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Effect of Cultural Practices on Growth and Yield of Weedy Rice and Direct Seeded Rice Population in Malwatta Region of Ampara District in Sri Lanka.

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Abstract: Weedy rice (WR) (*Oryza sativa f. spontanea*) was first reported in 1990 and it is occurring with varying population densities in all agro-ecological zones in Sri Lanka. Location field trial was conducted on rice field in Malwatta area during May to August 2018 in *Yala* season to study the effect of cultural practices on growth and yield of weedy rice and direct seeded rice (*Oryza sativa*)(AT362). Seven rice farmers having one rice field per farmer, F1, F2, F3, F4, F5, F6 and F7 from 7 different sampling sites were selected for this study. Preliminary Study of the infestation of weedy rice was con ducted The sites were selected on the basis of previous observations of the infestation of weedy rice. It was noted that those farmers followed different cultural practices from land preparation until harvesting. Information on the cultural practices followed by the farmers was recorded on a regular basis by individual contact. Samples were observed and collected from seven rice fields at least 300m distance between plot and at least 50m between from each sample collection point from each location. Sampling points were noted as S1, S2, S3. Samples were collected in 3 different stages as seedling stage, flowering stage and maturity stage. Samples were randomly taken by using 1 x 1m^2 quadratic frame randomly in the selected field. Different types of samples collected in different stages found within the frame have carefully counted and uprooted from each throw. bags were brought to the laboratory to evaluate the population, plant height, number of tillers, number of panicles, panicles height, number of spikelets per panicle, number of grain within 1 m^2 and yield within 1 m^2. The collected data were analyzed statistically and mean differences among the yield and different farmers under different growth stages were adjudged as per Duncan's Multiple Range Test (DMRT) at 5% level of significance. The result of this survey shows that, the source of seed paddy and cultural practices applied by the farmers in different growth stages impact on the weedy rice population and this leads to impact on growth and yield of direct seeded rice in the selected area. This experiment determined the effective control of weedy rice cannot be based on one single practice, but should rely on a complex management programme based on an appropriate combination of preventative, cultural, mechanical, chemical and genetic means.

Keywords: Cultivated rice, Growth, Yield, Weedy rice

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Introduction

Sri Lanka being an agricultural country, majority of the rural population involved in paddy cultivation as their main livelihood. Paddy has been grown from time immoral in Sri Lanka. About 1.8 million families of the island are engaged in paddy farming and employ 39 percent of the Jobbers in the country. History of paddy cultivation in Sri Lanka goes back to 543 B.C (Rupasinghe *et al*., 2013).

Paddy occupies 34% of the total cultivated area of the country and it is the single most and extensively cultivated crop in Sri Lanka. In the island country, there are several niches where rice farming is practiced with different technologies (Perera, 2010). Rice is the most liked and most preferred staple food in the island. The paddy crop contributes 15 percent of agricultural output, which is the highest contribution made by any single agricultural commodity (Karunaratne *et al*., 2017).

Weedy rice is taxonomically classified as the same species as cultivated rice and becoming a serious problem in rice growing areas all over the world. It is being genetically close and having a similar physiological and life history to that of cultivated rice, has made a vast challenge to rice farmers. Weedy rice was first reported in Ampara district of Sri Lanka in 1997 (pers comm. with farmers). Recently many farmers from rice production areas such as Ampara, Vavuniya, Kurunegala, Mathara, Puttlam complained that their paddy fields cannot be cultivated due to weedy rice problem and they informed that their yield losses due to the weeds range from 50% to 100%. At present it is spreading in an alarming rate irrespective of agro ecological regions zones and threatens food security in the country.

Controlling weedy rice is difficult due to its physiological and morphological similarity to commercial rice varieties, easy seed shattering and seed dormancy. Weedy rice seeds usually have a red pericarp, although some strains have white pericarps (Abeysekara *et al*., 2010). It is characterized by early tailoring and flowering as well as anthocyanin pigmentation of different plant parts such as collar, ligule, grain apiculus, sigma and awns (Amirul *et al*., 2016). Since it is considered as a natural hybrid between cultivated rice and wild rice it may be possible to use as a bridge to transfer gene from secondary gene pool to cultivated rice. It may also contain important genes which can be incorporated into the cultivated varieties.

Weedy rice is becoming common in most of the rice growing areas in Sri Lanka. In mid1990's, weedy rice was first identified as a threat in Vavunia, Ampara, and Batticaloa, districts (Marambe and Amarasinghe, 2000) and since then it has spread in varying population densities, over all agro-ecological regions of the country. At present, weedy rice infestation is widely distributed in Puttlam, Ampara, Anuradhapura, Polonnaruwa, Kurunegala and Matara districts (Ratnasekera *et al*., 2014). This raises production costs and diminishes crop quality. Lack of a selective herbicide for the control of weedy rice, or other effective measures, has made its control as subject of national significance.

Understanding of the key biological and ecological processes and crop management practices are important to control weedy rice. The most affected areas of weedy rice are where direct seeding is commonly practiced. Weedy rice is a serious threat in direct-seeded rice systems as it competes with cultivated rice, decreases crop yield, and reduces market value of the harvested crop due to contamination. Site visits in the province showed that rice farmers totally abandoned their paddy fields where severe weedy rice infestation occurred.

As labour and or water costs rises in many Asian countries, transplanting of rice seedlings, the well adapted crop establishment method, has been replaced by direct seeding (DS) where the emergence of WR is assumed to have initiated. Direct seeded rice ecosystems provide environments conducive for the emergence and propagation of WR as compared to transplanted rice having standing water that suppress the emergence of WR at the early stages of the crop. Furthermore, selective herbicides to control WR are yet to be identified. Thus, managing WR is a challenging problem for farmers because of its morphological and physiological similarities to cultivated rice. Weedy rice can cause severe yield losses to cultivated rice in relation to the density, type of weedy plants and cultivated varieties. Short varieties are usually more susceptible to WR competition than tall ones.

Rice is the principal source of food for more than half of the world population. It is grown on approximately 153 Mha globally, of which 90% of the area is in Asia. Rice is traditionally grown in Asia by manual transplanting of seedlings into puddled soil. In the recent years, there have been concerns of labour and water shortages in many areas along with the problem of uncertainty of rainfall due to climate change. Rural labour is migrating to the cities and labour costs have thus increased rapidly. It is also hard to find labour at the time of rice transplanting. By 2025, a significant amount of rice area may suffer from 'physical' and 'economic' water scarcity.

All these factors forced the farmers to shift from transplanting to direct seeded rice (DSR) system. Although there are several advantages of direct seeded rice, weeds are the major constraints in direct-seeded rice production because of the absence of the suppressive effect of standing water on weed growth at crop emergence and the absence of stage difference between the weeds (Abidin *et al*., 2010). Among these weeds, weedy rice is the most problematic one which is difficult to manage causing huge yield loss to rice producers. Ratnasekera *et al*. (2014) reported weedy rice as one of the most problematic weeds in 21st century which affects rice yields seriously.

Weedy rice is an unwanted plant of the genus Oryza that infest and compete with rice and other crops and produces grains with a distinctly red or rough pericarp, But its infestation was first reported in Malaysia in 1988, in Philippines in 1990, and in Vietnam in 1994 (Abidin *et al*., 2010). In India, infestation was first reported in 1994, but in Kerala infestation became serious from 2005. It is known by different names like Padi Angina in Malaysia, Khoanok in Thailand, Valvi in Sri Lanka, Junglidhan in India and Varinellu/ Meesha in Kerala. Until recently, India had no problem of weedy rice due to the fact that transplanting was the main planting method. Reduced labour and decreased availability of irrigation water compelled farmers to shift from transplanting to DSR as a result weedy rice problem in India (Singh *et al*., 2013).

Weedy rice is becoming common in most rice growing areas in Sri Lanka. In mid1990's, weedy rice was first identified as a threat in Vavunia, Ampara, and Batticaloa, districts and since then it has spread in varying population densities, over all agro-ecological zones of the country. At present, weedy rice infestation is widely distributed in Puttlam, Ampara, Anuradhapura, Polonnaruwa, Kurunegala and Matara districts. The objective of this study is to identify the growth and development of weedy rice (*Oryza sativa* f. *spontanea*) on growth and yield of direct seeded rice (At362) in "Malwatha" region of "Ampara" District.

Materials and Methods

Experimental Site

This study was conducted in the Ampara District, Malwatha area which is approximately 10 km from Ampara and 3 km from Rice Research Station Sammanthurai. Field trial was conducted on rice fields in Malwatta area during May to August 2018 in *Yala* season. The study area, Ampara belongs to the Low country Dry Zone having a mean annual rainfall of less than 1750mm. The rice field sites were selected on the basis of previous observation of the infestation of weedy rice. At the initial stage of the study, weed surveys were performed to record the severity of weedy rice infestation, based on visual scoring, to determine the sampling plots by field assistants who has experience in identifying the weedy rice.

Sampling Technique

Seven rice farmers having one rice field per farmer, F1, F2, F3, F4, F5, F6 and F7 from 7 different sampling sites were selected. It was understood that those farmers followed different cultural practices from land preparation until harvesting. Information on the cultural practices followed by the farmers was recorded on a regular basis by individual contact.

Samples were observed and collected from seven rice fields at least 300m distance between plot and at least 50m between from each sample collection point from each location. Location of the samples collected point noted as S1, S2, S3 (Table 1).

		Farmers Plot						
		F1	F2	F3	F4	F5	F6	F7
Samples	S1	F1S1	F2S1	F3S1	F4S1	F5S1	F6S1	F7S1
	S2	F1S2	F2S2	F3S2	F4S2	F5S2	F6S2	F7S2
	S3	F1S3	F2S3	F3S3	F4S3	F4S3	F6S3	F7S3

Samples were collected from 3 different stages

1. Seedling Stage
2. Flowering stage
3. Maturity stage

Samples were randomly taken using 1 x 1m^2 quadratic frame. The frame was thrown randomly in the selected field. Different types of samples collected in different stages found within the frame have carefully counted and uprooted from each throw. Labeled samples were put into a bag to bring to the laboratory to evaluate the population, plant height, number of tillers, number of panicles and panicles height.

Farmer Survey

The following data were collected at 5th weeks (Seedling stage), 11th weeks (flowering stage) and 15th (Maturity stage) from seven farmers. Samples of 21 locations were randomly selected from each treatment for data collection. Data collected through farmer survey were weedy rice Population / Plant Population, Plant height (cm), Number of tillers per plant, yield and yield components, number of panicles per plant, length of panicle, number of spikelets per panicle, number of grains within 1 m^2 and yield in g within 1 m^2.

Statistical Analysis

The data measured were statistically analyzed using Analysis of Variance (ANOVA) to detect the significance if any at treatment level. The difference between treatment means was compared by Duncan Multiple Range Test (DMRT) using SAS package version 9.1.

Results and Discussion

Farmer Survey

The result of the farmer survey on the cultural practices applied by the selected 7 rice farmers are shown in Table 2 and 3.Out of seven farmers only 4 farmers (F1, F5, F6 and F7) obtained the seed paddy from seed paddy farmers or local suppliers. Before land preparation 5 farmers (F1, F4, F5, F6 and F7) burn the straw after previous cultivation which is a good practice to control weeds. Before seeding and during seeding few farmers (F5, F6 and F7) followed good practices such as herbicide application after first tillage, pre planting herbicide application, deep (8cm) tilling (4th tillage), cow dung application before ploughing, water seeding (direct), proper seeding rate (2.5 bushel per acre) and clean farm implements regularly. Further during seedling stage field surveillance and monitoring was done by all farmers except F1. During flowering stage manual weeding was done by F2, F4, F5, F6 and F7. Further regular field inspection was done by F6 and F7 farmers. In addition,F7 farmer has livestock movement in his field. Therefore, F7 farmer has followed all 12 good practices followed by F6 and F5 farmers.

Table 2. Cultural practices followed by selected 7 farmers in their rice fields during the cultivation period.

Cultural Practices	Farmers						
	F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**
Source of seed paddy							
Self served	No	Yes	No	Yes	No	No	No
Seed paddy farmers / local supplier	Yes	No	No	No	Yes	Yes	Yes
Certified Seeds	No	No	No	No	No	No	No
Farmer to farmer	No	No	Yes	No	No	No	No
Before land preparation							
Cut stable and spread the straw evenly	No	Yes	Yes	No	No	No	No
Burn the straw after previous cultivation	Yes	No	No	Yes	Yes	Yes	Yes
Before / during seeding							
First tillage at dry culture	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Apply herbicide after first tillage	Yes	No	No	No	No	Yes	Yes
Second tillage at wet culture	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spray of pre planting herbicide	No	No	No	No	No	Yes	Yes
Third tillage (wet / dry)	No	No	No	No	No	Yes	Yes
Deep tilling (8cm) - 4th tillage	Yes	Yes	No	No	Yes	Yes	Yes
Land leveling and smothering	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3: Cultural practices followed by selected 7 farmers in their rice fields during the cultivation period.

Cultural Practices	Farmers						
Before / During seeding	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**
Stale seed bed technique	No	No	No	No	No	No	No
Applied cow dung before ploughings	No	No	Yes	Yes	Yes	No	Yes
Water seeding - direct	No	No	Yes	No	Yes	No	Yes
Wet direct seeding	Yes	Yes	No	Yes	No	Yes	No
Applied inorganic fertilizer	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Seeding rate (2.5 bushel / Acre)	No	Yes	Yes	No	Yes	Yes	Yes
Highest pant density (3 bushel / Acre)	Yes	No	No	Yes	No	No	No
Clean farm implement	No	No	No	Yes	Yes	Yes	Yes
Other routing activities							
a) Repairing irrigation channel	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b) Cleaning and repairing levees	Yes	Yes	Yes	Yes	Yes	Yes	Yes
c) Using rats baits and traps	No	No	No	No	No	No	No
Seedling stage							
Flooding	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Livestock movement	No	No	No	No	No	No	No
Field surveillance and monitoring	No	Yes	Yes	Yes	Yes	Yes	Yes
Application of N_2 Fertilizer	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Flowering stage							
Chopping by bush cutter	No	Yes	No	No	Yes	Yes	No
Manual weeding / Hand removing	No	Yes	No	Yes	Yes	Yes	Yes
Chemical topping / Weed wipes	No	No	No	Yes	Yes	Yes	No
Livestock movement	No	No	No	No	No	No	Yes
Regular field inspection	No	No	No	No	No	Yes	Yes
Flooding	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Weedy Rice Population

Seedling Stage

Weedy rice population differed significantly ($p<0.05$) among the selected 7 farmers (Figure 1). This result shows that all the selected farmers having weedy rice problem in their field. The highest weedy rice population observed in F3 farmer's plot (197) and lowest weedy rice population observed in F6 farmer's plot (50). The farmer F3 has used seed paddy from non reputed source (farmer to farmer). Before land preparation he cuts stable and spread the straw evenly in their land. It enhances germination of the lower buried weedy rice seeds. Farmers F6, F7 plots had lowest weedy rice problem because they used seed paddy from local seed paddy supplier. It may contain less amount weedy rice mix, also these two farmers were burned the straw after harvesting.

Using clean, certified seed from a known source and keeping machinery and canals free from weed seeds and infestations is an effective way of controlling weedy rice populations. Manual weeding and good land preparation can also reduce initial infestations of weedy rice. Transplanting had been the major method of weedy rice control (Somaratne *et al.*, 2014). Appropriate water management particularly on timing and depth of flooding are important factors for controlling weedy rice grown in rice ecosystem (Somaratne *et al.*, 2014).

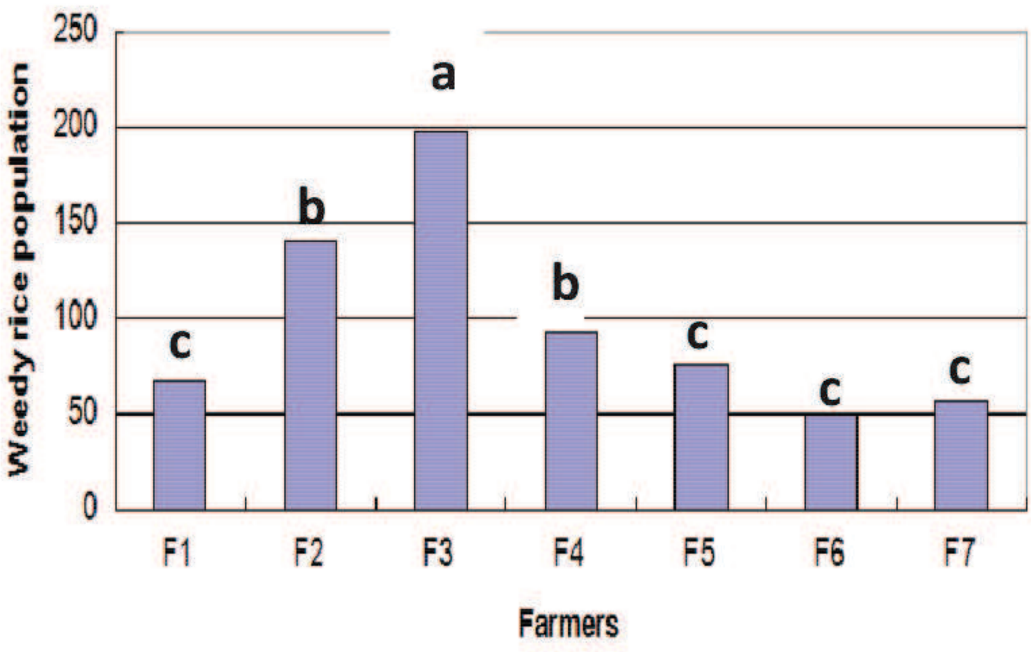

Figure 1: Average weedy rice populations

Flowering Stage

There was a significance ($p<0.05$) different between farmers in terms of population of weedy rice and cultivated rice (At362) in flowering stage (Figure 2). The highest weedy rice population was observed in F4, F3, F2 (61, 51, 51) farmers respectively whereas lowest was observed in F6 (10) farmer. At the same time highest cultivated rice population was observed in F7 (404) and F6 (403) farmers and not significantly different between other 5 farmers. Farmers F6 and F7 applied following cultural practices such as first tillage at dry culture, applied herbicide after first tillage, second tillage at wet culture, spray of pre-planting herbicide, third tillage, 4th tillage (deep tilling - 8cm) land leveling and smothering to suppress weeds.

Rice plants require oxygen, moisture, and optimum temperature for germination and if one of these factors is missing it may cause a reduction in rice germination. In the water-seeding technique, pre-germinated rice seeds are sown on well-leveled soils having minimum residue with clear standing water by the broadcasting method to decrease the weedy rice population.

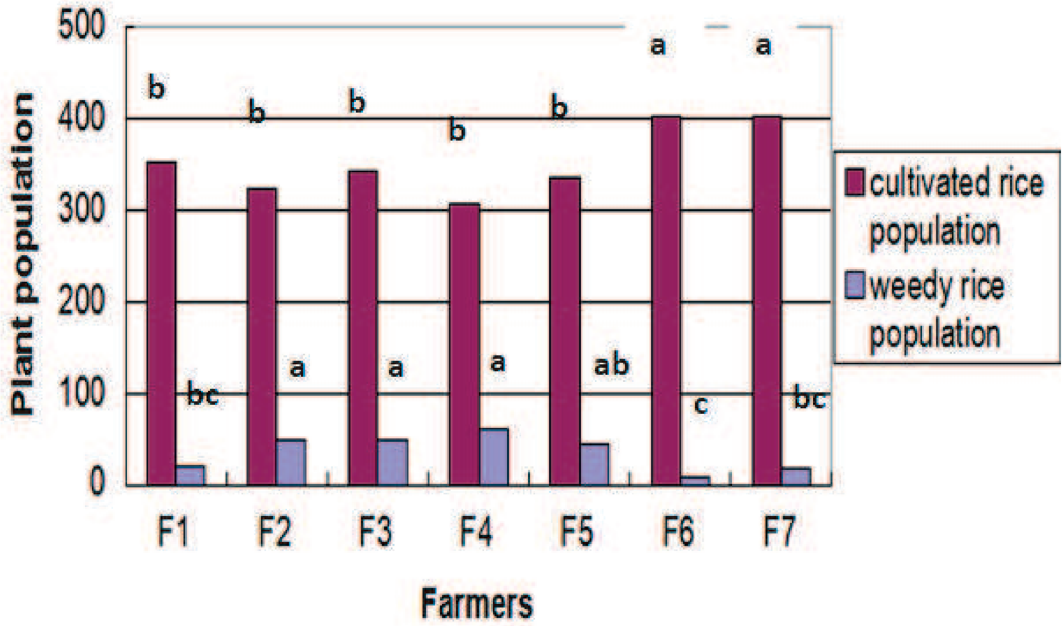

Figure 2: Average populations (in number/ m^2) of (number/m^2) at seedling stage. weedy and cultivated rice (At362) at flowering.

Note: Different letters denote significant differences between treatments ($P\leq0.05$) by least significant difference test.

Maturity Stage

There were significant ($p<0.05$) differences between treatments of average weedy rice and cultivated rice population in maturity stage. The highest amount of average weedy rice (194) and cultivated rice (At362) population (217) was found in F7 farmer (Figure 3). The lowest amount of average weedy rice population was found in F6 farmer. F6 farmer had the lowest average weedy rice population during seedling stage and flowering stage. F6 farmers practiced chemical topping to wipe weedy rice, manual weeding and chopping the weedy rice by bush cutter. These combine application methods will disturb the growth and productivity of weedy rice. These methods will reduce the canopy of weedy rice and cultivated rice. Then it can grow without competition due to less shattering by weedy rice. Also cultivated rice will gain more nutrition and sunlight for highest photosynthesis. Lowest average cultivated rice (At 362) population was found in F1 farmers. This farmer did not adopt any prevention measures to control weedy rice.

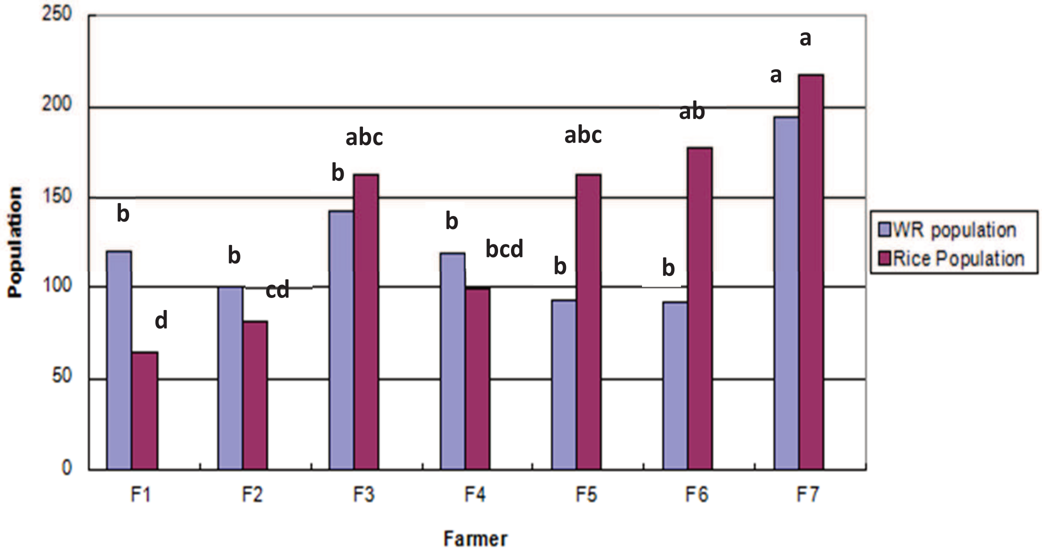

Figure 3: Average populations (in number//m^2) of weedy rice and cultivated rice - maturity stage.

Growth Parameters

Shoot Height (cm) at Flowering Stage

There is significant difference ($p<0.05$) between weedy rice shoot height and cultivated rice shoot height (Figure 4). The highest weedy rice shoot height (126.7cm) and cultivated rice shoot height (95cm) were found in F7 farmer and the lowest height (99cm) of weedy rice shoot height was found in F6 farmer. The lowest shoot height of cultivated rice was found in F3 (67.3cm). F7 farmer applied cow dung before ploughings and applied inorganic fertilizer during the flowering stage. Therefore, the shoot height might have increased in F7 farmer's field.

Shoot Height (cm) at Maturity Stage

There is no significance found within the average shoot length of weedy rice and

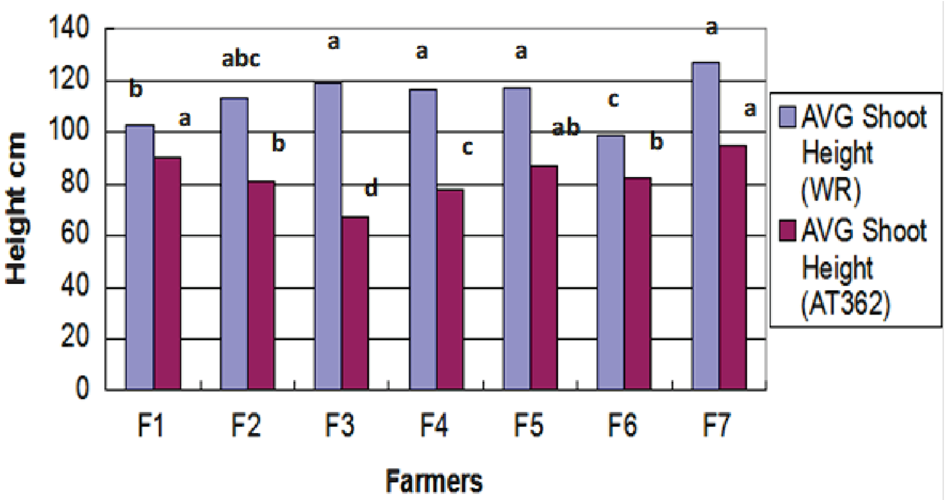

Figure 4: Average shoots height of plant at flowering stage

there was significant difference between the treatments in shoot height of cultivated rice (At362) (Figure 5). The highest cultivated rice (At362) shoot height (108cm) was found in F5 and F6 farmers due to lowest weedy rice population in this stage. These farmers applied cow dung before ploughing which improves the soil nutrients and increased the shoot height. The lowest cultivated rice (At362) shoot height (77cm) was found in F1 farmer.

Good water management is another alternative for weedy rice control. Flooding fields at the appropriate time and depth can help in suppressing weedy rice emergence and growth. In Vietnam, a water depth of more than 5 cm was found to suppress the germination and emergence of weedy rice. Early flood establishment after crop establishment can help suppress weedy rice. Mineralization and immobili zation are biochemical in nature that mediated by the activities of microorga

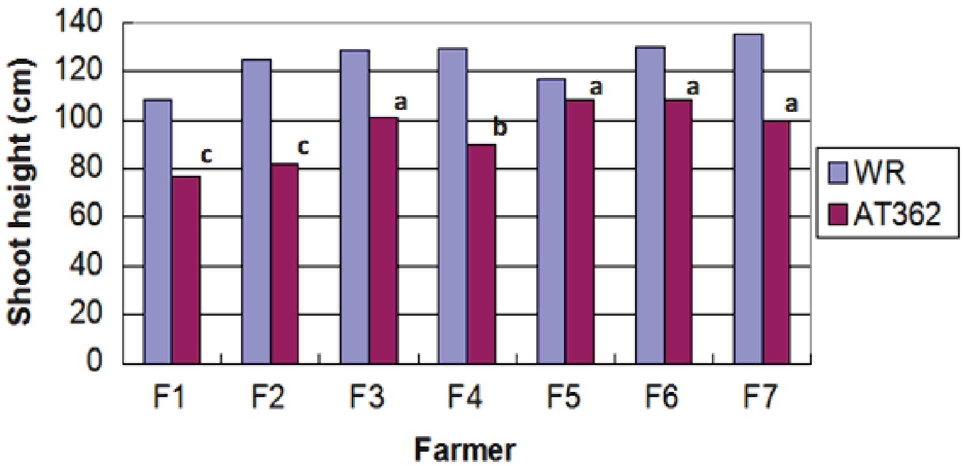

Figure 5: Average shoots height at maturity stage.

nisms. The rate and extent of mineralization determines crop availability of nutrients. The transformation of N, P and S in soil depends on the quality and quantity of organic matter in soil. Cow dung is well known organic manure in the country. Soil organic matter improves the physicochemical properties of the soil and ultimately promotes crop production. Recently the attention is focused on the global environmental problems; utilization of organic manures as the most effective measure for the purpose. Application of cow dung needs to be done for the improvement of soil physical properties and supply of essential plant nutrients for higher yield, necessary for BRRI dha-33. It was found that cow dung manure can supply plant nutrients and thus can contribute to plant growth (Somaratne *et al*., 2014).

Yield Parameters

Number of Tillers at Maturity Stage

There was significant ($p<0.05$) difference between treatment of number of tillers of weedy rice and cultivated rice (At362) in maturity stage (Figure 6). The highest average number of weedy rice tillers (19) was found in F7 farmer due to highest weedy rice population, adopted organic, inorganic fertilizer application, optimum plant density and manual weeding. The lowest average number of weedy rice tillers (2) found in F1 farmer due to lowest shoot height, poor tillage and irregular field inspection. The highest average number of cultivated rice (At362) tillers (21) found in F7 farmers was due to highest plant population and highest fertilizer application and the lowest average number of cultivated rice (At362) tillers (8) found in F1 and F3 farmers due to poor tillage and irregular field inspection.

Weedy rice is generally taller and posses heavily tillering ability, more open or spreading, have weaker culms, are more

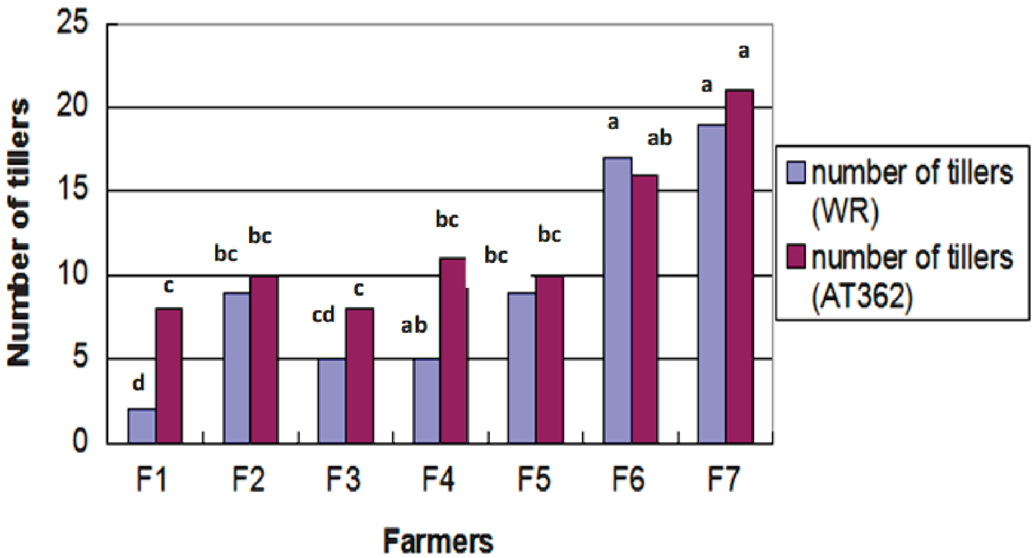

Figure 6: Number of tillers of weedy rice

susceptible to lodging, produce more straw, germinate and emerge a day or two earlier, emerge from greater depths, and exhibit more rapid seedling growth when compared to the cultivate rice that they infest (Somaratne *et al*., 2014). The duration of the dormancy varies according to the biotype and the storage conditions of the seeds after shattering, and could range from 1-3 years, and the longevity of weedy rice could be up to 12 years (Somaratne *et al*., 2014). Seed age, burial depth, flooding conditions and heavy soil all have a negative influence on weed germination and emergence. The germination of weedy rice seeds were reported to be low when compared to those of cultivated varieties (Marambe, 2009).

Average Number of Spikelet per Panicle

It was found that there were significant ($p<0.05$) differences between treatments in the average number of spikelets per panicle of cultivated rice (At362) plant during the maturity stage. The highest average number of spikelets per panicle of cultivated rice was found in F5 farmers (14) and the lowest average number of spikelet per panicle of cultivated rice plant was found in F1 and F3 (6) farmers (Figure 7). In F5 farmer field lower amount (93) of average weedy rice population and the highest average number (163) of cultivated rice population in maturity stage were obtained. Therefore, highest average number of spikelet per panicle was obtained in F5 farmer's field in maturity stage. Also this farmer had the highest cultivated rice (At362) shoot height (108cm). Further F5 farmers followed 10 good practices out of during the cultivation.

Yield (g / Sq.ft)

There was significant ($p<0.05$) differences between treatments in yield of weedy rice and cultivated rice (At362) / sq.ft

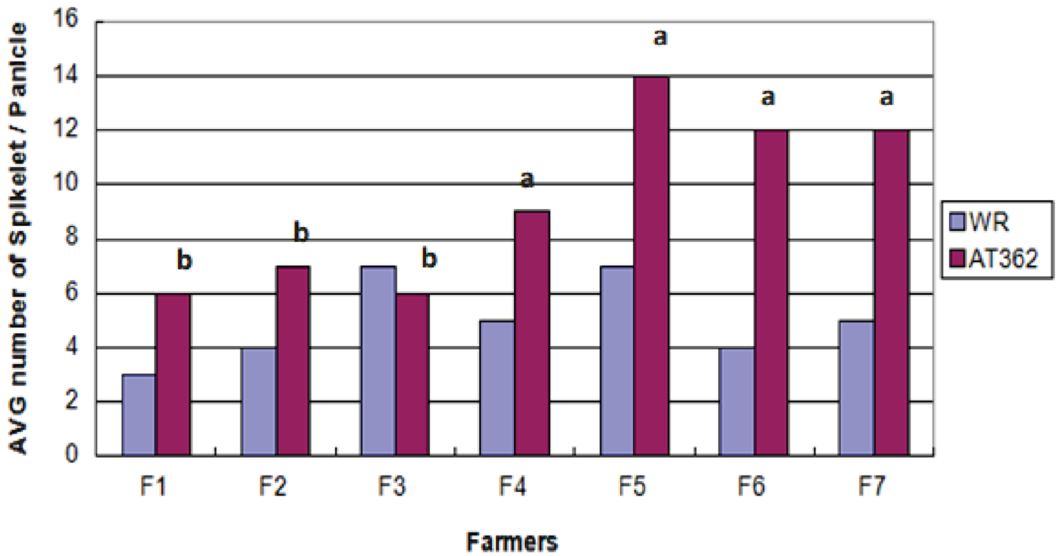

Figure 7: Average number of spikelet per panicle during Maturity stage

and cultivated tice in Maturity stage

(Figure 8). The highest yield (32.7g) of cultivated rice (At362) yield / sq. ft found in F5 and F7 farmers and he lowest yield (12g) of cultivated rice / sq.ft found in F3 farmer. The highest yield (4g) of weedy rice / sq.ft found in F3 farmer and lowest yield (1.66) of weedy rice /sq.ft found in F2 farmer.

The highest yield of cultivated rice / sq.ft was observed in F5 and F7 farmer's fields due to lowest yield of weedy rice / sq.ft. When considering the cultural practices of both farmers, they used seed paddy from local seed paddy farmers, before land preparation they burn the straw after previous harvest, first and second tillage, deep tilling at 8cm, applied cow dung before ploughings and both practice water seeding.

Tillage plays an important role in controlling weedy rice populations in direct seeded rice (DSR). Weedy rice seeds emerge from shallow soil depths; therefore, weed seeds present in the upper soil layer can be buried deep by deep ploughing. Under zero-till conditions, weedy rice seeds present in upper soil layers can be depleted before rice crop sowing by employing the stale seedbed technique. Residue should be retained on the soil surface as mulch under zero-till conditions can help in reducing weedy rice recruitment.

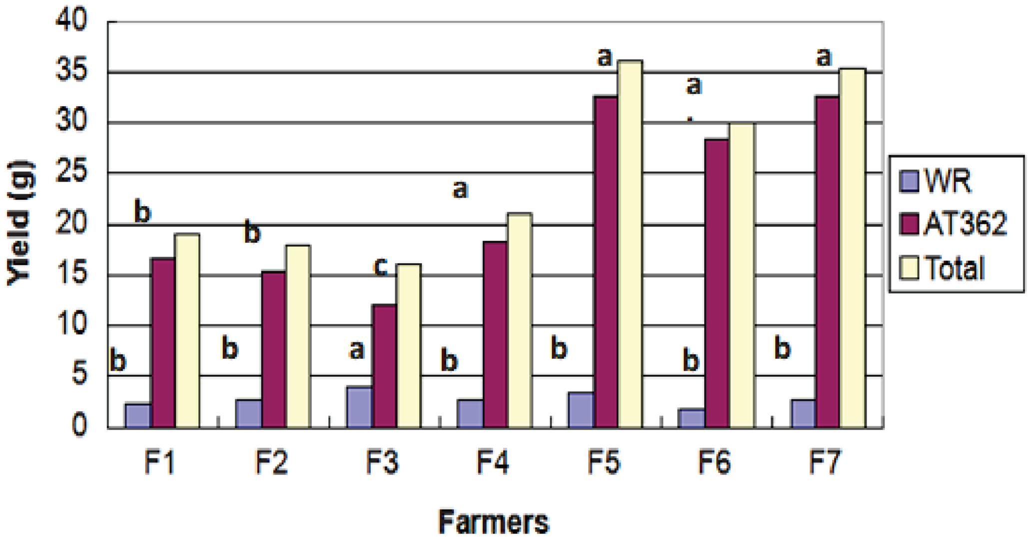

Figure 8: Yield / sq. Ft of weedy rice and cultivated rice.

During the flowering stage F5 and F6 farmer followed hand weeding, chopping by bush cutter and chemical topping. F7 practiced hand weeding. Chopping is applicable for controlling weedy rice plants, which are taller than cultivated rice. The panicles are chopped from the weedy rice plants before seed setting takes place. Weedy rice plants growing taller than cultivated rice can be controlled by treating them with foliar herbicides respectively, by using a wiper / wick applicator. This technology helps in reducing viable seed setting / production. Weed wipers are made up of a frame with a rope, sponge, or carpet that can absorb the herbicide solution and wipe it on the weeds without affecting the crop adversely because of the difference in the height of the crop and weed. This technology can be more useful if using short stature rice cultivars than tall cultivars because some of the panicles of weedy rice can remain below the crop canopy of tall cultivars and therefore not be exposed to wipers.

Conclusions

This experiment determined the effective control of weedy rice cannot be based on one single practice, but should rely on a complex management programme based on an appropriate combination of preventative, cultural, mechanical, chemical and genetic means. The highest yield of cultivated rice / sq.ft was observed in F5 and F7 farmer's fields due to the lowest infestation of weedy rice / sq.ft. When considering the cultural practices of both farmers, they used seed paddy from local seed paddy farmers, before land preparation they burn the straw after previous harvest, first and second tillage, deep tilling at 8cm, applied cow dung before ploughings and both practice water seeding. During the flowering stage, F5 and F6 farmer followed hand weeding, chopping by bush cutter and chemical topping. F7 practiced hand weeding. A management programme aimed at local eradication at the field level followed by integrated management strategies should be given prime attention to sustain rice production.

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