Journal of Zhejiang University SCIENCE
ISSN 1009-3095
http://www.zju.edu.cn/jzus
E-mail: jzus@zju.edu.cn

Dissipation of pencycuron in rice plant*

PAL R.†1, CHAKRABARTI K.[1], CHAKRABORTY A.[2], CHOWDHURY A.[1]

([1]*Department of Agricultural Chemistry and Soil Science, Calcutta University, Calcutta, Pin-700 019, India*)

([2]*Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal, Pin-741 252, India*)

†E-mail: p_raktim@rediffmail.com

Received Apr. 12, 2005; revision accepted Apr. 28, 2005

Abstract: Pencycuron is a non-systemic protective fungicide for controlling sheath blight of rice. However, information on the fate of pencycuron in rice plant is lacking. The degradation of pencycuron in waterlogged tropic rice field was investigated. Pencycuron was applied at recommended field dose (187.5 g a.i./ha) and double recommended dose to cropped plots for three consecutive years. Pencycuron was rapidly degraded in rice plant at all doses of pencycuron application with first order half-lives of 1.57~2.77 d. The study revealed that pencycuron is safe from the human and environmental contamination point of view.

Key words: Pencycuron, Dissipation, Rice plant, Sheath blight, *Rhizoctonia solani*

doi:10.1631/jzus.2005.B0756 **Document code:** A **CLC number:** S48

INTRODUCTION

Pencycuron [1-(4-chlorobenzyl)-1-cyclopentyl-3-phenylurea], a relatively new non-systemic protective fungicide for controlling sheath blight (*Rhizoctonia solani*) of rice (Sylvanie and Cornis, 1989; Tomlin, 1997), is expected to be used widely in agricultural production particularly in Asia. However, information on the dissipation pattern of pencycuron in rice plant is lacking. Little information on the environmental fate of pencycuron has been published although there were some published studies on rice sheath blight fungus (Mithrasena *et al*., 1989; Wickramasinghe and Mithrasena, 1989; van Eeckhout *et al.*,1991; Osada, 1993).

Rice is now the major cereal crop in the Indian subcontinent. The introduction of improved technology for present day rice production invites insect pests and diseases. Among different rice varieties commercially cultivated in West Bengal of India, most are highly susceptible to sheath blight and suffer considerable loss. Among many classes of fungicides, pencycuron (Monceren) is now going to be introduced to the Indian subcontinent by Bayer Crop Science, India. As information on the residue and dissipation of pencycuron in rice plant under cultivation under our agro-climatic conditions is not available, systematic study on the residue and dissipation of pencycuron in rice plant grown under our agro-climatic conditions should be conducted.

MATERIALS AND METHODS

Field experiments on rice (cv IET 1444) were conducted for three consecutive years in the June to October wet seasons of 2001, 2002 and 2003 at the Agriculture Experimental Farm, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (located at 22°52′ N, 88°30′ E, 1.3 m above mean sea level), West Bengal, India. The climate of the region is sub-humid with average total annual precipitation of 1300 mm, and maximum rainfall in June to September. The maximum temperature of the study zone reaches to

* Project supported by Bayer Crop Science India Ltd., India

about 38.6 °C in May and the minimum temperature reaches to 11.3 °C in January. Warm conditions (35.7 °C) and high humidity (94%) prevail during the rainy season.

The land was prepared by puddling with the help of a power tiller. Decomposed cow manure (DCM) applied at 10 t/ha seven days before rice transplantation contained dry weigh 14.0% organic C and 1.36% total N at pH 7.4. All the plots received a recommended dose of 60:30:30 N, P and K ha^{-1} in the form of urea, single super phosphate and muriate of potash. The half dose of N and full dose of P and K were applied as basal fertilizers. The remaining half dose of N was applied 21 d after rice seeding transplantation. High yielding rice variety IET-1444 seedings (23, 24 and 27 d old in the year 2001, 2002 and 2003, respectively) were transplanted in rows 20 cm apart and 15 cm between hills. Each hill contained three seedlings. Pencycuron 250 SC obtained from Bayer Crop Science India Ltd. was applied at recommended field dose (187.5 g a.i./ha) and double recommended dose. The 1st and 2nd spray of pencycuron were given at 33 and 49 (in the year 2001), 35 and 50 (in the year 2002) and 34 and 48 (in the year 2003) day after transplantation respectively. Treatments were replicated three times in a randomized complete block design.

Pencycuron was quantified using high performance liquid chromatography (HPLC 1050 Hewlett Packard equipped with UV detector and 3392A integrator). For recovery studies, rice plants were fortified with acetone solution of pencycuron to obtain concentrations corresponding to different doses. The samples were immediately extracted three times with 100 ml of acetone on an electric blender for 5 min. After centrifugation at 3000 r/min for 10 min, the extracts were combined and pencycuron was partitioned in $CHCl_3$ ((100+50+50) ml). The $CHCl_3$ layer was evaporated to dryness, rinsed with HPLC grade methanol and filtered (0.2 μm) for direct HPLC analysis. Pencycuron was separated on an Intersil 150 mm×4.6 mm ODS 2, 5 μm (RPC_{18} column) using a mobile phase of methanol and water (90:10) at a flow rate of 1 ml/min and column temperature at 40 °C. Quantification was performed against pencycuron standard at a wavelength of 240 nm. Under this condition the retention time of pencycuron was 3.2 min, the limit of detection was 0.01 mg and the sensitivity of the method was 0.005 mg/kg. The average recovery was 90.0%~93.4% for pencycuron with relative standard deviations ranging from 2.5~3.0. Determination of pencycuron residues in the treated samples was carried out as per the recovery study.

RESULTS AND DISCUSSION

Data on the initial deposits, dissipation percentage, half-life values and regression equation of pencycuron residues in rice plant following the application @ 187.5 g a.i./ha (T_1) and 375.0 g a.i./ha (T_2) are presented in Table 1.

The initial deposit of pencycuron after two hours spraying was found to be 0.0190~0.0204 and 0.0386~0.0440 mg/kg irrespective of the seasons for the treatments T_1 and T_2 respectively. The loss of residues over a period of time showed steady dissipation from 67.62%~95.10 % within 7 d. The residue level fell below detectable limit on the10th day for T_1 and 15th day for T_2.

The dissipation of pencycuron residue followed first order reaction kinetics in all the doses as a straight line was obtained in each case when log values of the residue were plotted against different time intervals. From this study it appeared that the rate of dissipation was independent of initial deposit and that the half-life ($T_{1/2}$) of pencycuron varied from 1.57~2.77 d irrespective of the seasons and application rate.

For the untreated control, no residues of pencycuron were detected irrespective of the seasons and in grain, husk and straw at harvest. During the experiment no phytotoxicity was observed for any of the treatments. The half-lives of pencycuron in rice were observed to be short and should be of no concern regarding contamination of the food chain and environment.

ACKNOWLEDGEMENTS

The author is grateful to the Department of Agricultural Chemicals, Bidhan Chandra Krishi Viswavidyalaya, India for excellent technical assistance.

Table 1 Dissipation of pencycuron in rice plant

Treatment	Season	Period (days)	Mean residue±*SD*	Dissipation (%)	Regression equation	Half-life (days)
T_1=187.5 g a.i./ha	1st (2001)	0	0.0190±0.0002		y=−0.1818x+1.3132	1.66
		1	0.0153±0.0008	19.47		
		3	0.0056±0.0002	70.53		
		7	0.0011±0.0001	94.21		
		10	N.D.			
	2nd (2002)	0	0.0204±0.0023		y=−0.1912x+1.3283	1.57
		1	0.0153±0.0007	25.00		
		3	0.0052±0.0003	74.51		
		7	0.0010±0.0001	95.10		
		10	N.D.			
	3rd (2003)	0	0.0202±0.0009		y=−0.1745x+1.3098	1.72
		1	0.0156±0.0010	22.77		
		3	0.0051±0.0002	74.75		
		7	0.0013±0.0002	93.56		
		10	N.D.			
T_2=375.0 g a.i./ha	1st (2001)	0	0.0386±0.0025		y=−0.1088x+1.6311	2.77
		1	0.0298±0.0012	22.80		
		3	0.0215±0.0008	44.30		
		7	0.0125±0.0007	67.52		
		10	0.0024±0.0003	93.78		
		15	N.D.			
	2nd (2002)	0	0.0440±0.0010		y=−0.1153x+1.6763	2.61
		1	0.0321±0.0013	27.04		
		3	0.0223±0.0011	49.32		
		7	0.0126±0.0009	71.36		
		10	0.0023±0.0002	94.77		
		15	N.D.			
	3rd (2003)	0	0.0407±0.0015		y=−0.1192x+1.6756	2.52
		1	0.0333±0.0022	18.18		
		3	0.0231±0.0015	43.24		
		7	0.0114±0.0011	71.99		
		10	0.0021±0.0002	94.84		
		15	N.D.			

N.D.: Not detected

References

Mithrasena, Y.J.P.K., Adhikari, W.P., Wickramasinghe, D.L., 1989. Studies on sheath blight of rice in the low country wet zone. *Trop. Agricul.*, **145**:75-86.

Osada, S., 1993. Effect of several fungicides on the seasonal occurrence of rice sheath spot, caused by Rhizoctonia oryzae Ryker and Gooch. *Ann. Rep. Soc. Pl. Prot. North Jn.*, **44**:11-13.

Sylvanie, D.R., Cornis, L., 1989. High performance liquid chronmatography for the determination of pencycuron residues in several vegetables. *J. Agric. Food Chem.*, **37**:975-978.

Tomlin, C.D.S., 1997. Pencycuron. *In*: Tomlin, C.D.S. (Ed.), The Pesticide Manual. Eleventh Edition, British Crop Protection Council, UK, p.935-937.

van Eeckhout, E., Rush, M.C., Blackwell, M., 1991. Effects of rate timing of fungicide applications on incidence and severity of sheath blight and grain yield of rice. *Pl. Dis.*, **75**(12):1254-1261.

Wickramasinghe, D.L., Mithrasena, Y.J.P.K., 1989. Sheath blight disease of rice in the low country wet zone of Sri Lanka: Effect on yield and factors influencing spread and distribution. *Tropic. Agric. Res. Series.*, **22**:38-48.