Potential of Weeds for Ruminant Feed on Rice Fields in Java

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Abstract

Weeds compete with rice for sunlight, nutrients and water, and may reduce the yield. However, in traditional rice farming systems farmers utilize many kinds of weeds for food, forage or household purposes. Rice weeds are also utilized to feed ruminants.The aims of this research were to explore the weed diversity of rice field in various regions and rice farming systems in Java. Field researches were conducted in November 2011 – January 2012. Designated research areas: West Java: Cianjur (upland) and Karawang (lowland); Central of Java: Karanganyar (upland) and Brebes (lowland); East Java: Malang (upland) and Gresik (lowland). Locations of plots have been selected according the principles of stratified random sampling. Weed assemblages were sampled in fields of intensive and extensive farming systems as well as in fallowed areas before weeding time in two seasons. The result showed that approximately 295 species of weeds growth in rice field and terrace area. Dominant weed species present at the terrace in experimental site were Cynodondactylon, Eleusineindica, and Fimbristylismiliaceae. Potency of weed for ruminant feed gains approximately 903,5 g/m2 at terrace area.

Keywords: potency, ruminant feed, weeds diversity

Introduction

Increasing the level of rice self-sufficiency of Indonesia led to an increase in the intensity of rice (*Oryza sativa* L.) cropping in many areas since the 1970s. In Indonesia, rice cultivation covers a total of about11.5 million hectares throughout the archipelago, on Java alone around 5.4 million hectares (National Development Planning Board, 2003).About 70% of the area comprise irrigated rice fields, which have been estimated to be 100 times more productive than upland rain-fed rice farming upland rice (Fairhurst and Dobermann, 2002).

One consequence of cropping intensification in irrigated systems is a shift and an increase in weeds populations. Weeds compete with rice for sunlight, nutrients (Nyarko and Datta, 1993) and water, and causes loss of yield by about 10-50% (Chin

et al, 2000). Weed management therefore poses a significant challenge to Indonesian farming systems. Herbicide treatments change the weed community composition interrelated to crop productivity (Ulber 2010). A new approach to biodiversity friendly management is therefore to enhance the benefits derived from desirable weed species with high value for the farmer and the agroecosystem. The use of weed species is possibly the most efficient management to overcome problems of pollution through herbicide usage, slow breakdown or burning. Weed plants and vegetation vary enormously in morphology, phytomass and species composition depending on habitat conditions and land-use (Soerjani *et al*., 1987). Due to their chemical and physical characteristics weeds may or may not be grazed by ruminants. The feeding value of rice field weeds is little-known in scientific literature but the local farmers have considerable knowledge which should be combined. The main objectives of the present study were ‑to assess characteristics of farming systems in Java and to evaluate the potential of rice weed biomass as ruminant feed.

Materials and Methods

The research was done in October 2011 until March 2012 in lowland (0-100 m) and upland areas (>400 m)of rice field in Java, i.e. Karawang (33 – 53 masl), Brebes (26 – 44 masl), Gresik (14 – 41 masl), Cianjur (527 – 856 masl), Karanganyar(403 – 714 masl) and Malang (526 – 684 masl). In each of the sites, suitable landscape sections of ca. 5 km x 5 km size were selected and 15 plots located therein.The weeds were sampled in cultivated areas, fallowed areas and on rice field terraces.

Fresh biomass was measured from weed sources in each plot by placing squareframes sized 30 cm x 30 cm. The weeds were sampled on three plots on each rice field and terrace in each district. Weed samples were collected in each plot, cut and weighed as fresh biomass. The samples were dried at 60°C for 48 h and weighed as dry biomass.

Results and Discussion

Overview

The study revealed that rice farming systems in Indonesia are dependent on elevation. In upland areas continuous water supply throughout the years facilitated weed control and reduced herbicide application. Herbicides were commonly applied in lowland areas. The proportion of farmers who used herbicides on their farms was 60% or more in the lowland areas while less than 15% of the farmers applied herbicides in the upland areas (Table 1). Weed biomass source sites in upland areas were mostly on terraces as a result of continuous control in rice field area while in the lowlands the most important weed biomass sources were fallows. Manual weeding was common practice to reduce weeds in almost every rice field area. Weeding is

Table 1. Characteristics of rice farming systems

Parameters	District					
	West Java		Central of Java		East Java	
	Cianjur	Karawang	Karang-anyar	Brebes	Malang	Gresik
Herbicide application (%)	13.33	60	0	66.67	6.67	66.67
Manual weeding (%)	71.5	100	100	100	100	93.3
Time of fallow (weeks)	3-4	6-10	3-5	3-8	3-4	10-14
Weed biomass source	Terrace	Fallowed area	Terrace	Fallowed area and terrace	Terrace	Fallowed area and terrace

usually done two times, specifically 20 and 40 days after transplanting of rice plants, with the exception of Gresik.

In Gresik, direct seeding was practiced due to a shortage of labor and the higher costs of rice transplanting. Manual weeding in Gresik would commonly be done simultaneously with rice plant thinning to reduce labor costs. Labor for manual weeding is becoming increasingly scarce. Therefore the application of herbicides in the first tillage increases to eradicate all weeds that emerged in the time of fallow. In addition, poor maintenance of the irrigation infrastructure reduces water availability for rice production in the dry season and increases surface water sand flooding in rice field areas in the rainy season.

Weed Biomass

Weed biomass is the most important indicator of feed availability for ruminant in rice field area. There was a significant difference in weed biomass among rice field areas, with upland areas (Cianjur, Karanganyar and Malang) producing higher biomass values than lowland areas (Karawang, Brebes, Gresik) (Table 2). There were no significant differences between the locations of eastern, central, or western Java, respectively. Fresh weed biomass in the first rice growing season (early rainy season) yielded 891-2369 g/m^2(Table 2). Weed biomass varies enormously between regions and even between small farms in the same village due to differences of environmental factors and farming management. The results showed that high values of fresh weed biomass had the potential to supply ruminant feed in Java although variability in water regime affected the populations and growth of weed species.

Fresh weed biomass in Javanese rice fields differed from that found byRoder *et al*. (1998) who measured 220-990 g/m^2/year of fresh weed biomass over the rice growing season in northern Laos. There are many factors affecting the weed biomass

Table 2. Weed biomass in rice field areas

Parameters	District					
	West Java		Central of Java		East Java	
	Cianjur	Karawang	Karang-anyar	Brebes	Malang	Gresik
Characteristic of region	Upland	Lowland	Upland	Lowland	Upland	Lowland
Fresh weight (g)	2369.0[a]	900.1[b]	1912.2[a]	922.3[b]	2130.7[a]	890.7[b]
Dry weight (g)	284.3[a]	140.1[b]	245.8[a]	151.3[b]	258.3[a]	127.5[b]
Dry matter (%)	12.0[d]	15.6[a]	12.9[c]	16.4[a]	12.1[d]	14.3[b]

Different superscript in the same line means significantly different ($P<0.05$)

between countries, such as seasonal and climatic variation as well as different farming management systems (Machado, 2005). Yakup (2007) reported that weed infestation in rice farms increased along with elevation. Common weeds in the upland rice field areas in West Java are *Myriophyllum aquaticum* and *Sagittaria guayanenesis* while in lowland areas *Leersia hexandra, Sacciolepis interrupta* and *Ipomea aquatic* are common (Yakup, 2007).

The combination of herbicide application and manual weeding in the lowland rice field areas of Karawang, Brebes and Gresik resulted in a significantly higher degree of weed suppression. Variability of surface water condition affects the growth ofrice weed communities (Juraimi *et al.,* 2011). Hence, weed biomass in upland areasis concentrated on terraced sites since weeds have been suppressed on about 70% of the rice field areas through ponding surface waters. In all lowland areas, rice weeds were found to grow mainly in times of fallow and the values were not significantly different from each other.

There were biologically small but statistically significant differences in the comparison of dry matter percentage in each location. In the lowland areas higher dry matter values were found than in the upland area. Cutting times and plant structural composition seems to affect production yields (Yolcu *et al.,* 2006).

Conclusions

Selecting weed species suitable for ruminant feed supply and production in a particular region (based on agro-pastoral farming) is very important to sustain animal production both economically and ecologically. Rice weeds have the potential to yield substantial amounts of biomass in fallowed areas and terraces. Rice weed biomass in upland areas is currently higher than in lowland areas due to the combination of herbicide application and manual weeding in the lowlands.

Xinqing *et al.* (2006) suggested four principles for selecting appropriate species as feed, i.e. biogeographical matching of species, ecological matching, production yield and forage quality.It is essential, therefore, to further study the phytogeographical, ecological, biological and functional traits of the Javanese wild plants of rice fields.

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