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Investigation of the farmers' Safety and Protective Behavior to Use Pesticides in the Farms

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Abstract

Aim: The main purpose of this study was to investigate the safety and protective behavior of farmers in relation to the application of chemical pesticides in the fields and the factors influencing their behavior.

Methods: This quantitative and survey research was conducted in Mahidasht County, Kermanshah Province, in 2016. The population consisted of 170 farmers (N=200) Mahidasht County, who were determined by randomly method. Questionnaire used as a research tool. Validity and reliability of the tool were confirmed by a panel of experts and Cronbach's alpha coefficient. Correlation coefficient and statistical test was used for analyzing the data by SPSS20.

Findings: Most people have poor performance in the use of protective equipment when spraying pesticides. There was positive correlation between safety behavior of using pesticides, work experience, economic status, attitudes toward the correct application of pesticides, and participating in training.

Conclusion: Due to the farmers' inappropriate performance in safety and protection actions and significance relationship between participation in the training programs and safety behavior, it is necessary to design education programs to improve their knowledge.

Keywords: Agriculture, Safety and protective behaviors, Pesticides, Farmers

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Introduction

Today, in most of the developing countries, pesticides and chemical control play a major role in protection of products due to great advances in agricultural technologies [1]. This is often done incompletely or inexplicably because of the farmers' inadequate familiarity with the proper principles of chemical control that, in addition to failing to achieve a favorable outcome, will cause interference of natural balance and poisoning of users of toxins and consumer products in the longrun [2]. However, in the developed countries, the amount and method of using chemical pesticides have become more logical with the advent of environmentally friendly methods and the existence of controlling laws and regulatory organizations [3]. Acute effects usually result from the ingestion of a lot of chemicals to the body, and their effect on health includes dizziness, nausea, diarrhea, vomiting, inflammation of the lungs, skin lesions, and even death [4-7]. In spite of promoting public awareness about the dangers of the excessive use of fertilizers and chemical pesticides, in Iran, there is an increase in the health and environmental costs associated with the use of these materials in the agricultural sector [8]. So, one of the main reasons for the use of chemical pesticides is in pest control [9]. This is despite the fact that many farmers are working in the fields in the agricultural sector, and the evidence shows that there are severe contamination and poisoning among farmers and users of chemical pesticides [10]. However, the measure of lethal damage caused by the use of chemical pesticides in the years 1993 to 2008 was 46.3 per 1,000 people per year [11]. It has been shown that in the United States, more than two billion pounds of pesticides are used annually in various sectors, including agriculture and forestry [12]. By continuing the production of pesticides and poisons, their production will be 2.7 times higher than before and people and the environment will be more exposed [13]. In Iran, according to the data of the Iranian Center for Statistics in 1996, the total sales of pesticides were 15 thousand tons, and in 2001, this amount reached 27.2 thousand tons. Also, in 2006, the share of herbicides from total poisons distributed among farmers was 44%. In 2006, 11100 tons of herbicide were consumed in Iran out of which 5500 tons had been used in wheat farms [14].

Also organophosphate poisoning has been reported as the third cause of poisoning and the main cause of mortality due to poisoning [15]. There is a significant relationship between the use of pesticides and cancer among farmers, so that non-melanoma skin cancer, colon cancer, breast cancer, lymphoma and prostate cancer are common among farmers [16, 17]. The high use of pesticides increases the risk of

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disruption of the nervous system among farmers [18]. Another study has shown that non-safe use of pesticides has led to complications such as respiratory dysfunction among farmers [19].

The study of Eyvazi and Pour Najaf (2004) revealed that 25.2% of farmers and 10% of their family members have been poisoned. Another research has shown that farmers have a low level of health in the use of pesticides and a high level of knowledge and awareness about the harmful effects of pesticides on the environment, and their safety measures against the potential risks of pesticides are inadequate [20]. Low education of rural people, lack of information and training on the safe use of insecticides, lack of spraying technologies, and inadequate protective equipment during pesticide use have a significant relationship with the diseases and injuries from pesticides [21]. Some researchers believe that the farmers' protecting behavior in the use of pesticides is heavily influenced by their level of knowledge [22]. The results of a research on the factors affecting farmers' decision to use chemical fertilizers show that irrigation, increase in yield, profit and income have a significant and positive relation with the amount of fertilizer and pesticides used, while farm size, application of organic fertilizer, soil fertility and distance to pesticide market have a negative relationship with fertilizer and pesticide use [23]. The findings of Nazaryan et al. indicated no significant difference between the two groups in terms of knowledge about the dangers of pesticides and the attitude towards the risks of pesticides and safety behavior in the use of pesticides. There was also a significant relationship between access to information and communication channels, income levels, and knowledge about the dangers of chemical pesticides [24]. Various research results [25, 26] have shown that poor managerial practices regarding the safe use of pesticides are lack of awareness and lack of training. The results of a study in India showed that 70% of farmers knew the effect of pesticides on individual health and 40% knew their effect on the environment. In addition, 40% of the farmers had good knowledge about how to use pesticides [27]. A study in Oman showed that agricultural workers have not had sufficient knowledge and awareness of the consequences of the uncontrolled use of chemical pesticides [28]. In contrast, a research in Ethiopia revealed that most of the farmers were aware of the impact of pesticides on human health [29]. However, there was no awareness of exposure to pesticides and its use with pesticide use practices and maintenance [30]. Another study results indicated a significant relationship between the use of pesticides and depression [31]. In general, the use of pesticides and chemical fertilizers in

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agriculture has contributed to the increase in the production of products, as well as to the increase in poisoning, disease and accidents. The use of protective equipment has also been welcomed in some areas [32], though in some areas, due to lack of access and cost of protective equipment, their use is less common [33]. However, most of occupational poisoning with pesticides and other chemicals during acute agricultural operations is acute, indicating the need to pay more attention to improving the safety and protection of farmers as the first actors in the production cycle.

Research Method

The main purpose of this study was to investigate the safety and protective behavior of farmers in relation to the application of chemical pesticides in the fields and the factors influencing their behavior. Based on main purpose, the objectives of the study are as follows:

- Examining the professional and individual characteristics of farmers
- Examining the farmers' attitudes toward the correct and safe use of chemical pesticides on farms
- Relationship between the farmers' safety behavior and effective factors on their behavior
- Investigation of effective factors in explaining the farmers' safe behavior.

This study is a non-experimental (descriptive-correlation) and applied research. The statistical population of the study consisted of maize growers (200 farmers) in Mahidasht County. Sampling was done by simple random sampling, and the sample size was determined as 127 farmers using Krejcie and Morgan tables [34]. The data collection tool was a researcher-made questionnaire, consisting of individual and professional characteristics of the farmers, assessing the behavior and attitude of the maize growers in the use of chemical pesticides in the fields. The attitude and behavior of maize growers in the use of chemical pesticides were measured by a five-level Likert scale. The face and content validities of the research tool were confirmed by a panel of experts, and its reliability was proved through a pilot study and calculating Cronbach's alpha ($\alpha = 0.7$). The data were analyzed using $SPSS_{23}$. The variables included age, education, farming experience, the duration of daily work, communication channels, income, attitudes and behaviors of maize growers in the safe use of chemical pesticides in the fields.

Findings

The results showed that the most frequency of age of maize growers was in the range of 30 to 42 years and their average age was 40 years. The most frequency in terms of education level was diploma. Average of the maize growers'

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experience was 20 years that shows the importance of agriculture in the region. Findings showed that the farmers worked on average seven hours a day, 33.3% of the farmers did not receive training on the use of chemical pesticides in the fields, and 43.3% of farmers used hand tools, 58.3% used semi-machines and 37.8% mechanized vehicles for spraying. 42% of the farmers, sometimes, used masks, 43% seldom used gloves, and 61.4% never used protective glasses. 35.4% of them sometimes, used wipe to cover their mouths and faces, and only 11% used protective clothing (Table 1).

Table 1: Frequency (%) of maize growers on the use of personal protective equipment when preparing and spraying chemical pesticides

Protective tool	Never	Rarely	Sometimes	Most of the time	Always
Mask	8.7	23.6	42.5	17.3	7.9
Gloves	43.3	20.5	19.7	9.4	7.1
Protective glasses	61.4	22	10.2	4.7	1.6
Wipes to cover the mouth and face	15.7	7.8	35.4	17.3	22.8
Protective clothing	16.5	15.7	53.5	11	3.1

Findings related to the behavior of maize growers in the face of health risks showed that most of the maize growers (58.3%) avoided eating and drinking during spraying, and 63% avoided smoking during spraying. 44.1% of the maize growers sometimes used protective equipment, and 27.6% never used safe clothing during spraying. 44.1% of the maize growers sometimes used cans of chemical pesticides for other uses, and 48.8% sometimes held poisons in cans for food and drink. 24.4% of the maize growers believed that poisons do not carefully blank, and 18.1% often washed all equipment after work. Finally, 42.5% of the maize growers rarely sprayed in the wind direction (Table 2).

Table 2: Frequency (%) of the farmers' behavior in the face of life-threatening health risks

Behavior	Never	Rarely	Sometimes	Most of the time	Always
Eating and drinking during spraying	58.3	26	15.7	----	---
Smoking during spraying	63	29.9	3.9	3.1	---
Use of necessary protective equipment	13.4	22.8	44.1	14.2	5.5
Spray with safe clothes	27.6	22	34.4	12.6	3.1
Keeping poison cans for other uses	10.2	29.9	44.1	5.5	10.2
Maintenance of toxins in cans for food and drink	29.9	21.3	48.8	---	---
Emptying the toxins carefully	24.4	6.3	51.2	11	7.1
Washing all the tools after work	22.0	7.1	39.4	18.1	13.4
Spraying on the wind	8.7	42.5	17.3	9.4	22
The amount of poison prepared and consumed	6.3	11	52.8	5.5	24.4

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The protective and hygienic behaviors of maize growers during spraying are presented in Table 3. Most of the maize growers sometimes read the instructions on the cans of poison (33.9%). Most of the maize growers washed their hands and contaminated instruments after spraying. 7.9% of them rarely looked at warning signs on the label of poisons before spraying. 24.4% of the maize growers never changed their clothing after spraying. 54.3% of them sometimes used toxins more than the recommended amount, and most of the maize growers were less likely to pay attention to poison dishes.

Table 3: Frequency (%) of farmers' behavior in regard to applying principles of safety and health during spraying

Health and safety principles	Never	Rarely	Sometimes	Most of the time	Always
Studying instructions on cans of toxins	---	15.7	33.9	22.8	27.6
Washing hands and infected toxins after spraying	16.5	2.4	37	20.5	23.6
Attention to warning signs and symptoms on the label of pesticides before spraying	16.5	7.9	45.7	11	18.9
Changing clothes	24.4	7.1	49.6	7.1	11.8
Excessive recommended intake of poisons	12.6	7.9	54.3	11.8	13.4
Installation of warning signs on the containers containing poisons	3.9	19.7	42.5	13.4	---

The findings showed that 42.5% of the farmers often sell empty poison dishes, 44.6% rarely burn the dishes, and 49.5% rarely bury containers. 42.5% of the farmers sometimes leave empty containers in the environment, 19.7% always use containers after washing at home, and 34.6% often repatriate with other garbage (Table 4).

Table 4: Frequency distribution (%) of farmers' behavior based on the use of empty poisons

Behavior	Never	Rarely	Sometimes	Most of the time	Always
Selling	37.8	4.7	9.4	42.5	5.5
Burning	18.9	44.9	15.7	9.4	11
Burying	11.0	49.5	9.4	12.6	---
Leaving the environment	20.5	18.1	42.5	4.7	14.2
Using it after washing at home	23.6	11	42.5	3.1	19.7
Disposing with other garbage	11	11.8	23.3	34.6	---

The ISDM was used to measure the maize growers' attitude (Formula 1). The results showed that 26.8% of the maize growers had negative attitude toward pesticide use in the fields, 64.6% had average attitude, and 8.7% had positive attitude:

$$Low\ level = D < M - \frac{1}{2} SD \qquad \text{(Formula 1)}$$

$$Mean\ level = D\ M - \frac{1}{2} SD \leq D \leq M + \frac{1}{2} S$$

$$High\ level = D > M + \frac{1}{2} SD$$

Also, with respect to information channels on

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the safety principles of using chemical pesticides, most of local channels were related to family and friends (25.2% and 24.4%), and most of the farmers (61.4%) used television (nation channels) and 34.6% were used Internet (international channels) (Table 5).

Table 5: Frequency distribution of communication channels used by farmers

Communication channels		Frequency	Percentage
Local channels	Family members	17	13.4
	Relatives	32	25.2
	Friends	31	24.4
	Health network	11	8.7
	Neighbors	6	4.7
	Local leaders	1	8
	Rural informants	22	17.5
	Agricultural Organization	7	5.5
National channels	Television	78	61.4
	Book	36	28.3
	Magazines and newspapers	5	3.9
	None of them	8	6.3
International channels	Internet	44	34.6

In this research, multiple stepwise regression was used to determine the factors affecting the maize growers' safety behavior during the use of chemical pesticides. In this method, the strongest variables are entered into the regression equation, respectively. This will continue until a significant test error reaches 5%. After entering the variables that had a significant correlation with the dependent variables (agricultural experience, attitude, economic status, participation in educational courses), the regression equation goes up to three steps.

The results showed that in the first step, the attitude toward the use of pesticides as the most important variable influencing the maize growers' safety behavior was entered into the model. The second step showed that the second variable affecting the maize growers' safety behavior was the training course. Finally, the third step showed that the third variable affecting the maize growers' safety behavior was economic situation. At the end of step 3, the regression model reached its final stage. Accordingly, three variables were entered into the regression model.

$Y= 1.714+0.735X_1 +3.89X_2 + 1.171X_3$

Y= Safety behavior X_1= Attitude X_2= Training course X_3= Economic situation

This model shows that the most important variable affecting the maize growers' safety behavior during the use of chemical pesticides was their attitude towards the use of pesticides, and in the next stage, comes participation in the training course and economic situation, respectively. As given in Table 7, in steps 1-3, the value of R^2 was 0.35, 0.37, and 0.43,

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respectively showing that the three variables were able to explain 43% of the change in farmers' behavior. In addition, the most influential independent variable on the dependent variable was the farmers' attitude toward the use of pesticides (Beta coefficient was 0.378). That is, one unit of change in the standard deviation of the attitude toward the use of pesticides creates 0.378 unit of variation in the standard deviation of the farmers' safety behavior in the use of chemical pesticides. Other variables were important in influencing the safety behavior of farmers in educational institutions with a Beta coefficient of 0.222 and economic status with a Beta coefficient of 0.177. Other variables were participation in educational (β= 0.222) and economic (β= 0.177) situations.

Table 6: Multi-regression coefficients

Steps	Independent variable	B	Beta	t	sig	R	R^2
1	Attitude	0.617	0.378	5.289	0.000	0.59	0.35
	Constant	29.07	-----	3.111	0.02		
2	Attitude	0.642	0.383	3.629	0.000	0.61	0.37
	Training course	4.196	0.222	5.638	0.02		
	Constant	33.406	-------	3.629	0.000		
3	Attitude	0.735	0.450	3.424	0.001	0.66	0.43
	Training course	3.89	0.206	6.198	0.005		
	Economic situation	1.171	0.177	2.428	0.016		
	Constant	1.714	-----	2.291	2.291		

Discussion

The research results showed that the use of semi-mechanized tools and hand tools was common among the farmers; especially the use of hand tools could endanger the health of farmers. The most commonly protective equipment was napkins to cover the mouth and face. Therefore, it can be concluded that the farmers have no access to protective equipment or are not sufficiently aware of other protective devices. In this regard, Aghili Nejad et al. (2006) reported that 68% of farmers do not use any personal protective equipment, and only 25% of them understand the information contained in the pesticide label [35]. In addition, the findings of this study are consistent with those of Ahmed Khan et al. [36], Hashemi et al. [37] and Atreya et al. [20]. In this regard, Raksanam et al. indicated that eight factors are affective on not using pesticides by farmers: farmers' false belief about the toxicity of pesticides, lack of attention to protective measures, environmental hazards, lack of attention to information on pesticides' containers, defective spray equipment, improper maintenance of spraying equipment, lack of appropriate protective clothing, and toxin

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transport [38].

The results showed that most of the farmers' attitude about the use of pesticides was moderate; this moderate level can provide a platform for strengthening and improving people's attitudes through various training. On the other hand, it can be admitted that farmers are almost aware of the harms of pesticide use that is a very good advantage, because according to the theory of planned behavior [39] and the results of research by Mills et al. [40], attitudes are predictive of behavior, and a most important step is to adopt the changes. In this regard, the results of Arcury et al. [41] showed that farmers have different beliefs about the safe use of pesticides that affect health activities. In addition, as another finding of research, improving the farmers' experience and their attitude towards proper application of pesticides in farms would improve their safety behavior in pesticide application. This finding is consistent with the results of Yazgan and Tanik [42], implying that farmers' attitudes and behaviors are based on their previous experiences. Therefore, work experience can also be an effective factor in attitude and behavior. On the other hand, there was a positive and significant relationship between the farmers' safety behavior and economic situation and participation in training courses. It is concluded that those who have a better economic situation have more access to information resources and protective equipment, and they are not confronted with the provision of safety and security equipment, as well as participation in training courses. It is also possible to raise their level of knowledge and attitude followed by protection behavior. In this context, the role of education and information networks is very important. The World Health Organization (WHO) has recommended that only trained personnel should use pesticides [43].

Conclusion

The use of chemicals, pesticides and fertilizers in agriculture has contributed to an increase in poisoning, diseases and accidents during acute agricultural operations, which threatens the farmers' health. Therefore, farmers' behavior in protecting themselves during the use of chemical pesticides can affect their health. Given that most of the farmers in this study used television, making people aware of such media can be effective in connecting farmers with other family members and friends. Therefore, by improving the farmers' behavior, comparative results can be obtained to improve the safety and behavior of other farmers in the application of pesticides and chemicals in the farms. Furthermore, due to the direct link between agricultural extension and education with farmers, the necessary training measures can be implemented through joint

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collaboration of the Health Administration and agricultural extension and education with regard to the safe and proper use of pesticides and the introduction of a variety of protective devices and their application. Finally, since the drought has brought economic pressure to farmers over the last few years, it needs the cooperation of the Agricultural Jihad Organization to provide low-interest loans, as well as inputs and agricultural equipment at affordable prices to farmers so that they can equip the protection and safety.

Conflict of interest statement

The authors declare that they have no conflict of interest.

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