

CYHALOFOP BUTYL: GRASS HERBICIDE
- FIELD PERFORMANCE IN RICE IN JAPAN -

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Summary. Cyhalofop butyl, (R)-butyl 2-(4-(4-cyano-2-fluorophenoxy)phenoxy) propionate is a new grass herbicide having outstanding selectivity between rice and *Echinochloa crus-galli*, even under conditions in which rice seedling roots are directly exposed to paddy water. The safety margin for japonica rice was over 10 times greater than the rate required for control of *E. crus-galli*. Cyhalofop butyl had consistent performance under a variety of paddy management conditions, combining rapid knockdown with short soil residuality. Neither selectivity nor efficacy was affected by leaching conditions. In field trials in Japan, cyhalofop butyl controlled *E. crus-galli* up to 4 leaf stage as a granule application and up to 6.5 leaf stage as a foliar spray, without injury to rice.

INTRODUCTION

Cyhalofop butyl, coded XDE-537 (DEH-112 in Japan), is a new post-emergence aryloxyphenoxy propionate herbicide discovered by DowElanco. Cyhalofop butyl has high selectivity between rice and target grass weeds, due to different metabolism of the molecule (1). Cyhalofop butyl kills target grass weeds within one week after application. The purpose of the present work is to elucidate the herbicidal properties of cyhalofop butyl for rice in granule and foliar spray applications.

METHODS

Field trials. In 1989 and 1990 seasons, field trials were carried out at Fukuoka field station of DowElanco division in Japan. After the paddy field was rotary-tilled, puddled and levelled, target weed seeds were infested. Rice seedlings at 2.5 leaf stage were transplanted into the paddy field at a planting depth of approximately 2 to 3 cm by transplanter a few days after levelling. The plots were separated by corrugated plastic boards. Trials with a plot size of 6 m² were block randomised with 3 replications. The granular formulation of 0.6% cyhalofop butyl was broadcasted by hand onto the water surface at appropriate timings. The EC formulation of 30% cyhalofop butyl was sprayed over the top of plants by a knapsack sprayer at 1000 L/ha of spray volume with a wetting agent at 0.03%. The water in the test plots was maintained at 3 to 4 cm deep during trial period. Weed control efficacy and crop injury were visually evaluated in comparison with the untreated plots 2 and 4 weeks after application. The soil characteristics were alluvial soil, 55.9% sand, 26.7% silt, 17.5% clay, 3.4% organic matter, CEC 20.8 meq/100 g and pH 6.5. One cm of water loss in depth was observed in a day.

Pot trials. Soil was puddled and leveled in the 1/5,000 are Wagner's pot. Pot trials for residual activity, leaching and crop tolerance were conducted at Gotemba laboratory of DowElanco in 1989 and 1990. A water level trial was conducted at Fukuoka field station in 1992 under greenhouse conditions. For the residual trial, 30 pre-germinated seeds of *E. crus-galli* were settled on the soil surface in the pot at designed days after application (0, 3, 7, 14 DAA) and

Abbreviations: EC, emulsifiable concentrate; Gr, granule; LF, leaf stage; DAA, days after application; a.i., active ingredient.

evaluated 2 weeks after seeding by visual rating with 3 replications. Water level was maintained at 3 cm. For the leaching study, *E. crus-galli* at 2 leaf stage was treated with cyhalofop butyl granules and maintained under leaching conditions at 5 cm/day for 2 days from 1 day after application with 3 replications. For the tolerance study, one group of 2.5 leaf stage rice plants were transplanted at a planting depth of 3 cm and the other were settled on the soil surface with their roots exposed to the paddy water directly. They were treated 1 day after transplanting with 3 replications. The characteristics of Gotemba soil were humic volcanic ash soil, 29.5% sand, 44.6% silt, 25.9% clay, 5.95% organic matter, CEC 67.5 meq/100 g and pH 6.25. For water level trial, *E. crus-galli* at 3 leaf stage was applied with granules of cyhalofop butyl at the water depth of 1, 2 and 3 cm with 3 replications and the water depth was maintained for 4 weeks. Temperature of both greenhouses was kept at 30°C in the daytime and 20°C in the night.

RESULTS AND DISCUSSION

Weeding spectrum (field trial). Cyhalofop butyl at 180 g ai/ha gave perfect control of 1 to 3 leaf stage of *E. crus-galli*, while it did not control any annual and perennial broad leaves and sedges (Table 1).

Table 1. Weed control spectrum of cyhalofop butyl at 180 g ai/ha (field trial)
% weed control 4WAA

	Time of application		
	1	2	3 LF
<i>Echnichloa crus-galli</i>	100	100	100
<i>Cyperus difformis</i>	0	0	0
<i>Monochoria vaginalis</i>	0	0	0
Annual broad-leaved weeds	0	0	0
<i>Scirpus juncooides</i>	0	0	0
<i>Cyperus serotinus</i>	0	0	0
<i>Sagittaria pygmaea</i>	0	0	0

Activity of cyhalofop butyl on *E. crus-galli* (field trial). The granular formulation of 0.6% cyhalofop butyl gave perfect control of 3 and 4 leaf stage *E. crus-galli* at 180 and 360 g ai/ha, while the EC formulation in foliar spray exhibited perfect control of 5 and 6.5 leaf stage *E. crus-galli* at 240 and 600 g ai/ha, respectively (Table 2).

Residual activity (pot trial). Residual activity of cyhalofop butyl was observed up to 3 days after application at 180 g ai/ha (Table 3).

Effect of leaching on activity of cyhalofop butyl (pot trial). There was no significant difference in the activity of cyhalofop butyl on *E. crus-galli* under leaching and non-leaching conditions (Table 4).

Effect of water level on the activity of cyhalofop butyl (pot trial). Deep water conditions gave better control of *E. crus-galli* than shallow water (Fig. 1). Cyhalofop butyl required a minimum water depth of 3 cm to maximise performance.

Weeds in cereals and rice

Tolerance (pot trial). Granular cyhalofop butyl at 1,080 and 2,190 g ai/ha (6 and 12 times recommended use rate) caused no injury to 2.5 leaf stage rice seedlings transplanted at a planting depth of 3 cm, and very slight/slight injury to rice seedlings of with roots directly exposed to paddy water (Table 5). No phytotoxicity was observed on rice below 1,080 g ai/ha under the exposed conditions. The symptom of injury was slight browning of leaf tips without reduction of height and weight. Cyhalofop butyl had outstanding rice selectivity, even under conditions in which rice seedling roots were directly exposed to paddy water. The safety margin of the granular formulation for japonica rice was over 10 times greater than the rate (180 g ai/ha) required for control of 3 leaf stage *E. crus-galli*. Foliar spray treatment (field trial) was also highly selective to japonica rice (Table 6).

Table 2. Activity of cyhalofop butyl on *E. crus-galli* (field trial)

% *E. crus-galli* control 4WAA

Treatment application	Rate g ai/ha	Time of application				
		2	3	4	5	6.5 LF
Cyhalofop butyl 30% EC Foliar spray	600	100	100	-	100	100
	300	100	100	-	100	-
	240	-	100	-	100	86
	180	100	100	-	80	-
Cyhalofop butyl 0.6% Gr	360	100	100	100	83	-
	180	100	100	85	63	-
	90	97	93	70	47	-
	45	80	73	-	-	-
Quinclorac 1% Gr	600	100	100	98	80	-
	300	100	100	87	70	-
	150	98	73	60	27	-
	75	67	40	23	-	-

Table 3. Residual activity of cyhalofop butyl in granule (pot trial)

% control of *E. crus-galli* seedlings

Cyhalofop butyl 0.6% Gr	Interval between herbicidal application and seeding			
	0	3	7	14 days
180 g ai/ha	100	98	45	16

Efficacy was evaluated 2 weeks after seeding

Table 4. Effect of leaching on activity of cyhalofop butyl (pot trial)

Treatment	Rate g ai/ha	% <i>E. crus-galli</i> control 4WAA	
		Leaching	Non-leaching
Cyhalofop butyl 0.6% Gr	180	98	99
	90	90	88
Quinclorac 1% Gr	300	85	97
Mefenacet 4% Gr	1,200	60	60

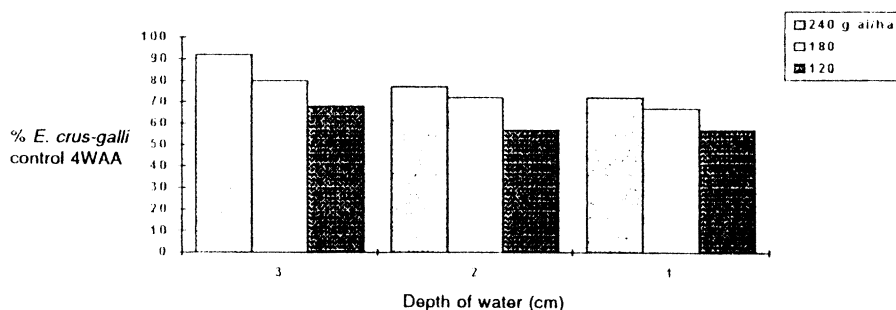


Figure 1. Effect of water depth on activity of cyhalofop butyl

Table 5. Tolerance of rice plants granular against cyhalofop butyl in under different transplanting conditions (pot trial) 2WAA

Treatment	g ai/ha	Planting depth			
		3 cm		0 cm	
		Visible injury	Plant height % of untreated	Visible injury	Plant height % of untreated
Cyhalofop butyl 0.6% Gr	2,160	Nil	97	Slight	99
	1,080	Nil	99	Very slight	102
	720	Nil	103	Nil	104
	360	Nil	99	Nil	111
Mefenacet 4% Gr	1,200	Nil	101	Significant	54
Untreated	-	-	100	-	100

Rice at 2.5 leaf stage was treated 5 days after transplanting

Table 6. Tolerance of rice plants against cyhalofop butyl in foliar spray (field trial)
Injury 2WAA

Treatment	g ai/ha	Growth stage		
		3	4	5 LF
Cyhalofop butyl	450	Nil	Nil	Nil
30% EC	300	Nil	Nil	Nil

REFERENCES

1. Ray, P.G., Pews, R.G., Flake, J., Secor, J. and Hamburg, A., 1993. 14th APWSS, in press.