequency Value at station C is that of *Cyperus rotundus* Linn of 8.43%, which may be classified as nut grass weeds. This type of weed grows on wet and dry soil, in cool area, or on waterlogged soil, grows slowly, produces few flowers and tubers and is sensitive to shade (Galinato, Moody, & Piggin, 1999) [6].

Station D (Wawongira Village)

The Relative Frequency Value at station D shows that *Imperata cylindrica* Beauv (cogon grass) is not the highest type of weed of 9.65%. Pudjiharta, Widyati, Adalina, & Syafruddin, (2008) [13], argue that this type of weed is aggressive and very competitive with regard to nutrients and water. Besides, cogon grass may cause soil productive to decline. Holzmueller & Jose, (2012) [7] state that cogon grass is invasive, that it can reduce the population of original plant and threaten biodiversity.

Relative Density

Station A

The highest weed relative density value at station A is that of *Phyllanthus niruri* L. with density value of 3.32%. This shows that this type of weed has the highest density among the weeds in the station.

Station B

The highest weed relative density value at station B is that of *Paspalum commersonii Lamk* with density value of 2.99%, which is weed with the highest density among the weeds in the station.

Station C

The highest weed relative density weed at station C is that of *Imperata cylindrica* Beauv with density value of 29.73%, which is weed with the highest density among the weeds in the station.

Station D

The highest weed relative density weed at Station D shows that *Imperata cylindrica* Beauv is weed with the highest relative density of 26.22%

Field observation result shows that *Imperata cylindrica* Beauv has high density, which may be caused by farmers' delayed weeding. Consequently, the relatively high growth of *Imperata cylindrica* Beauv causes upland rice's growth to get delayed and even leads to upland rice yield loss. Pane & Jatmiko, (2009) [12] explain that weed control method should be performed differently from plant pest and disease control, because: 1) weed community is more varied, 2) it harms plants from the beginning until harvest, 3) weed is associated with pests, pathogens and natural enemies, 4) weed grows in association with plant.

Importance Value Index / IVI

Station A

The result of weed's Importance Value Index measurement at station A shows that wide-leaf weeds *Borreria laevis* (Lamk), *Brachiaria mutica* (Forsk.) Stapf, *Borreria latifolia* (Aubl.) K. Sch, and *Phyllanthus niruri* L. are dominant on the upland rice area, with importance value index respectively 5.64, 3.13, 4.43 and 4.68.

Station B

The result of Importance Value Index measurement at station B shows that the highest value is that of grassy weed *Paspalum commersonii Lamk* of 6.93, followed with that of *Ottochloa nodosa* with importance value index of 4.82, *Cyperus rotundus* Linn with importance value index of 4.43 and *Phyllanthus niruri* L with importance value index of 4.24.

Station C

The result of Importance Value Index measurement at station C shows that the highest value is that of grassy weed *Imperata cylindrica* Beauv of 38.16. This type of weed is derived from Asian and Southeast Asian tropical regions, and widely distributed to American and African tropical regions. It is common on upland rice farms in India, Indonesia, Filipina, Thailand, and Vietnam, and now in Bangladesh, Laos, and Myanmar (Galinato *et al*., 1999) [6].

Station D

The result of Importance Value Index measurement at station D shows that the highest value is that of grassy weed *Imperata cylindrica* Beauv of 35.81. The research result shows that the importance value index is dominated by *Imperata cylindrica* Beauv which is found at 2 stations. This weed is classified in the 10 species malicious weeds, (Moenandir, 2010) [10].

The weed is called malicious since it may inflict negative influence on the growth of surrounding cultivated plants. This type of weed is quite harmful when it grows on upland rice farm, that it is competitive, releases allelopathic effect, grows rapidly, and is difficult to control. The reason is that cogon grass (*Imperata cylindrical*) releases chemical compound or allelopathy that is able to increase the weed's competitiveness by suppressing other surrounding weeds' growth (Sembodo, 2010) [16].

Conclusion

The research result shows that there are 21 weed species of 11 families, which are dominated by *Poaceae*, *Passifloraceae*, and *Euphorbiaceae* families. The types of weeds at the 4 stations of the upland rice farm are relatively the same, constituting wide-leaf weeds (*Ageratum conyzoides* L., *Amaranthus gracilis*, *Phyllanthus niruri* L., and *Passiflora foetida* L.), grassy weeds (*Paspalum commersonii Lamk, Ottochloa nodosa, Eleusine indica* L. Gaertn., *Imperata cylindrica* Beauv, and *Paspalum conjugatum* Berg) and nut grass weed (*Cyperus rotundus* Linn). The measurement result shows that the relative density is dominated by some types of weeds, namely: *Phyllanthus niruri*, *Paspalum commersonii Lamk*, and *Imperata cylindrica* Beauv. The importance value index at some stations is dominated by *Imperata cylindrica* Beauv.

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