Compliance with the "4 right" principle in pesticide using of decorative tree planters in Nam Phong village, Nam Dinh province, Viet Nam

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Abstract- The objective of the study is to describe the real situation of appliance with the "4 right" principle of planters and to study the impact of this compliance on safety and effectiveness. A cross-sectional study was designed in order to satisfy the aims of the study. Subjects are planters who have committed to use pesticides at least 5 times in the past 3 months. By choosing 1 person in each household, the total of 220 respondents participated in the questionnaire survey designed on the Likert scale. Results of the study reveal that the level of compliance with the principle "4 right" of the subjects is in the average level with a score from 3.68-3.91/5. The criterion of using the right pesticide in the principle of "Correct pesticide" was most violated (36.8% of respondents rarely declared and occasionally complied). There is a positive relationship between compliance with "principle 4 right" and safety and effectiveness in pesticide using through people's self-assessment. In conclusion, there was a widespread violation of the "4 right" principle of pesticide using. Communication and consultation programs on the use of pesticide for people should be maintained

Index Terms- Pesticides, compliance, decorative plants, planters, Nam Dinh province

I. INTRODUCTION

The term "pesticide" is considered to embrace active ingredients in any form, irrespective of whether, or to what extent, they have been formulated for application. Pesticides that kill or control pests, they also include some substances used to modify the behavior or physiology of pests or plants during production or archive [1].

Pesticides play an important role in ensuring food security through pest control, reducing the risk of crop failure, improving productivity and quality of agricultural products (Seyed & Mohamad, 2011 and WHO, 2019). However, pesticides have also been shown to be related to health problems (Seyed & Mohamad, 2011; Carolyn et al., 2015; Kim et al., 2017; Hu et al., 2015, and Mahmood et al., 2016). They can enter the body through the gastrointestinal tract, respiratory tract, skin and mucous membranes. The characteristics of the drug, its exposure time, exposure level and individual health status are the key determinants of post-exposure health problems (WHO, 1990). After penetration, pesticides can be metabolized, excreted, stored or bio-accumulated in the body and thereby cause human health problems (WHO, 1990; Pirsaheb et al., 2015, and Cui et al., 2015). Health problems caused by exposure to pesticides are very diverse, such as the neurological, cardiovascular, respiratory, Gastrointestinal - hepatobiliary syndromes, blood (Carolyn et al., 2015; Kim, Kabir & Jahan 2017). In order to limit the negative impact of pesticides on the environment and health, WHO has recommended that the use of pesticides for food production should adhere to good agricultural practices regardless of the economic status of the country (WHO, 2019).

Vietnam is a developing country in which agriculture plays an important role in ensuring national food security and National Gross Domestic Product. To ensure the safe usage of pesticides, Vietnamese Government has also issued guidelines and legalized regulations on good agricultural very soon. In 2015, the "4 right" principle in the use of pesticides was officially legalized. This is one of the important principles in plant protection and quarantine activities in Vietnam. However, the literature review found that there were very few studies evaluating people's compliance with the "4 right" principle. Besides, the current research has focused mainly on rice and vegetable planters (Cuong & Thuan, 2017, and Giang et al., 2016), the test gap on this issue on decorative tree planters still exists. The objective of the study is to describe the real situation of compliance with the principle "4 right" in the use of pesticides by decorative tree planters, and at the same time explore the relationship between compliance with the principle "4 right" with safety and effectiveness in the usage through their self-assessment.

II. METHODS

The study was conducted in 2019 at decorative tree planting village of Nam Phong commune, Nam Dinh province. This is the coastal area in the southeast of the Red River Delta region of Vietnam. The surveyed subjects were kumquat and peach planters who have committed to the acts of spraying pesticide at least 5 times in the past 3 months, they did not participate in testing tools, but they were be able to answer and agree to participate in answering the interview. Each household chose 1 person who regularly sprayed or was present at home when the enumerator came. A total of 220 people from 220 households planting kumquats and peaches in the village agreed to participate in the interview (reaching 97.8%).

The research toolkit consists of 2 parts: Part I "4 right principles" is based on the "Principles of plant protection and quarantine activities" in the 2013 Plant Protection and Quarantine Law of Vietnam. The "4 right" principles include: right pesticide (RP1-RP5), right time (RT1-RT4), right concentration and dose (RC1-RC5), right way (RW1-RW5). The evaluation scale consists of 5 steps built according to the Likert-scale. This is specifically listed as follows: (1) = Never comply; (2) = Very little comply; (3) = Occasional comply; (4) = Regular comply; (5) = Always comply. Part II self-assesses the safety and effectiveness of people's pesticide using (GS1-GS3). The 5-level Likert scale evaluates the levels including: (1) = Strongly disagree; (2) = Disagree; (3) = Confused; (4) = Agree; (5) = Totally agree. The result of testing the tool showed that the content validity index was suitable (6 experts: S-CVI/Ave=0.96; S-CVI/UA=0.86) and Cronbach's Alpha coefficient = 0.884.

The used statistical methods included descriptive statistics, assessment of reliability of scales, Exploratory Factor Analysis (EFA), and multivariate linear regression analysis. Regression model with 4 independent variables including: X1 was the average value of the factors measuring the right pesticide factor (RP1-RP5); X2 was the average value of the factor measurement variables at the right time (RT1-RT4); X3 was the average value of the variables measuring the factor of correct concentration and dose (RC1-RC5); X4 is the average value of the proper factor variables (RW1-RW5). The Y-dependent variable was the average value of the variables measuring the level of safety and effectiveness when using the drug (GS1-GS3). The regression equation showed the relationship between the status of compliance with the principle of "4 right" and the level of safety and effectiveness when using pesticides with the form: $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + u_i$

III. RESULTS

A total of 220 people participated in the interview, of which men accounted for 63.2% with the average age was 46.02; The majority of newcomers completed lower secondary school (66.8%). About 77.3% of subjects had an experience of spraying ≥10 years. The average number of sprays in the past three months was 26.37 times (the lowest was 10 and the highest was 37 times). The rate of subjects spraying from 20-30 times/past three months accounts for about 49.5%; more 30 times is 32.3%

The level of compliance to the "4 right" principle of people was at a moderate level. The rate of compliance always reached a low level of 3.2-14.1%; The regular compliance rate was from 52.7 to 70.5%; The ratio sometimes complied with 19.1-38.2%; The rate rarely complied under 2.7%. The right timing was the best compliance principle, while the right medication was the most violated principle as shown in Table 1 below.

Table 1. Real situation of complying the "4 right" principle of research subjects (n=220)

Principles	**Notation**	**Compliance level** (rate %)				**Mean±SD**
		Very little compliance	Occasional compliance	Constant compliance	Always compliance	
The criteria of the "right drugs" principle						
Right pest	RP1	1.4	27.7	65.0	5.9	3.75 ± 0.57
Right crop plants	RP2	0	26.4	70.5	3.2	3.77 ± 0.49
Right list of prescribed drugs	RP3	0.9	25.9	62.7	10.5	3.83 ± 0.61
Right farming condition	RP4	1.8	29.1	64.5	4.5	3.72 ± 0.57
Right type (Name of drugs and active ingredient)	RP5	0.9	35.9	57.3	5.9	3.68 ± 0.59
The criteria of the "right time" principle						
At the right time of the pest (age, stage of disease)	RT1	0	27.7	61.8	10.5	3.83 ± 0.59
Right time on a day (Morning, noon, after noon)	RT2	0	19.5	69.5	10.9	3.91 ± 0.55
At the right time of crop plants (growing period)	RT3	0	25.5	65.0	9.5	3.84 ± 0.57
Right weather condition (rainy, sunny)	RT4	0	27.7	64.1	13.2	3.90 ± 0.59
The criteria of the "right concentration and dosage" principle						
Right amount of dosage recommended on the label	RC1	1.8	34.1	53.6	10.5	3.73 ± 0.67

Right amount of water recommended on the label	RC2	2.3	27.7	58.6	11.4	3.79 ± 0.66
Calculate and weigh drugs to use	RC3	0.5	38.2	52.7	8.6	3.70 ± 0.63
Spray the correctly calculated area	RC4	2.7	32.3	57.3	7.7	3.70 ± 0.65
Spray all calculated and dispensed amount of drugs	RC5	1.4	29.1	59.5	10.0	3.78 ± 0.63
The criteria of the "right way" principle						
Fix the drugs correctly (drug form)	RW1	0.5	27.7	63.2	8.6	3.80 ± 0.58
Take drugs alternately	RW2	1.4	21.8	62.7	14.1	3.90 ± 0.64
Spray in the wind	RW3	1.8	19.1	65.5	13.6	3.91 ± 0.63
The way to spray different types of diseases is different	RW4	1.8	21.4	67.3	9.5	3.85 ± 0.60
Wash the packaging thoroughly (at least 3 times)	RW5	0.5	25.0	65.9	8.6	3.83 ± 0.57

The results of the reliability test of the scale show that the coefficient Cronbach's Alpha = 0.87. All correlation coefficients between component variables and total variables (Corrected Item-Total Correlation)> 0.3 and Cronbach's Alpha if Item Deleted values were also <0.87. Therefore, all observed variables of the factors were preserved and continued to run EFA analysis. Results of running EFA by Principal components method with Varimax rotation showed KMO value = 0.827, Barlett's test = 1945.741 with significance level <0.001. There are 4 groups of factors formed from 19 initial observed variables. Total Variance Explained value = 63,715, Eigenvalues value of 4 factors from 1,445 - 5,789 to ensure requirements. Factor loading> 0.5 and there was no case that the variable uploaded both factors at the same time with the load factor close together. So factors ensured the convergence and differentiation when analyzing EFA. In addition, there was no disturbance of factors, only the disturbance of the position of the items in each factor (see Table 2 below).

Table 2. Rotated Component Matrix between the variables of compliance "4 right" principle in using plant protection drugs of decorative tree planters

Rotated Component Matrix[a]

Item	Component			
	1	2	3	4
RC2	.868			
RC1	.850			
RC3	.795			
RC5	.732			
RC4	.713			
RW3		.843		
RW2		.823		
RW4		.790		
RW1		.749		
RW5		.647		
RT4			.796	
RT1			.794	
RT2			.771	
RT3			.768	
RP5				.767
RP1				.734
RP4				.699
RP3				.681
RP2				.511

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

After running EFA, the independent variables were kept for regression analysis. The results of the regression analysis showed that the Adjusted R Square was 0.446. Testing the hypothesis of the overall fit of the model results in a value of F = 45.146 with p <0.001, showing that R^2 of the population was non-zero, this means that the linear regression model built was consistent with it the overall. The analysis results also showed that there was no multi-collinear phenomenon in the model (Table 3). Other assumptions of the model such

as the normal distribution of residuals, linear relation, constant variance and independence of error were all guaranteed (Attachment file). The regression equation had the form: Y = 0.648 + 0.36X1 + 0.085X2 + 0.195X3 + 0.17X4.

Table 3. Analyzing result of linear recurrent to describe the relation between real situation of complying "4 right" principle and self-evaluation of safety and effectiveness in using plant protection drugs of the planters.

Factors	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Constant	.648	.235		2.755	.006		
Right drugs	.360	.057	.381	6.329	.000	.698	1.433
Right dosage	.085	.041	.114	2.052	.041	.823	1.215
Right time	.195	.047	.229	4.136	.000	.828	1.208
Right way	.170	.046	.208	3.720	.000	.812	1.231

IV. DISCUSSION

Complying the principles of pesticide using is a necessary condition in agricultural production in general because this activity is related to the level of safety for users as well as the impact on the living environment. The research results showed that the level of compliance with the "4 right" principle in the pesticide using of kumquats and peach planters was quite average. The average score of the criteria was only from 3.68/5 (DT5) to 3.91/5 (DL21 and DC3). Compared with studies in Vietnam, it was better to comply with the "4 right" principle of the subjects in this study. The survey on vegetable planters in Thanh Hoa showed that the average score of the criteria in the principle of "4 right principle" was only from 2.06-3.63/5 points (Cuong & Thuan, 2017). A similar result was also reported on rice farmers in Thai Binh when this went up to 80% of households violated "4 right principle" correctly (Lan, Le & Phong, 2014). A violation of the "4 right" principles could also be partly attributed to previous research results on pesticide use (Giang et al., 2016; Hoa et al., 2019; Lanh, 2016; Luu et al., 2014, and Toan 2013). As a result, this research result was correlated with the results of the studies that had been consistent with the view that violation of the principles of pesticide using was quite common in rural areas of Vietnam.

The right pesticide is considered the first rule in the "4 right" principle because if you do not choose the right pesticide, the compliance with the remaining principles will not work. The results of this research were similar to previous studies when it was considered the most violated principle. A recent study in Mazandaran - Iran showed that selecting the right pesticide list allowed only 22 out of 25 proposed criteria for planters' choice of drug usage [19]. A survey report at Ekiti State - Nigeria found that up to 86.7% of the drugs were classified as highly dangerous by WHO but still selected to be used by people [20]. The use of pesticide outside the list of regulations/recommendations had also been reported in many studies in Vietnam (Cuong et al., 2017; Lan et al., 2014, and Nhan et al., 2015). The overuse of unknown active ingredients and their toxicity could lead to increased pest resistance, negative impacts on the ecosystem and user health.

The right time is the principle that is best complied in 4 principles, but only at a moderate level (3.83/5-3.91/5). Previous reports on this issue in Vietnam also showed similar results. Only about 63% of rice farmers in Phong Dien-Can Tho and tea planters in Pong Drang commune, Dak Lak province implemented the right time to start spraying (Hoa et al., 2019 and Luu, Ngoc & Ngoc 2014). Even this rate among vegetable planters in Da Lat, Lam Dong province was only 14.4% (K'Vay & Dung, 2013). The survey in Le Xa, Hung Yen province also showed that only 50% of planters implemented the time of starting spraying according to experience, neighbors and when the presence of pests / diseases was present (Lanh, 2016). This situation had also been described in studies in Tanzania (Jakaya, Mizengo & Yoweri, 2015), in Malaysia (Halimatunsadiah et al., 2016), in Ghana (Mattah, Mattah & Futagbi, 2016) and in Nepal (Khanal & Sigh, 2016).

The research results also showed that the violation of the principle of right concentration and dosage is taking place quite popularly. Specifically, 30-38.7% of people rarely and occasionally comply with the criteria of this principle. This situation has also been confirmed in many previous studies. Planters can measure the pesticide dosage with a spoon or bottle or whatever is available and even measure the amount of pesticides to be made by hand, mixing pesticides higher than recommended, according to the economic experience. Experiments and often increase the dose higher than recommended (Lan, Le & Phong, 2014; Truong & Vi, 2016; Raksanam et al., 2012). The main reason for using a higher dose than directed is to make sure it is effective after spraying, saving time and labor (Toan, 2013).

This finding repeated the results of studies which suggested that "the right way" is also a frequently violated principle, although the level seems to be lower than other principles (Cuong & Thuan, 2017; Lan et al., 2014, and Mattah, Mattah & Futagbi, 2015). The least compliant criterion in this principle is "making the right pesticide (the form of powder or solution, the order of mixing the drugs)". The situation of mixing two or more pesticides with irregular rules, arbitrarily mixing drugs was also recorded in many previous reports (Lan et al., 2014; Linh, Binh & Lam, 2014, and Thang et al., 2011). Some causes of improper mixing of pesticides were proposed: Planters often used a mixture of pesticides with the hope that they could create a new drug that had a wide impact, could be deducted simultaneously to eliminating pests and improving the effectiveness of drugs. Many planter households hire sprayers, because they want to save time, the sprayer has mixed a variety of drugs at once. Due to the lack of knowledge about the pesticide mixture, the mixtures are often unreasonable (Lan et al., 2014). To save time and labor, to prevent and repel many pests after spraying, and simply do follow their neighbors when they realize the effect of this approach (Toan, 2013).

According to FAO, there are many factors affecting crop productivity and quality such as Agronomic factors, Management, Land development and land improvements, Conservation and the environment, Socio-economic factors (FAO, 1985). Being able to assess all of these factors at the same time requires a lot of resources. With limited resources, the scope of this study only focused on understanding the effectiveness of the "4 right" principle on the safety and effectiveness of pesticide usage through users' self-assessment. The results from the regression model showed that all factors in the "4 right" principle had a positive effect on the safety and efficiency of the usage. This means that improving any of these factors will improve people's safety and effectiveness of using plant protection drugs. Basing on the Standardized Coefficients of the regression model, the influence of the independent variables on the dependent variable can be determined as follows: the "right pesticide" factor group has the strongest impact; the second one is "Right time" factor group, the "Right way" factor group stands in the third position and the final one is the "Right dose" factor group. However, these four factors only explained 44.6% of the variation in the level of safety and effectiveness when it is used. This is entirely consistent with the recommendations of FAO because pesticides contribute only a part in the success of a crop. A similar report was also found on vegetable planters in Thanh Hoa-Viet Nam, where the five principles of plant protection drug usage also explained 51.7% of the variation in safety and efficacy (Cuong & Thuan, 2017).

V. CONCLUSION

The principle of "4 right" plays an important role in agricultural production because it is related to the level of safety for users, impacts on living environment and economic efficiency. Current research shows that the level of compliance to the "4 right" principles of decorative tree planters is only fairly average. The most violated principle is " right pesticide" with typical criteria as "Correct pesticide category". All 4 criteria in the "4 right" principle are positively related to safety and effectiveness when used through self-assessment of the people. This study has provided a very useful data from a decorative tree village in Vietnam. However, the research results may be affected by the data collection through interviews only.

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