

Changes in rice farmers' pest management in the Mekong Delta, Vietnam

N.H. Huan^a, V. Mai^a, M.M. Escalada^b, K.L. Heong^{c,*}

^aPlant Protection Department, Ministry of Agriculture and Rural Development, Viet Nam

^bVisayas State College of Agriculture, Baybay, Leyte, Philippines

^cInternational Rice Research Institute, P.O. Box 3127, Manila, Philippines

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Abstract

Between 1992 and 1997, two insecticide reduction interventions were introduced to farmers in the Mekong Delta, the media campaign to motivate farmers to experiment whether early season spraying for leaf folders was necessary and the farmer field schools (FFS). The media campaign reached about 92% of the 2.3 million farmer households in the Mekong while the FFS trained about 108,000 farmers or 4.3%. Farmers' insecticide use, early season sprayings and pest management beliefs reduced markedly over the 5-year period. Spray frequencies changed from 3.4 to 1.0 sprays per season, a reduction of 70%. Less farmers sprayed in the seedling, tillering and booting stages changing from 18, 65 and 45%, respectively to 1, 12 and 22%, respectively. Changes in farmers' beliefs were significant, with the belief index reducing from 11 to 6.7. There were significant differences between farmers reached by media and trained by FFS, farmers reached only by the media, and those not reached by either intervention. Spray frequencies were 0.5, 1.2 and 2.1, respectively and similar differences in early season spraying and beliefs were observed. It is evident that the two interventions, media and FFS, played complementary roles in significantly changing farmers' beliefs and insecticide use in the Mekong Delta. © 2000 Published by Elsevier Science Ltd. All rights reserved.

Keywords: Rice leaf folders; Insecticide use; Pest management

1. Introduction

Surveys in 1992 and 1994 in the Mekong Delta showed that farmers' insecticide use was high (Heong et al., 1994; Mai et al., 1997). A large proportion of sprays was directed at controlling leaf-feeding larvae, particularly the leaf folder (*Cnaphalocrocis medinalis* Guenee). Farmers strongly believed that the leaf folder with its visible defoliation damages would cause yield loss. However, research showed that leaf-feeding insects that often infest the rice crop in the vegetative stages rarely cause yield loss (see Way and Heong, 1994 for review). Insecticide sprays in the vegetative crop stages can instead cause secondary pest problems, such as the brown planthopper (*Nilaparvata lugens* Stal.) (see Heong and Schoenly, 1998 for review). Farmers' pest management decisions are influenced more by perceptions (Norton, 1982; Mumford

and Norton, 1984) rather than the economics of the situation. It is highly likely that these decisions, often made under uncertainty, rely on decision rules or heuristics (Kahneman and Tversky, 1973). A heuristic is an informal rule-of-thumb used by people to simplify information processing and decision-making. Since these heuristics are developed from experience and guesswork about possible outcomes, they may have inherent faults and biases (Tversky and Kahnemann, 1974; Slovic et al., 1977). Thus farmers' spraying to control leaf folders routinely may well be due to faults in their beliefs and the heuristics they use. When Festinger's (1957) cognitive dissonance theory was applied to motivate farmers to test a heuristic in conflict with prevailing beliefs, participating farmers changed their beliefs and reduced their sprays (Heong et al., 1995; Heong and Escalada, 1997). According to Festinger, information that contradicts existing attitudes, choices or behaviours can lead to a state of psychological dissonance. This state of dissonance does not immediately disperse and to resolve his or her dissonance, a person may resort to a re-evaluation of options.

* Corresponding author.

Farmers, who participated in the simple experiment to evaluate the conflict information, subsequently changed their attitudes. In 1994 a media campaign was implemented in the Mekong Delta to motivate farmers to test whether the heuristic: 'Insecticide spraying in the first 40 days after sowing for leaf folder control is not needed' (Details in Heong et al., 1998). The campaign used leaflets, posters and a radio drama to challenge the general belief that leaf folders were important pests and had to be sprayed early in the crop season. At the same time, Integrated Pest Management (IPM) training using the farmer field school (FFS) approach (Useem et al., 1992; Matteson et al., 1994), was also introduced in the Mekong Delta. In this approach, farmers underwent weekly 5-h training sessions for 14 consecutive weeks throughout the crop season facilitated by trainers. The curriculum included analyses of the rice ecosystem at various growth stages, biological control, crop fertility and pest management.

In this paper, we report on an analysis of changes in farmers' pest management beliefs and insecticide in 1992 and 1997. The analysis used two data sets collected in the Mekong Delta, the 1992 data set published by Heong et al. (1994) and a data set collected in 1997.

2. Methods

2.1. The Mekong Delta

The Mekong Delta is situated in the southern part of Vietnam (Long. 8°60' N to 10°N and lat. 104°50'E to 106°80'E) populated by an agricultural population of about 12.6 million households, representing about 25% of Vietnam's total. Administratively the Mekong Delta comprises 12 provinces, An Giang, Bac Lieu, Ca Mau, Can Tho, Dong Thap, Kien Giang, Long An, Soc Trang, Tien Giang, Tra Vinh and Vinh Long. The main crop in the Delta is rice, grown in irrigated lowlands (52%) and under rain-fed lowland conditions (IRRI, 1993). The Mekong Delta has three major rice cropping seasons: winter-spring, summer-autumn and wet season, producing about 11 million tons of rice annually or 56% of Vietnam's total production of 19.5 million tons.

2.2. Data acquisition

Data from the 1992 survey (Heong et al., 1994) and the one reported here obtained from a survey of 2598 farmers from the Mekong Delta in September 1997 were used in this study. Several pest management variables common in both data sets were compared; namely farmers' spray frequencies, spray targets, timing of sprays, types of pesticides used and pest management beliefs. The same five belief attributes (see Table 4) were used in both surveys. Data collection procedures in the September 1997 survey

were similar to that described in Heong et al. (1998), except samples were stratified by province. The variables and questions used in survey were determined by conducting a conversational analysis in an exploratory field research by the authors. The questionnaire was developed, translated into Vietnamese and pre-tested with 25 respondents. Open-ended questions were used wherever possible. In each province, farmer respondents were randomly selected. The senior author directly trained and supervised agricultural technicians in the data collection and the data obtained were coded and entered into a computer using EXCEL®.

2.3. Analytical procedures

Frequency distributions and cross tabulations were generated using SPSS for Windows version 7.5 (SPSS, 1997). Means were compared using *t*-tests and both parametric and non-parametric statistics were used in correlation analyses and comparing variables. The surveys measured farmers' beliefs using five statements to which respondents responded whether they agreed, disagreed or were indifferent to them. A three-point Likert scale (1 for the preferred answer, 2 for indifference and 3 for the not preferred answer) was used to score responses. The three statements for assessing beliefs about leaf folders were; 'Leaf folders in the first 40 days after sowing (DAS) can cause severe damages to the crop'; 'Leaf folders in the first 40 DAS will cause yield loss' and 'Spraying in the first 40 DAS to control leaf folders is necessary'. The two statements for assessing beliefs in insecticide use were; 'Applying insecticides will increase yields' and 'Killing natural enemies by insecticide spraying will not cause more pest problems'. A composite belief index for each respondent was also computed using all 5 attributes, which ranged from 5, the preferred minimum to 15, the maximum.

3. Results

3.1. Farmer profiles

Table 1 summarizes the profiles of the farmer respondents in the two surveys. Most respondents were aged between 30 and 50 y, operating on small farm sizes of less than 2 ha. The yields reported were generally more than 4 t/ha.

3.2. Spray frequencies

Table 2 shows farmers' insecticide use in 1992 and 1997 in the Mekong Delta. Mean number of sprays per farmer per season reduced significantly from 3.4 in 1992 to 1.0 in 1997, representing a reduction of 70%. Sixteen percent of the farmers did not spray any insecticides in 1992, and in

Table 1
Comparison of farmer respondents in surveys carried out in 1992 and 1997

	Survey in 1992	Survey in 1997
Date survey carried out	May 1992	September 1997
Reference	Heong et al. (1994)	This paper
Number of respondents	685	2598
Age group (yr)		
< 31	12.5	11.6
31–40	28.7	32.7
41–50	24.7	35.8
51–60	22.7	13.5
61–70	10.5	5.9
> 70	0.9	0.5
Farm sizes (ha)		
< 0.5	27.3	34.2
0.6–1	23.8	26.9
1.1–2	26.5	26.0
2.1–3	11.4	8.4
3.1–4	5.4	2.3
> 4	5.6	2.2
Yields (t/ha) reported		
< 2	1.7	1.2
2.1–3	5.5	1.7
3.1–4	15.4	10.5
4.1–5	32.9	12.7
> 5	44.5	41.3

Table 2
Comparison of farmers' insecticide use in the Mekong Delta, Vietnam in 1992 and 1997

	1992	1997
Mean number of insecticides applied per farmer	3.39	1.01 ^a
Standard deviation	2.76	1.09
Mode	3	0
Median	3	1
Highest number of sprays applied	12	6
% farmers not using insecticides	16.2	40.8

^a $t = 35.2, p < 0.001$.

1997 this was increased to 41%. The maximum number of applications also reduced from 12 to 6.

3.3. Timing and targets of insecticide sprays

Proportions of farmers spraying at the different crop stages also changed significantly, implying that many farmers had stopped early season spraying (Fig. 1). In the seedling, tillering and booting stages, proportion of farmers spraying reduced from 18.0, 65.0 and 45.0%, respectively to 1.1, 11.7 and 22.3%, respectively. In the heading stage, an increase from 27 to 40% was observed and at maturity the proportion of farmers spraying

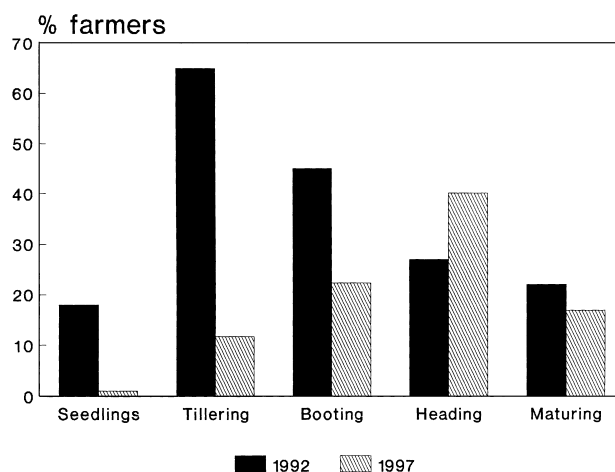


Fig. 1. Percentage of farmers applying insecticides at different crop stages in the Mekong Delta, Vietnam in 1992 and 1997.

Table 3
Main pest target of farmers' insecticide sprays in the Mekong Delta, Vietnam in 1992 and 1997

Insecticide spray targets	Percentage of sprays	
	1992	1997
Rice leaf folders	20.5	48.2
Other lepidopterous leaf-feeding insects	21.3	14.0
Stem borers	8.1	19.8
Thrips	4.7	2.5
Brown planthoppers	33.8	9.9
Other insects	11.6	5.6

decreased from 22.0 to 16.8%. Although farmers had changed their attitudes towards leaf folders attacking rice in the early crop stages, most continued to believe that leaf folders were problematic at the heading stage.

The main insect pest targets of farmers' insecticide sprays in both 1992 and 1997 were leaf-folders and leaf-feeding insects (Table 3). The proportion of sprays targeted at leaf folders and lepidopterous larvae accounted for 42% of sprays in 1992 and 62% in 1997. More sprays were targeted at stem borers in 1997 than in 1992, while there was a reduction in sprays for the brown planthopper, from 34% in 1992 to 10% in 1997.

3.4. Beliefs

Changes in farmers' responses to the 5 belief statements in 1992 and 1997 were highly significant (Table 4). The two beliefs that had the largest changes were "applying insecticides will increase yields" and "spraying insecticides for leaf folders has to be done in early season". In 1992, 83% of the farmers believed that insecticides would increase yields, while in 1997 only 13% did.

Table 4
Comparison of farmers' responses to belief attributes and belief index in the Mekong Delta, Vietnam in 1992 and 1997

Belief attributes	% farmers who believed in attributes	
	1992	1997
Applying insecticides will increase yields	82.5	13.2 ^a
Killing natural enemies can cause more pests	28.7	78.7 ^a
Leaf folders in first 40 DAS can cause severe damages	74.1	12.7 ^a
Leaf folders in first 40 DAS can cause yield loss	29.1	13.2 ^a
Spraying insecticides for leaf folders has to be done in early season	83.8	10.1 ^a
<i>Belief index</i>		
Mean	11.3	6.7 ^b
Std dev.	2.3	2.3
Mode	12	5
Median	12	6

^aChi squared test: significant differences at $p = 0.01$ probability level between 1992 and 1997.

^b $t = 43.1, p < 0.001$.

Similarly, farmers who believed that spraying leaf folders had to be done in the early season reduced from 84% in 1992 to 10% in 1997. The composite belief index also significantly reduced from 11 to 6.7, with most farmers scoring the minimum of 5.

3.5. Insecticide use

Farmers' insecticide use patterns between 1992 and 1997 changed significantly with pyrethroids being used more frequently in 1997 than in 1992 (Table 5). WHO

Table 5
Main insecticides (in % sprays) of rice farmers in the Mekong Delta, Vietnam, 1992–1997

Insecticides	WHO classification ^a	1992	1997
<i>Organophosphates</i>			
Monocrotophos	Ib	8.3	3.0
Methyl parathion	Ia	17.2	3.4
Methamidophos	Ib	10.4	15.2
Diazinon	II	8.0	8.2
<i>Organochlorines</i>			
Endosulfan	II	0.5	0.4
Lindane	II	0.5	0.0
<i>Carbamates</i>			
BPMC (fenocarb)	II	21.9	8.2
MIPC (isoprocarb)	II	9.0	0.2
Carbofuran	Ib	1.2	0.7
<i>Pyrethroids</i>			
Cypermethrin	II	4.8	12.7
Deltamethrin	II	7.0	11.9
Lambda cyhalothrin	—	2.9	17.4
<i>Others</i>			
Cartap	—	6.5	8.9
Buprofezin	V	0.7	2.2

^aBased on WHO's classification by hazard, Ia: extremely hazardous; Ib: highly hazardous; II: moderately hazardous; III: slightly hazardous;

V: unlikely to present acute hazard in normal use (CIRAD, 1991).

category I insecticides accounted for 22% of the sprays in 1997, a reduction from 1992, when they accounted for 36%. There was also a marked drop in the use of carbamates from 22 to 8%.

3.6. Farmer training, rice production and insecticide prices

Table 6 shows the number of farmers who had been trained through FFS, the total rice production in the

Table 6
Farmer training, rice production and insecticide prices in the Mekong Delta between 1992 and 1997

	Year					
	1992	1993	1994	1995	1996	1997
Number of farmers trained through FFS ^a	125	3850	20,275	28,425	29,950	24,582
Cumulative % of total households ^b	0	0.15	0.97	2.10	3.30	4.29
Gross paddy output (million tons)	10.95	11.07	12.12	12.83	13.82	13.96 ^c
Average yields (t/ha)	3.74	3.69	3.99	4.02	4.01	4.02 ^c
<i>Prices of common insecticides used (US\$/li)</i>						
Methyl parathion	na	na	2.40	2.09	4.17	4.61
Monocrotophos	na	na	5.20	4.36	3.67	3.46
Methamidophos	na	na	5.60	4.36	3.83	3.39
BPMC	na	na	3.40	3.00	2.67	2.46
Deltamethrin	na	na	10.00	9.27	8.83	8.46
Cypermethrin	na	na	18.80	16.91	14.83	12.92

^aFFS = Farmer field schools, data provided by the FAO Programme for Community IPM in Asia in Vietnam.

^bBased on 2.3 million farm households (General Statistical Office, 1996).

^cEstimated.

Mekong Delta and prices of common insecticides used. The FFS training program started in 1992 and by 1997, a total of 107,250 or about 4.3% of the 2.3 million farmer households in the Mekong Delta attended the training. In the 1997 survey the media campaign reached 92% of farm households. Rice production in the Mekong Delta between 1992 and 1997 increased by 27% from 10.95 to 13.96 million tons. In the same period, the domestic price of methyl parathion increased markedly, while prices of monocrotophos, methamidophos, pyrethroids and carbamates declined, implying that the influence of insecticide prices on use had been small.

3.7. Beliefs and practices of trained and untrained farmers

In our sample, about 40% said that they had attended the FFS training. We regrouped the data and compared three groups, farmers exposed to media only, farmers exposed to the media and trained and farmers not exposed to either the media or training. All the FFS trained farmers in our sample were exposed to the media. There were insignificant differences in age, farm size and yields

reported by the three groups (Table 7). The number of insecticide sprays per season was significantly lower in the group who were reached by both the media and the FFS ($\bar{x} = 0.54$). Farmers who were reached only by the media sprayed an average of 1.20 times per season, which was significantly lower than the group not reached by either media or FFS ($\bar{x} = 2.07$). The proportion of farmers who had stopped using insecticides was also higher in the group reached by both interventions (76%), followed by the group reached by media (51%). Similarly, the proportion of farmers spraying in the seedling and tillering stages was lowest in the group that had both interventions (15%), followed by those reached by the media (32%) and those not reached by either of the intervention (68%).

In all five beliefs, there were significant changes between farmers not reached by either of the interventions and those who were reached by either. About 39% of farmers not reached continued to believe that insecticides would increase yields, while only 15% and 5% of those who were reached by media only and both media and FFS, respectively, believed this to be true. Proportions of

Table 7

Comparison of farmers exposed to the media but untrained, exposed to the media and trained and exposed to neither the media or training in the Mekong Delta, Vietnam in 1997

Variables	Exposed to media		Not exposed to media or FFS
	FFS trained	Untrained	
Sample size	1027	1350	214
Age (y)	43.5	42.8	42.4
Farm size (ha)	1.15	1.23	1.21
Reported yields (t/ha)	5.70	6.01	6.09
Standard deviation	2.00	2.03	1.03
Number insecticide sprays/season	0.54	1.20	2.07
Standard deviation	0.75	1.13	1.75
Percent not using insecticides	76.1	50.6	40.2
<i>Beliefs</i>	Percent farmers believing ^b		
Applying insecticides will increase yields	5.2	15.1	39.3
Killing natural enemies can cause more pests	94.1	72.7	30.8
Leaf folders in first 40 DAS ^a can cause severe damages	5.6	13.9	29.9
Leaf folders in first 40 DAS can cause yield loss	11.5	11.2	32.2
Spraying insecticides for leaf folders has to be done in early season	1.9	11.0	41.6
<i>Belief index</i>			
Mean	5.80	6.92	10.16
Std dev.	1.40	2.26	2.89
Mode	5	5	10
Median	5	6	10
Relationship between insecticide sprays and belief index			
Regression coefficient	0.14	0.11	0.17
95% CL	+ 0.03	+ 0.03	+ 0.05
F value	113.7 ^c	42.0 ^c	46.4 ^c

^aDAS = days after sowing.

^bDifferences between the three groups of farmers were significant in all cases at $p = 0.05$ from Chi square tests.

^c $p < 0.001$.

farmers who believed that leaf folders could cause yield loss were not significantly different between those reached by media only and both interventions, but were significantly lower than those farmers not reached by either intervention. The belief index of farmers not reached by the two interventions was significantly higher, while there was little difference between those reached by media and both media and FFS. In all the three groups, the regression between insecticide sprays and belief was highly significant ($p < 0.001$). The regression coefficient was significantly higher for the group not reached by either FFS or media (0.17), implying that farmers tended to spray more with increase in belief index. The group exposed to media only had a lower coefficient (0.11) which was marginally significant from the group exposed to both FFS and media (0.14).

4. Discussion

In 1992 farmers' insecticide use was found to be very high with $> 41\%$ of the sprays directed at leaf-feeding insects, which were predominantly leaf folders. Two main insecticide reduction initiatives were introduced into the Delta in 1992 and 1994 were a pilot project. A pilot project to motivate farmers using the mass media to stop spraying for leaf folders in the early crop stages in Tan Thanh and Tan Tru districts in Long An (Heong et al., 1998) and IPM training using the FFS approach (Useem et al., 1992). The former initiative began in September 1994 was aimed primarily at changing farmers' perceptions about the leaf folders and reducing unnecessary insecticide use. The FFS, on the other hand, began in 1992 provided farmers training in crop husbandry skills with particular emphasis on reducing insecticide inputs. By 1997, 107,250 farmers had undergone the FFS training reaching 4.3% of the 2.3 million farm households in the Mekong Delta. The campaign approach of the Long An project was adopted by 11 other provinces and by 1997 reached about 92% of the population in the Mekong Delta. It is likely that all the FFS trained farmers in the Delta had been reached by the campaign as shown in the survey.

Between 1992 and 1997, farmers' pest management in the Mekong Delta had undergone significant changes. Insecticide applications decreased from 3.4 to 1.0 applications per farmer per season, a 72% reduction and this could be attributed to changes in perceptions of insect pests, particularly the leaf folders. The significant reductions in insecticide use occurred mainly in the seedling, early and later tillering stages of the crop. In 1992, 18, 65 and 45% of the farmers sprayed during these stages, respectively, while in 1997, these were reduced to 1, 12 and 22%, respectively. Farmers who believed that leaf folders could cause severe damages, yield loss and had to be sprayed early in the season decreased from

74, 29 and 84%, respectively in 1992 to 13, 13 and 10%, respectively in 1997. Proportion of farmers who believed that insecticides would cause high yields also dropped from 83 to 13%. In addition, the proportion of farmers who believed that insecticides would kill natural enemies increased from 29 to 79%, as protecting natural enemies was emphasized as an important benefit from stopping early season insecticide use in the 1994 campaign. Since farmers' insecticide applications were directly related with the belief index comprising the above five attributes, it is evident that farmers' spray decisions were influenced by these beliefs.

The gross paddy output in the Mekong Delta between 1992 and 1997 increased gradually from 11 to 14 million tons per annum. Average yields increased slightly probably as a result of improved varieties and agronomic practices. Insecticide prices, except for methyl parathion, had declined slightly in US dollar terms, but had remained very much the same in the local currency. Records from the Ministry of Agriculture and Rural Development indicated that insecticide availability had increased or remained similar. It thus seems evident that the changes in farmers' pest beliefs and attitudes and reduction in insecticide use recorded in the 1997 survey were caused by the two IPM related interventions introduced in 1992 and 1994.

The main message of the campaign initiative was 'spraying for leaf folders in the early crop stages is unnecessary' while the FFS emphasized biological control, harmful effects of pesticides and good management practices. Separate analyses of farmers who were reached only by the campaign, both the campaign and FFS and those not reached by either intervention showed that the two insecticide reduction initiatives had complementary effects. Farmers reached by the campaign and FFS sprayed significantly less (0.5 sprays), followed by those reached only by the campaign (1.2) and those who were not reached by either intervention (2.1). In addition, beliefs were also significantly changed. The spray-belief relationships of the three farmer groups were highly significant implying that the spray reductions were due to changes in beliefs. The campaign modified farmers' beliefs significantly and the FFS training modified them further. It is evident that the two intervention approaches have complementary roles in reducing unnecessary insecticide use among rice farmers. At the time of the study, about 108,000 farmers or 4.3% of the farm households in the Mekong Delta had received FFS training. If the training effort should continue at the same rate, it would require many years and huge resources for FFS training to reach the 2.3 million-odd farm households in the Mekong Delta. As shown in this study, farmers not reached by either intervention, continue to use insecticides unnecessarily. Perhaps the media approach, because of its extensive reach and low implementation costs, may be used as the initial motivation for farmers to reduce pesticides and

incentive to attend further training through FFS. In addition, media can also serve as a means to sustain the practice of using insecticides only when necessary and minimize discontinuance, a decision to reject a practice after having previously adopted it.

Although farmers in the Mekong Delta had reduced insecticide applications, a large proportion of the sprays was still directed at leaf folders, especially in the later crop stages. Benefits from late season leaf folder control are highly questionable (Rapusas and Heong, 1995), while research is needed to provide definitive evidences. Farmers exposed to both the media and training tended to spray less for leaf folders, even in the later crop stages. Yields of trained farmers who were using about 0.5 sprays per season, though slightly lower, were not statistically different from those who sprayed 1.20 and 2.07 times. There appears to be opportunities to reduce current insecticide use by another 50% with little production consequences. The recent initiative to stop registering insecticides for leaf folder control announced by the Ministry of Agriculture¹ is expected to play an important role in reducing unnecessary insecticide use by farmers. Although the restriction will not translate directly into pesticide sales and preventing leaf folder spraying at the farm level, it does communicate a governmental commitment to minimizing unnecessary insecticide use by discouraging leaf folder spraying. Further insecticide reduction would reduce farmers' production cost, health risks, environmental contamination and development of secondary pest problems, like brown planthopper outbreaks.

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¹ Letter from Mr Tran Quy Hung, Director General of Plant Protection Department No. 998 BVTV-CV dated 27 November 1998, Hanoi, addressed to companies dealing with pesticides that the Department will discontinue the registration of new pesticides for the control of the rice leaf folder.

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