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IN SEARCH FOR LOCAL WISDOM IN WEEDMANAGEMENT IN RICE CULTIVATION

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ABSTRACT

Rice production system has always been a subject to resource competition from weed species surrounding. Significant loss of rice yield due to resource competition with weeds has been extensively reported. Successful weed management, especially in well-developed countries, has relied on extensive application of herbicides. This practice, however, has resulted in concerns on the damage of the chemicals to the environment. Moreover, future agricultural systems have to be implemented in an environmentally-friendly way. Research to study weeds dominant in local genotype of rice and their control by farmers in three municipalities (Kabupaten Agam, Kabupaten Solok, and Kota Padang) in the Province of West Sumatra has been carried out from April to November 2009. Four sub-districts with 20 respondents each have been chosen in each municipality (total amount of respondents were 240 farmers). Results demonstrate that in Agam and Solok only small percentages of farmers used organic fertilizer to paddy field as much as 5.3 and 17.5, respectively. Interestingly, most of respondents in all areas do not use herbicides to control weeds. Only up to 35% and only in two sub-districts in Padang where respondents applied herbicides to control weeds. This fact tells that farmers have good awareness and concern about the damage of the agricultural chemicals may cause to the environment. Farmers usually take the weeds from the field and give them to their cattle or goats. Some farmers buried the weeds right to the paddy field at the time of control. We consistently found some species of weeds associated with local genotype of rice in all areas. The weeds are Echinochloa cruss-galli, Echinochloa colonum, Leersia hexandra (Family Poaceae), Cyperus spp., Fimbristylis miliaceae (Family Cyperaceae), gulma Lindernia spp. (Family Scrophulariaceae), and Alternanthera spp. (Family Amaranthaceae). Yield loss reached 37% when the rice grown in association with weeds without being controlled. The loss for each genotype of Kuriek Kusuik, Anak Daro, and Cisokan was 29.01; 37.38; and 35.58%, respectively.

INTRODUCTION

Pressures on agriculture, caused by the reduced amounts of arable land, and the impact of pests, diseases and weeds have prompted people to find appropriate methods to maximise agriculturál production. Sustainable agriculture aims for long-term maintenance of natural resources and agricultural productivity with minimal adverse impact on the environment (Narwal, 1999). This will help in achieving the long term goals of increasing and sustaining agricultural yield while causing minimum environmental damages.

Weeds have always been recognized as one of the major problem in agricultural practices. The problems of weeds has been as old as the history of agricultural practice itself and will always be as long as crops being cultivated to feed the world population. Weed definition varies among weed scientist, the simplest of which is 'a plant growing out of place'. A more precise definition might reflect the economic losses resulting from weed problems in agriculture. In this paper, we refer to weeds as plants that unussually persistent and pernicious, that significantly interfere with the growth of crops, and are optimally adapted to agroecosystems (Ross and Lembi, 1999). Therefore, weed management is considered to be a normal and necessary work for farmers.

Weed control, mostly by herbicide application, is one of the key management factors of most agricultural systems. However, this practice has resulted in increasing herbicide resistance in weeds (Foes et al., 1998; Tranel et al., 2004) and widespread concern about the environmental side effects of herbicides. Herbicides have resulted in a range of effects on fauna and flora living on or close to farmland (Cooke and Burn, 1995). Increasing herbicide resistance in certain weeds, rising costs, and widespread concerns about the environmental effects have resulted in great pressure to reduce the use of commercial herbicides (Swanton and Murphy, 1996). Future weed control practices must therefore eliminate or at least minimise the herbicide use and if possible, utilise other practices for weed management

In rice cultivation, resource competition may occur between rice and weeds which reduces yield up to 82% (Solfiyeni and Setiawati, 2003). The competition between weeds and rice may result from similarities in growth habit, similarities in resource requirements, and similarities in their niches (Soerjani *et al.*, 1987). In addition to resource competition, weeds may release secondary metabolites (allelochemicals) to the environment and may influence the growth and development of agricultural and biological systems (Narwal, 1999).

In this article, we report on major weeds in rice cultivation in West Sumatra, how farmers deal with weeds in their rice cultivation, how they see and utilize weeds, and

rice yield loss when grown in association with weeds without being controlled.

MATERIALS AND METHODS

Research to study major weeds in local genotype of rice and their control by farmers has been conducted in three municipalities representing three levels of altitudes in the Province of West Sumatra. They were Kabupaten Agam, Kabupaten Solok, and Kota Padang for high, medium, and low levels of altitude, respectively. The research has been carried out from April to November 2009. In every municipality, four sub-districts with 20 respondents have been chosen as respondents (total amount of respondents were 240 farmers). The study was started by interviewing farmers to collect preliminary data on weeds in rice, how the farmers deal with the weeds, and how they utilise the weeds either in their land or for other purposes. Next, data collection on weeds found on the rice field in the sampling area was conducted. Weeds were collected from 1 x 1 m sampling plot with total of five plots in each paddy field. The five sampling plots were taken from the center of the paddy field and spread to the four directions diagonally to the east, west, south, and north. Data on species, amount of individual species number of plots where the species found, fresh weight, and dry weight of the weeds were recorded and used to rank the weeds according to their abundance and dominance. Finally, an experiment to study how effective the use of herbicide to control weeds in rice has been carried out. Local genotype of rice was grown in a 0.25 ha rice field in each location. The treatment was herbicide with active ingredients of metsulfuron 0.7% and etil kiorimuron 0.7%, with 275%,4-D sodium salt at 320 g/ha dose and 200 L/ha volume of the solution. The herbicide was applied at three weeks after planting. Data on rice yield was analysed using t-test and compared between three municipalities.

RESULTS

Farmers in Kota Padang prefer to grow hybrid rice variety (IR 42) to local genotypes; whereas, those in Kabupaten Agam and Kabupaten Solok like to grow local genotypes of rice. Weed control was slightly different. Weeding was conducted once by farmers in all areas within one cycle of rice cultivation. On the other hand, only in Kabupaten Agam and Kabupaten Solok where farmers controlled weeds twice in one cycle of rice plants' life. It is interestingly noted that over 30% of farmers returned the weeds back to the soil by burying the weeds right after weeding. In contrast, none of the farmers used weeds neither returning them to the soil nor using them as stock feed in Kota Padang. The fact that farmers in Kota Padang did not spend as many time in the field as those in the other two municipalities may have an explanation. Some farmers in Kota Padang also provide transportation service to the commuters using their motorcycles. This gives the farmers more financial benefit than spending all their time looking after rice plant in the field.

Data from Table 1 demonstrate that some farmers, especially those from Kabupaten Agam and Kabupaten Solok, have more awareness to the environment than those from Kota Padang. Returning weeds back to the soil will help mother nature to improve the quality of physical and biological properties of the soil (Lamerle and Murphy, 2000). Persistent efforts on returning organic materials such as weeds back to the soil may reduce the use of agricultural chemicals in the long run.

Rotating rice plants to legumes and other cereals is yet another important point in weed management (Lamerle and Murphy, 2000). Different crop species associates with different major weed species. Therefore, crop rotation will break the life cycle of certain weed species. Farmers in all areas have rotated their rice plant to other crops. The figure is quite surprising that between 18 to 56% of farmers rotate their crop species in paddy field. The aforementioned weed management by farmers need to be maintained as 'local wisdoms' and is worth to be spread widely.

Tabel 1. Data on farmers' view of weeds, weed control and use in rice cultivation

Remarks	Agam	Solok	Padang
Use of organic fertilizer	5.26%	17.50%	N/A
Weeding frequency			
a. once	66.23%	48.88%	100%
b. twice	28.77%	48.63%	0%
Weeding time			
a. 1 - 1.5 mo after planting	67.76%	81.68%	100%
b. 2 mo after planting	32.23%	18.32%	0%
Weeding method			
a. Manual	98.25%	100%	93.75%
b. Mechanical	1.75%	0%	6.25%
Use of weeds			
a. burried to the soil	32.87%	0%	0%
b. stock feed	6.52%	40%	0%
c. not being used	60.61%	73.30%	100%
Crop rotation			
a. Yes	55.79%	35%	18.75%
b. No	44.21%	65%	81.25%

Although major weeds varied between the municipalities, we consistently found some species of weeds associated with local genotype of rice in all areas. The weeds are *Echinochloa cruss-galli*, *Echinochloa colonum*, and *Leersia hexandra* (Family Poaceae), *Cyperus* spp., *Fimbristylis miliaceae* (Family Cyperaceae), *Lindernia* spp. (Family Scrophulariaceae), and *Alternanthera* spp. (Family Amaranthaceae). *Echinochloa cruss-galli* is one of ten world worst weeds (Holm *et al.*, 1988) and is an economically important weed of rice for 90% loss of rice (Kwesi *et al.*, 1991). Consequently, its presence in rice field should be taken into account especially its seeds could germinate even after six period of rice planting season (Azmi *et al.*, 1995). *Cyperus* spp is another species of weed found frequently in rice field. However, not all species form this Genera has been considered important weeds to rice plant and their presence in small number will not reduce rice yield economically (Soerjani *et al.*, 1987). *Cyperus iria* and *Cyperus difformis* were

found in two subdistricts in Kabupaten Agam with very low number of individuals. These two species are considered major weeds in rice cultivation (de Datta *et al.*, 1970) but their early growth is inhibited by water logging at the vegetative stage of rice growth. Therefore, these species are often found at the end of rice vegetative stage when the field is not inundated.

Herbicide application to control weeds has reduced the growth of weeds. There was significant loss of rice yield when grown in association with weeds without being controlled. The herbicide was able to prevent yield loss up to 38% (Table 2).

Tabel 2. Yield (t/ha) of various local genotype of rice in response to herbicide treatment

Location (genotype)	Rice Yield (t/ha) *		% Yield Loss
	With Herbicide	No Herbicide	
Agam (Kuriek Kusuik)	6.17 a	4.38 b	29.01
Padang (Anak Daro)	6.26 a	3.92 b	37.38
Solok (Cisokan)	6.51 a	4.20 b	35.58

Means for a particular location followed by a different letter differ at P≤ 0.05 in t-Dunnet.
* Rice yield was measured at water content of 14%

Rice grown in association with rice in Padang shows the lowest yield compared to other locations resulted from the presence of *Echinochloa cruss-galli* and *Echinochloa colonum*. These two weed species had the highest value of dominance (Summed Dominance Ratio – SDR) in all subdistricts in Padang. Although their seed weight is very low (5% of rice grain weight each) these weeds are highly competitive to rice plants (Soerjani *et al.*, 1987). In all locations, weeds grew together with rice resulted in severe loss of rice yield. Therefore, weed control is essential in rice cultivation to achieve optimum yield.

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