

Investigation and Analysis of Pesticide Use Behavior and Influencing Factors of Apple Farmers*

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Abstract—With the development of the economy and the improvement of people's living standards, the quality and safety of agricultural products has become a hot topic of people's attention. In recent years, frequent food safety incidents have not only seriously threatened people's health but also greatly hit the consumers' confidence, and to a certain extent affected the stability of society. In this article, the pesticide use behavior of Apple growers refers to the behavior of farmers choosing pesticide varieties, including the use of safe pesticides and the use of unsafe pesticides. The pesticide behavior of Apple farmers is influenced by many factors. It is the key for the government to make relevant policies and guide farmers to use safe pesticides. In this study, we analyze the pesticide behavior of apple farmers and find out the factors that affect the pesticide use behavior of farmers, and hope to control and control Apple quality and safety from the source of production.

Keywords—apple growers; pesticide use behavior; influence factors

I. INTRODUCTION

The pollution of chemicals has always been the focus of Apple quality and safety. Since the end of the 20th century, countries have gradually begun to pay attention to the quality and safety of apples, and pesticide residues are the most critical point. Pesticide residues are still a widespread problem in the global arena, but many developed countries

have already controlled pesticide residues at a very low level. Since the 1990s, China has paid attention to the quality and safety of apples, focusing on pesticide residues and excessive harmful elements. According to the report, the pesticide residues of Apple in China mainly include organochlorine, organophosphorus and chrysanthemum vinegar pesticides. This type of pesticide characterized by a long residual period and a high frequency of excess, which can be said to be the main influencing factors of Apple quality. The "No. 1 Document" of the Central Committee for 2017 clearly emphasizes "the need to promote green production methods, promote zero growth in fertilizer and pesticides, and implement the action plan for the prevention and control of soil pollution."

II. ANALYSIS OF PESTICIDE USE BEHAVIOR AMONG APPLE FARMERS

A. Farmer Characteristics and Pesticide Use Behavior

1) *Age*: The apple farmers' age divided into five stages, and the age of farmers and the behavior of pesticide use analyzed.

As shown in the "Table I", the younger are the Apple growers, the more they tend to use safe pesticides.

TABLE I. THE EFFECT OF AGE ON FARMERS' BEHAVIOR

Age	Safe medication		Unsafe medication		total
	quantity	percentage (%)	quantity	percentage (%)	quantity
Under 30	11	78.6	3	21.4	14
31-40	29	78.4	8	21.6	37
41-50	60	71.4	24	28.6	84
51-60	80	69.6	35	30.4	84
Over 61	31	60.8	20	39.2	115
total	211	100	90	100	301

2) *Educational attainment*: The education of Apple

growers surveyed divided into four levels: primary school and below, junior high school, high school, secondary school and above, and analyzed with the pesticide use

*Sponsors: The research was sponsored by the education department project of Liaoning Province (Project No. WSNZD201701).

behavior of farmers, as shown in the figure. From the “Fig. 1”, as the level of education increases, educated farmers are more likely to choose to use safe pesticides and the proportion of unsafe pesticides reduced.

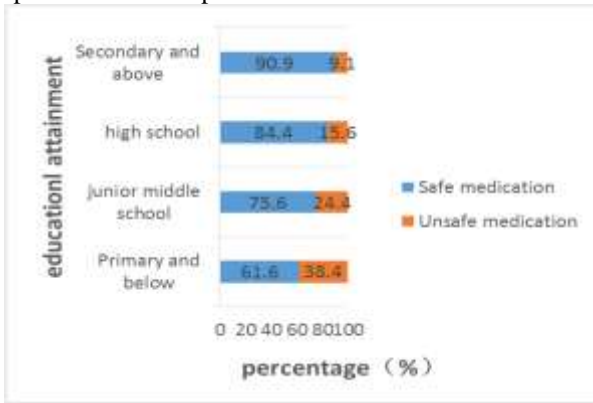


Fig. 1. The effect of education on farmers' behavior.

TABLE II. THE EFFECT OF FARMING NUMBER ON FARMERS' BEHAVIOR

Number of farmers	Safe medication		Unsafe medication		total quantity
	quantity	Percentage (%)	quantity	Percentage (%)	
1-2 persons	68	73.9	24	26.1	92
3 persons	56	72.2	21	27.3	77
4 persons	63	64.3	35	35.7	98
5 and above	24	70.6	10	29.4	34
total	211	100	90	100	301

2) *Main sources of income:* This article divides the main source of income of farmers into Apple planting as the main income and Apple planting as the main income, and interacts with the pesticide use behavior, as shown in the “Fig. 2”. As can be seen from the figure, the proportion of farmers who use safe pesticides as their main source of income is higher than that who do not use Apple as their main source of income.

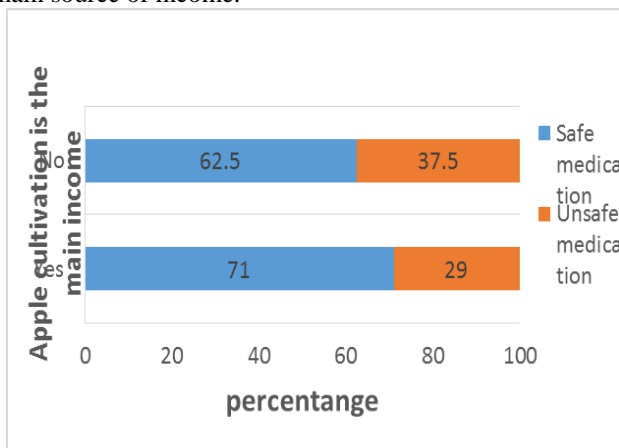


Fig. 2. The effect of main income source on farmers' behavior.

B. Household Characteristics and Pesticide Use Behavior

1) *Number of family farmers:* In theory, the more households farm, the more reasonable the knowledge and use of pesticides, so the number of households farm and pesticide use behavior is interactive analysis, as shown in the “Table II”. From the table, it was that the household agricultural population and pesticide use behavior did not show a certain degree of regularity, so it is not possible to judge the relationship between household agricultural population and pesticide use behavior.

C. Cultivation Characteristics and Pesticide Use Behavior

1) *Area under cultivation:* According to the questionnaire survey, the planting area divided into 2 acres or less, 2-5 acres, 6-10 acres, and 10 acres or more, and it analyzed interactively with the pesticide use behavior. As shown in the “Table III”:

TABLE III. THE EFFECT OF PANTING SCALE ON FARMERS' BEHAVIOR

Area under Cultivation	Safe medication		Unsafe medication		total
	quantity	Percentage (%)	quantity	Percentage (%)	quantity
2 acres or less	37	72.5	14	27.5	51
2-5 acres	52	71.2	21	28.8	73
6-10 acres	89	67.4	43	32.6	132
More than 10 acres	33	73.3	12	26.7	33
total	211	100	90	100	301

From the "Table III", it was that the planting area of Apple growers has no significant relationship with pesticide use behavior, so it is not possible to judge the impact of planting area on pesticide use behavior.

2) Length of planting: The questionnaire divided the number of years Apple growers planted apples into less than

10 years, 11-20 years, 21-30 years, and more than 30 years. It analyzed interactively with pesticide use behavior. As shown in the table, Apple growers planted apples. The longer is the period of time, the higher the proportion of safe pesticides used. (See "Table IV")

TABLE IV. EFFECTS OF PLANTING YEARS ON PESTICIDE USE BEHAVIOR OF FARMERS

Length of planting	Safe medication		Unsafe medication		total
	quantity	Percentage (%)	quantity	Percentage (%)	quantity
Up to 10 years	33	61.1	21	38.9	54
11-20 years	57	67.1	28	32.9	85
20-30 years	84	71.8	33	28.2	117
More than 30 years	37	82.2	8	17.8	45
total	211	100	90	100	301

3) Participation in technical training: In the course of the questionnaire, it found that most of the people had participated in technical training, and 194 of the 301 apple growers had participated in technical training, accounting

It was from the "Fig. 3" that 76.3 percent of households with technical training used safe drugs, and 58.9 per cent of households without technical training used safe drugs.

for 64.5% of the total number of samples. An interactive analysis carried out, the distribution of which shown in the figure below:

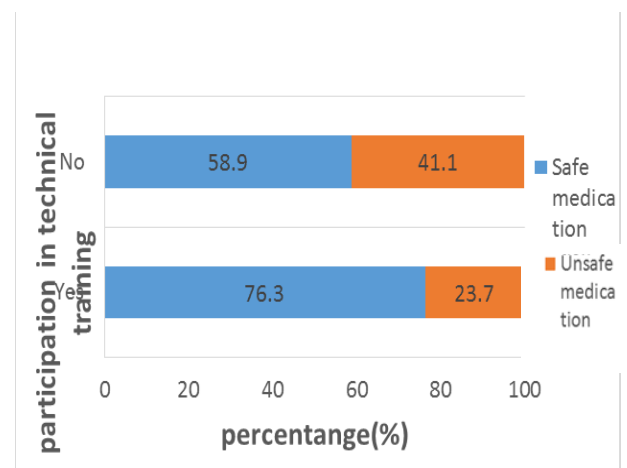


Fig. 3. The effect of training farmers' behavior.

D. Apples Safety Awareness and Pesticide Use Behavior

1) *Concern for Apple's safety:* In the design of the questionnaire, the farmer's concern for Apple's safety divided into five categories: no concern at all, no concern at

all, some concern, more concern and great concern. The "Table V" shows that the higher the concern of Apple growers for the safety of apples, the higher the proportion of safe pesticides used.

TABLE V. THE EFFECT OF SAFETY ATTENTION ON FARMERS' BEHAVIOR

<i>Level of attention</i>	Safe medication		Unsafe medication		total
	<i>quantity</i>	<i>Percentage (%)</i>	<i>quantity</i>	<i>Percentage (%)</i>	<i>quantity</i>
Not at all	6	37.5	10	62.5	16
Little attention	19	54.3	16	45.7	35
Some concerns	44	71	18	29	62
More attention	89	71.8	35	28.2	124
Very much	53	82.8	11	17.2	64
total	211	100	90	100	301

2) *Awareness of pesticide to health hazards:* The effects of pesticides on human health divided into no impact, little impact, general impact, large impact, and severe impact. Interact it with pesticide use behavior, as shown in the

"Table VI". Farmers believe that the greater the impact of pesticides on human health, the more they will choose to use safe pesticides.

TABLE VI. THE EFFECT OF USING PESTICIDE ON FARMERS' BEHAVIOR

<i>Awareness of Pesticide to Health Hazards</i>	Safe medication		Unsafe medication		total
	<i>quantity</i>	<i>Percentage (%)</i>	<i>quantity</i>	<i>Percentage (%)</i>	<i>quantity</i>
no impact	13	48.1	14	51.9	27
little impact	45	60.8	29	39.2	74
general impact	83	70.3	35	29.7	118
large impact	48	84.2	9	15.8	57
severe impact	22	88	3	12	25
total	211	100	90	100	301

3) *Understanding of national prohibited drugs:* The questionnaire divided the farmer's understanding of the country's banned drugs into a lack of understanding, understanding, general understanding, comparative

understanding and very good understanding. Interact it with pesticide use behavior, as shown in the "Table VII". The higher the level of knowledge, the more likely the farmers are to use safe pesticides.

TABLE VII. THE EFFECT OF KNOWLEDGE OF NATIONAL DISABLED PESTICIDE ON FARMERS' BEHAVIOR

<i>Understanding of National Prohibited Drugs</i>	Safe medication		Unsafe medication		total
	<i>quantity</i>	<i>Percentage (%)</i>	<i>quantity</i>	<i>Percentage (%)</i>	<i>quantity</i>
do not understand	17	54.8	14	45.2	31
A little bit	43	62.3	26	37.7	69
General knowledge	99	71.7	39	28.3	138
Better understanding	38	80.9	9	19.1	47
total	211	100	90	100	301

Through the analysis of the differences in the use of pesticides by Apple growers, it found that the younger the farmer is, the more he prefers to use safe pesticides, and with

the improvement of his education, the more likely he is to use safe pesticides. At the same time, farmers are more willing to use safe pesticides. Finally, the higher the level of

concern for Apple quality and safety, the greater the health risk of pesticide use, and the better understanding of the country's ban on pesticides, the more farmers will choose safe pesticides.

III. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusion

The use of pesticides is the key to determining the quality and safety of apples. As the main body of Apple production, Apple farmers use pesticides to determine the quality of apples. The improvement of Apple quality needs to start from the source of production, improve farmers' awareness of pesticides, standardize the use of pesticides by farmers, reduce the use of highly residual pesticides, and provide consumers with green and healthy apples. This paper mainly studies the factors that influence the pesticide use behavior of Apple growers, and draws the following conclusions:

1) *The labor force of apple farmers is mainly in the middle and old age, the population is seriously aging, and the education level is generally low:* According to the survey data from the questionnaire, the largest proportion of Apple growers is between the ages of 40 and 60, accounting for 66.1 % of the total number of samples, 37 households aged 30-40, accounting for 12.2 % of the total, and 14 households under the age of 30. With 4.7 per cent of the total, the trend towards ageing is evident. At the same time, the generally low level of education of Apple growers may be that the main labor force was born in the 1950s and 1960s and objectively had a low level of education, which led to a low level of education among Apple farmers.

2) *Some Apple growers still use pesticides that are residual and banned in the country:* Of the 301 samples in Wa Fangdian City, the survey showed that 90 households still use residual pesticides, accounting for 29.9 % of the total number of samples. Overall, the proportion of unsafe pesticides used by Apple growers is still high, and there are still some hidden dangers to Apple quality and safety.

B. Policy Recommendations

1) *Increase investment in education in rural areas and improve the cultural quality of the rural labor force:* The educational level of Apple growers affects the pesticide use behavior of farmers and poses a threat to the safe production of apples. Therefore, the behavior of farmers using unsafe pesticides, the most basic measure is to solve the problem of low education, that is, to increase rural education investment, to improve the scientific quality and moral and cultural quality of Apple farmers. While ensuring basic education, it is also necessary to provide some professional and technical knowledge for Apple growers with higher education levels. It is necessary to carry out Apple planting technology training to cater for the different needs of farmers with different levels of education.

2) *Carry out various forms of science and technology training to improve the skills of Apple farmers:* In the

process of Apple production, pest control and Apple planting technology have a great relationship with the use of pesticides. Farmers with higher planting technology can always obtain higher benefits at lower input costs. Apple cultivation requires relevant expertise, especially the use of pesticides. Compared with highly toxic pesticides, the knowledge required for the use of safe pesticides is higher and more complex. Due to the low level of education of Apple growers at this stage, it is impossible to rely on their initiative to learn and master them. At this time, the relevant departments must play their role as governments and continuously improve farmers' cultivation techniques by organizing various types of professional and technical training. This in turn reduces dependence on pesticide use. At the same time, in order to combine theory with practice, relevant departments can send experts and technicians to do practical guidance and solve the actual problems of farmers in the planting process in a timely manner.

3) *Raising awareness among apple farmers about the importance of Apple safety:* Apple-growers blindly pursue economic interests and ignore quality and safety. This is an important reason why farmers still use high toxicity and other countries to ban pesticides. Therefore, we must improve farmers' understanding of Apple safety. Only when farmers subjectively recognize the importance of Apple quality and safety. At the same time, the survey found that farmers do not know much about the types and policies of pesticides banned by the country. Therefore, to raise the awareness of Apple growers to the importance of the safety of vegetables, we should publicize the knowledge of pesticides through various forms, especially the harmful publicity of pesticides such as high toxicity and high residues, and raise the awareness of farmers about the National pesticide use policy.

4) *Strengthen the cultivation of new types of agricultural business entities, cultivate agricultural industrialization alliances, and increase the degree of organization of vegetable farmers:* The low level of organization of Apple production, the problem of extremely dispersed and small scale in both production and trading, the high cost of government supervision, and the testing of every transaction are unrealistic and uneconomical. Therefore, the degree of organization of Apple farmers improved. It actively leads the new agricultural management body to put forward a clear pesticide application standard for the farmers and give full play to the role of agricultural industrialization organization.

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