

CONTROL OF WEEDY RICE IN DIRECT-SEEDED RICE USING THE CLEARFIELD PRODUCTION SYSTEM IN MALAYSIA

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ABSTRACT

Weedy rice (Oryza sativa complex) is a serious threat to direct-seeded culture in Malaysia because of its taxonomic and physiological similarities to cultivated rice. This weedy rice problem was first observed in 1988 but later became widespread and prevalent in rice cultivation in the 2000's. Farmers have considered weedy rice as of significant importance and a serious threat since no selective herbicide was available for controlling it prior to the advent of an imidazolinone tolerant variety (IMI-TR). The development of local IMI-TR rice, a collaborative project between MARDI and BASF (Malaysia) Sdn Bhd, started in 2003 at MARDI Station in Penang. IMI-TR Line No. 1770 from USA was crossed with a popular local rice cultivar MR 220 using conventional breeding techniques. The goal of the project is to offer farmers an effective and farmer friendly solution to the weedy rice problem with minimal changes to their normal practices. Two locally developed IMI-TR varieties namely MR 220CL1 and MR 220CL2 together with the technique known as Clearfield Production System (CPS) were officially launched on the 8th July 2010 in FELCRA Seberang Perak rice granary. This CPS for rice was the first launch in Malaysia as well as in the Asia Pacific Region. This system is justified by the need to offer an innovative alternative method to manage weedy rice in wet-seeding culture. The CPS package for rice consists of three main components namely Clearfield certified seeds, OnDuty® herbicide (imazapic/imazapyr) and the Stewardship Guide. The seeds are supplied in standard 20 kg bags while the OnDuty® herbicide is packed in a box of 4 sachets of 31 g each. The seed rate per ha is 7 bags (140 kg/ha) which is the normal seed rate used by farmers. The seeds and OnDuty herbicide are sold together as a package to ensure that; a) both seeds and herbicides are available together at all times, b) OnDuty herbicide and seeds are applied at the correct rate, and c) the correct variety together with the correct herbicide are used. To ensure successful crop establishment and attainment of high yield of Clearfield rice varieties, standard good agricultural practices have to be implemented and followed from sowing to harvesting. All these practices are basically similar to practices currently adopted by farmers in Malaysia.

Keywords: Clearfield Production System, direct-seeded, imidazolinone, rice, weedy rice.

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INTRODUCTION

A major factor that contributes to a higher production cost for rice is weed control. Currently, rice farmers throughout the world face a unique weed problem. A weedy relative of cultivated rice known as weedy rice has invaded and severely infested rice fields. Weedy rice has long been a major threat in the direct-seeded rice culture in Asia, especially in Malaysia. Because of the close genetic relation to commercial rice, weedy rice has proved to be difficult to control, as it cannot be controlled with conventional rice herbicides. Weedy rice biotypes have morphology similar to cultivated rice varieties and, therefore, are more difficult to control compared to other weeds. Weedy rice cannot be harvested and reduces yield because it matures earlier than cultivated rice, shatters and lodges easily. Under moderate weedy rice infestation (15-20 panicles m^{-2}), yield loss is approximately 12 to 15%; under high infestation (21 to 30 panicles m^{-2}) yield loss is 15 to 22%; while under heavy infestation (more than 50 panicles m^{-2}), lodging of weedy rice plants may occur and can cause total yield loss under tropical climatic conditions (Azmi and Abdullah, 1998; Azmi and Karim, 2008).

Herbicide-tolerant rice cultivars may hold the answer to effective management of problem weeds especially weedy rice (*Oryza sativa* complex) in direct-seeding in Malaysia (Azmi and Karim, 2008). It is estimated that USD 40 million in rice yield value is lost to weedy rice competition every season. Following the discovery of weedy rice in 1988, it has rapidly become an important and prevalent weed in all grain areas in Malaysia.

The combination of imidazolinone tolerant varieties (MR 220CL1 and MR 220CL2) with imidazolinone herbicides is known as the Clearfield Production System (CPS). Clearfield Rice Production System is able to effectively control weedy rice, which no other herbicides or system can control in wet-seeding culture. The use of the CPS will directly benefit the rice industry in Malaysia by providing an effective chemical control for the management of weedy rice and other noxious paddy weeds. The CPS is the first herbicide tolerant rice to be introduced in Malaysia that is non GMO, and signifies the beginning of a paradigm shift in modern agriculture for effective weedy rice control.

The Clearfield Production System

The use of a herbicide tolerant rice variety will benefit the rice industry and farmers:

- √ Herbicide tolerant cultivars will help to lower the cost of weed management making rice cultivation even more cost effective.
- √ The use of the imidazolinone tolerant variety has been demonstrated to bring fields, that are under performing due to

heavy infestation of weedy rice (1-2 ton/ha), back into higher levels of productivity (>5.5 t/ha)

- √ This technology is cost efficient, where returns ranging from 5 to 8 times, equivalent to USD 1000 to USD 1600, could be expected from investment on this technology of about USD 200/ha.
- √ It allows good flexibility in the timing of herbicide application to control weeds not controlled by conventional means or products
- √ Replacing the larger volume herbicides with imidazolinone herbicides which are applied in much lesser volumes, will result in the reduction of herbicides released into the environment and the eco-system
- √ This technology saves water through delayed flooding because this herbicide works best and is highly effective under saturated or minimal water condition. This itself indirectly prevents Golden Apple Snail attack on rice crop as the snails become inactive under minimal water condition

Market potential

- √ It is estimated that at least 10% of the granary areas in Malaysia (20,500 ha) have a severe weedy rice problem which results in a total loss of 50,000 t/season (RM55 million). As many as 20,000 farmers could gain by using a imidazolinone-tolerant rice variety as a result of weedy rice control.
- √ Dedicated rice seed producers were appointed to produce the Clearfield certified seeds to be commercialised under the CPS. Under this system, farmers will be offered an imidazolinone tolerant rice seed package containing certified seeds, imidazolinone herbicide and Stewardship Guide

Comparisons between Clearfield Production System and major crop establishment methods

The CPS is basically the same as wet seeding technique. The field is thoroughly puddled and leveled before sowing. Sowing can be carried out using motor-blower or line seeders such as drum seeders or knapsack row seeders. Under water seeding culture, water is retained in the field for seeding. On the other hand, transplanting requires saturated soil without standing water for good crop establishment. Other comparisons are in Table-1.

Large scale evaluation

A large scale evaluation of CPS cultivation (47.62 ha) was carried out in the off season 2010 in fields seriously affected by weedy rice infestation in the previous season (main season 2009) in FELCRA Seberang Perak rice estate. Weedy rice populations were effectively controlled in the fields resulting in an average yield increment of 0.76 ton ha⁻¹ from 4.93 ton ha⁻¹ (main season 2009) to 5.69 ton ha⁻¹ (off season 2010) giving a better B/C ratio from 2.55 to 3.42 (Table-2).

Table-1. Comparisons between Clearfield Production System, mechanical transplanting, water seeding and wet seeding technique.

	Clearfield Production System	Mechanical transplanting	Water seeding	Wet seeding
Optimal field conditions	Saturated	Saturated	5-10 cm water depth	Saturated
Crop establishment	Low incidence of golden apple snail	Low incidence of weedy rice and golden apple snail	High incidence of golden apple snail attack	High infestation of weedy rice and low incidence of golden apple snail
Cost of establishment	Low	High	Low	Low
Cost of weed control	Moderate - High	Low	Low	Moderate - High
Optimal season	Off season	Main season	Main season	Off season
Equipment	Motor-blower, drum seeders, knapsack row seeder	Transplanter	Motor-blower	Motor-blower, drum seeders, knapsack row seeder
Weeds associated with planting method	A wider range of weeds i.e. grasses, broadleaves and sedges.	Broadleaves but other weeds i.e. grasses and sedges depend on time of flooding	Broadleaves are the dominant weeds	A wider range of weeds i.e. grasses, broadleaves and sedges
Weed control	Total weed control with imidazolinone herbicides with minimum roguing of weedy rice.	2,4-D, Sulfonyl ureas, pre-emergence herbicide and roguing of weedy rice.	2,4-D, Sulfonyl ureas and roguing of weedy rice.	Graminicide, 2,4-D and sulfonyl urea product followed by roguing of weedy rice.

Table-2. Financial analysis of Clearfield Production System in the 2010 off-season compared with Felcra management at Felcra Seberang Perak Rice Estate in the main 2009 season.

Block	Area (ha)	Main Season	Off Season	Yield Increment (t/ha)	Increase in Income (RM/ha)
		2009/10	2010		
		Yield (t/ha)			
T 5A	10.68	4.11	5.43	1.32	659.16
T 5B	10.88	3.84	4.61	0.77	384.51
T 6A	14.76	5.61	6.51	0.90	449.43
T 6B	11.30	6.14	6.20	0.06	29.96
Av/ha		4.93	5.69	0.76	380.76
B/C ratio		2.55	3.42		
B/C ratio*		2.29	3.08		* Sensivity analysis - return 10%
B/C ratio**		2.32	3.11		** Sensitivity analysis - cost increase 10%

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