

## The protocol of herbicides application in direct-seeded rice in Malaysia

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### Abstract

Weed management in direct-seeded rice is a holistic inter-play of agrotechnical and herbicide application operations with precision timings to maximise mortality and lowering fecundity of weed populations while giving the rice crop a comparative advantage. The universal usage of paraquat at 1.0 kg a.i./ha with or without 2,4 D IBE at 0.75 - 1.0 kg a.i./ha followed by two or three rounds of wet or dry tillage and seeding immediately after land levelling help to reduce weed populations. Pretilachlor at 0.5 kg a.i./ha applied 3-5 days after seeding (DAS) or mixtures of molinate + 2,4 D IBE (2.5 + 0.5 kg a.i./ha); molinate + bensulfuron (2.5 + 0.03 kg a.i./ha); thiobencarb + 2,4-D IBE (2.5 + 0.5 kg a.i./ha); oxadiazon + 2,4-D IBE (0.5 + 0.5 kg a.i./ha); propanil + 2,4-D amine (2.5 + 0.5 kg a.i./ha); propanil + molinate (2.5 + 0.5 kg a.i./ha) and cinosulfuron (0.04 kg a.i./ha) applied at 8-10 DAS on moist or moderately inundated field conditions (5-10 cm depth) help to control a broad spectrum of sedges, graminoids and broadleaved weeds. At 14-20 or 21-25 DAS, the respective herbicide application options are molinate + 2,4-D IBE (4.0 + 0.75 kg a.i./ha) or molinate + 2,4-D IBE (3.0 kg a.i./ha + 0.75 kg a.i./ha) followed by 2.0 kg a.i./ha of molinate 10 days later. Fenoxaprop-ethyl at 0.1-0.12 kg/ha applied at 26-30 DAS provided good control of graminoids particularly *Echinochloa crus-galli* although transient phytotoxicity to the rice crop do prevailed. Invariably, molinate + bensulfuron and molinate + 2,4-D IBE mixtures at the above rates remain a better option for effective weed management in direct-seeded rice in Malaysia.

### Introduction

Weeds have always been a principal constraint to increasing yields wherever rice is grown and Malaysia is no exception. This is especially so in the direct-seeded culture. Undoubtedly, the central issue in weed management is none other than the maximization of mortality and lowering of fecundity of targeted weed populations while giving the rice crop a comparative advantage (2). Precise timings of herbicide applications is important not only to help optimise herbicides efficacy against weeds but also minimise or protect crops against injury.

Since the advent of direct-seeding rice culture in Malaysia in the early 1980's many studies have been conducted on herbicides-based weeding regimes (e.g. 1,2,3,4). The results obtained from these studies have been found to be variable (1) and this may be attributed *inter-alia* to the spatial and temporal heterogeneities of weed species prevailing under direct-seeded rice culture in the country. In land preparation, the almost universal usage of paraquat at 1.0 kg a.i./ha with or without 2, 4 D IBE of 0.75 - 1.0 kg a.i./ha followed by two or three rounds of water dry tillage and levelling help to reduce weed populations.

This paper summarises collated data from a series of experiments on the efficacy of selected herbicides and their protocols of applications in the management of weeds in direct-seeded rice in Malaysia.

### Materials and methods

A series of field experiments were conducted in 1987-1990 in MARDI Rice Research Centre, Bumbong Lima, Malaysia to ascertain the appropriate dosages and timings of application of selected herbicides for weed management in direct-seeded rice culture. For each experiment, pre-germinated seeds of MR 84 cultivar were sown onto puddled soils at the seeding rate of 60 kg/ha. Standard fertilizer dressings were made for each plot. Recommended pesticides were applied when necessary to control insect pests and plant diseases. The fields were maintained in inundated conditions following seedling establishment until late booting stage.

The treatments were replicated four times using 5m x 5m in a randomised complete block design. Yield estimates and weed incidence (dry weight measures) from 5m x 5m crop cutting test plots for each of the chemical weeding regime were recorded and monitored. Visual phytotoxicity ratings (0 to 10) of injury to the rice plants, if any, were assessed 10 days after applications of herbicides. The means of three seasons are displayed.

### Results and discussions

The age of targeted weed seedlings, *inter-alia*, is a central factor which may influence the bioefficacy of herbicides. As such, for effective weed control early application of herbicides is desirable but crop toxicity may overrule such decision. Conversely, late application may be good for the rice crop but is usually less effective in controlling the desired weeds. In such a situation, there is a need for a prudent decision in the choice of effective but safe herbicides for weed control. For example, fenoxaprop-ethyl at 0.05 kg a.i./ha gave better control over grasses but poor on sedges and broadleaves. However, treatments with cinmethylin, fenoxaprop-ethyl or oxadiazon mixtures caused appreciable but transient injury to the rice plants (Table 1).

The weed flora in direct-seeded rice culture in these studies was predominantly graminoid-based of which *Leptochloa chinensis* and *Echinochloa crus-galli* are the major species. Other principal weeds are *Monochoria vaginalis*, *Sagittaria guyanensis*, *Ludwigia hyssopifolia*, *Cyperus iria*, *Fimbristylis miliacea*, *Scirpus grossus* and *S. juncooides*. High prevalence of graminoids such as *E. crus-galli* in the unweeded plots in 1987-90 seasons resulted in drastically low yields ca. 2700 kg/ha. All herbicide combinations, except those of oxadiazon + bensulfuron, oxadiazon + 2,4-D IBE and EPTC + 2,4-D IBE, propanil + 2,4-D amine, pretilachlor + bensulfuron and molinate + 2,4-D IBE produced yields comparable if not higher than to those recorded in hand weeded plots. Plots treated with mixtures of cinmethylin + bensulfuron, cinosulfuron, cinosulfuron + molinate, pretilachlor + bensulfuron, pretilachlor-fenclorium or quinclorac + bensulfuron gave a wide spectrum of weed control thereby registering higher yield brackets *vis-a-vis* other weeding regimes. Cinosulfuron and cinmethylin showed promising control over sedges, broadleaves and grasses (especially *E. crus-galli*) when applied at 7-14 DAS. It appears that these herbicides

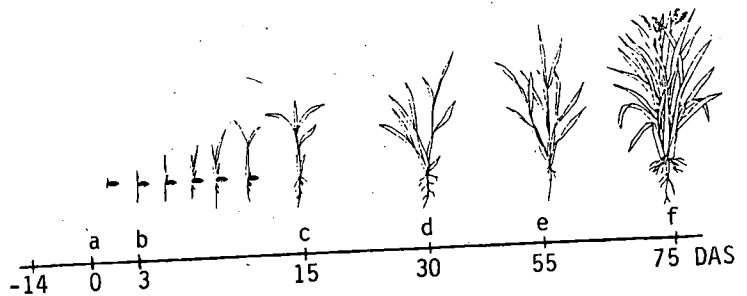
Table 1. Effect of herbicide treatments on weed incidence, crop injury and yields in direct-seeded rice cv MR 84 at MARDI Research Station, Bumbong Lima, Malaysia (1987-1990)

Herbicide	Application		Dry wt. (g/m <sup>2</sup> ) at 60 DAS			Rice	
	Rate kg a.i./ha	Time DAS*	Grasses	Broadleaves	Sedges	Injury**	Grain yield kg/ha
Cinmethylin	0.05	7	40	56	19	2.3	5378
Cinmethylin	0.10	7	21	16	2	4.5	6024
Cinmethylin + bensulfuron	0.05 + 0.03	14	11	0	3	1.0	6350
Cinosulfuron	0.04	7	1	0	0	1.0	6676
Cinosulfuron fb molinate#	0.02 + 2.00	10	0	0	0	1.0	5055
EPTC/2,4-DIBE##	0.8 + 0.4	10	106	27	27	1.0	3601
Fenoxaprop-ethyl	0.05	7	12	51	43	6.5	3790
Fenoxaprop-ethyl	0.10	20	21	16	1	6.8	5397
Fenoxaprop-ethyl	0.10	30	31	24	0	3.8	5109
Molinate + 2,4-D IBE###	4.0 + 0.75	14	6	45	16	1.0	4833
Molinate + bensulfuron	2.5 + 0.03	10	28	9	3	1.0	4723
Pretilachlor + bensulfuron	0.5 + 0.003	6	88	0	13	1.0	4808
Pretilachlor + fenclorin	0.40	4	3	5	3	1.2	6519
Propanil + 2,4-D amine	2.5 + 0.5	14	138	4	48	3.0	4420
Propanil + molinate	2.5 + 0.5	14	9	70	21	1.0	5954
Oxadiazon + 2,4-D IBE	0.5 + 0.5	10	121	1	0	6.0	4585
Oxadiazon + bensulfuron	1.0 + 0.03	10	218	5	2	5.5	3849
Quinclorac + bensulfuron	0.20 + 0.003	10	0	3	9	1.0	5708
Thiobancarb + 2,4-D IBE	2.5 + 0.5	10	200	31	26	1.0	6260
Manual Weeding (at 20 & 40 DAS)	-	-	2	2	1	-	5344
Unweeded check	-	-	139	48	62	-	2702

\* DAS - Days after seeding; \*\* - Rated 10 days after treatment on a scale of 1-10, where 1=no toxicity and 10=complete kill; # - followed by; ## - herbicides formulated as a proprietary mixture; ### - herbicides in tanks mixed and applied as such

at the tested doses and application timings holds promise for broad spectrum weed control without any appreciable toxicity problem in direct-seeded rice culture.

Against the above background and a range of herbicides available for weed control in direct-seeded rice culture in Malaysia, the protocols of application can be summarised in Figure 1.



### Herbicide

Paraquat + 2,4-DIBE —  
 Pretilachlor —  
 Molinate + 2,4-DIBE —  
 Molinate + bensulfuron —  
 Thiobencarb + 2,4-DIBE —  
 Propanil + 2,4-D amine —  
 Propanil + molinate —  
 Fenoxaprop-ethyl —  
 Thiobencarb —  
 Propanil —  
 Quinclorac + bensulfuron —  
 Cinmethylin —  
 Cinmethylin + bensulfuron —  
 Cinosulfuron —  
 Cinosulfuron fb molinate —

Figure 1. Timings of herbicide application in direct-seeded rice in relation to rice growth stages. Refer to Table 1 for rates of application. a=seeding; b=germination; c=tiller initiation; d=tillering; e=panicle initiation, and f=flowering

### References

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