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Investigation of consciousness levels of Çanakkale farmers on environmental and toxicological risks of pesticides

Çanakkale çiftçilerinin pestisitlerin çevresel ve toksikolojik riskleri konusundaki bilinç düzeylerinin araştırılması

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ABSTRACT

Pesticides are increasingly being used against pests in agricultural fields. However, unconscious use of pesticides results in health risks for humans and the environment. Efforts should therefore be spent to reduce the negative impacts of pesticides. The objective of this study was to measure farmers' awareness of pesticide use in the agricultural fields of Çanakkale. The sample size was calculated using the "Simple Random Sampling Based on Means" method. The present survey was conducted with 270 farmers. Of the farmers who participated, 25.55% had 31-40 years of farming experience, 47.78% were primary school graduates, and 35.56% were 55-65 years old. Farmers' knowledge of pesticide use was assessed through Likert scale. Chi-Square test was used to investigate the relationship of farmers' knowledge level with education, age, farming experience, land size and farming type. Only education was significant. As the education level increased, the knowledge level increased. In terms of farmers' attitudes, 78.89% of the farmers indicated that they changed their clothes after spraying, 46.67% cared about the information on pesticide labels, 45.18% used protective equipment during spraying, 69.63% cared about PHI (pre-harvest intervals), and 15.92% had knowledge about MRL (Maximum Residue Limit). 41.85% disposed of remaining pesticide solutions to the edge of agricultural fields, 40.74% to garbage and 6.3% to environment. It was concluded based on the present findings that farmers need serious training on pesticide use and the potential effects of pesticides on human health and the environment.

INTRODUCTION

Pesticides constitute an essential component of agricultural production. They are highly effective in protecting agricultural products against pests and diseases. Annually about $5x10^6$ tons of pesticides are used worldwide. Such a huge quantity may end up with significant damage to non-target organisms, food chains and biodiversity. Unsafe or misuse of pesticides pose serious risks to human health and the environment (Verger and Boobis 2013). Knowledge, attitude, practices, and

behaviours on pesticide usage play a vital role in the prevention of the negative effects of pesticides. For sustainable agriculture, the environment and human health, and food safety should be considered together (WCED 1987). According to 2022 data, the total pesticide consumption of Türkiye was 55.374 tons (TSI 2023). Çanakkale ranks 8th among the provinces in Turkey in terms of pesticide use, with 2.014,7 tons of consumption in 2022 (Anonymous 2022). Most of these quantities are used in irrigated agriculture. Possible residues as a result of unconscious use of pesticides affect our foreign trade. EU-RASFF (European Union-Rapid Alert System for Food and Feed) portal lists the number of warnings issued to each country about pesticide residues on agricultural commodities marketed within the EU boundaries. In this sense, Türkiye was issued 354 warnings for pesticide residues on fresh vegetables and fruits in 2021, 292 warnings in 2022 and 109 warnings in 2023 (the first 7 months) (RASFF 2023).

It is important to reveal the awareness levels of producers to reduce the negative effects of pesticide use. A Likert scale was used in previous survey studies to assess the responses of participants who were asked questions about their pesticide use awareness (Akar and Tiryaki 2018, Erdil and Tiryaki 2020, Likert 1932). Scale reliability is generally checked through Cronbach's alpha coefficient (Anonymous 2023, Cronbach 1951, Kılıç 2016). Compatibility and consistency of the questions asked are highly significant issues (Kaygısız Ertuğ and Göksel 2019). In similar survey studies, Chi-Square independence test is commonly used to assess the correlations of pesticide use awareness levels with different variables such as age, education, and farming experience. The degree of relationship is calculated by Coefficient of Contingency, CC (Düzgüneş et al. 1983).

Fan et al. (2015) conducted a survey study with 307 farmers in the Wei River basin of northern China and investigated farmers' knowledge of pesticide use in agriculture. It was reported that farmers dealing with vegetable and fruit production had a higher knowledge of pesticide use than farmers dealing with cereal farming. However, they were using greater quantities of pesticides to ensure reliable yield levels. It was also observed that there was mistrust among farmers, retailers and government bodies.

Aldosari et al. (2018) conducted a survey study with 195 farmers in Central Punjab-Pakistan to assess sustainable use of pesticides. The majority of the respondents did not receive any training on sustainable use of pesticides and about 66.7% farmers did not receive any training on alternative pest control methods. A positive correlation was encountered between educational level and the other parameters of the farmers.

Quinteiro et al. (2013) conducted a survey study with pesticide applicators in Spain's Galician greenhouses to investigate the effects of education level on safe pesticide application. It was reported that there was no relationship between education level and safe pesticide application. Jallow et al. (2017) conducted a survey study with 250 farmers of Kuwait to investigate farmers' knowledge and behaviour of safe pesticide use. About 71% of participant farmers indicated pesticides as harmful to health, 65% harmful to the environment, 70% did not care about label information and 58% did not use any protective equipment.

Erdil and Tiryaki (2020) conducted a survey study with 384 farmers to assess farmers' awareness of pesticide use in agriculture in Manisa provinces of Türkiye. Farmers' knowledge of pesticide use was high in 63.8% of participants and moderate in 25.3% and low in 10.9%. These values in another study, carried out in Antalya province were 58.2%, 28.3% and 13.5%, respectively (Akar and Tiryaki 2018). Chi-Square independence test revealed that there was a significant correlation knowledge and education of Manisa farmers and between knowledge and farming experience of Antalya farmers. It was also observed that 12.7% of Antalya farmers and 15.4% of Manisa farmers did not care about PHI (preharvest interval) of the pesticides.

There are several other detailed studies on farmers' practices of pesticide use in different provinces of Türkiye such as in Isparta province (Demircan and Yılmaz 2005), Adana province (Akbaba 2010), Tokat province (Kızılaslan and Kızılaslan 2005), Bingöl province (Çelik and Karakaya 2017), Samsun province (Eryılmaz et al. 2018), Manisa province (Özyörük et al. 2019), and Gaziantep province (Atakan et al. 2020). Although there is no detailed study on pesticide applications in Çanakkale province, a few local studies have been conducted. In a study conducted in a village of Çanakkale-Evreşe-Yülüce (Cevizci et al. 2012), the use of pesticides was associated with cancer diseases. Researchers recommended safe use of pesticides and storage conditions, they also recommended farmers' training on safe use of pesticides. In another study, farmers living in Çanakkale province were asked about the safe use of pesticides and disposal of containers. Environmental impacts of pesticides were also assessed. The information obtained from the participant farmers and observations made in the villages revealed that their knowledge levels were insufficient. It was concluded that there was a need for training (Cevizci and Bakar 2012). Present study focused on farmers' knowledge, attitudes, practices and awareness of pesticide use on agricultural fields of Çanakkale province. Farmers' attitudes on environmental and toxicological risks of pesticides were assessed proportionally. Reliability of the Likert scale was checked with Cronbach's alpha test and the relationships between the level of knowledge and the other factors (such as age and education) were assessed through Chi-Square test.

MATERIALS AND METHODS

Study area and data collection

This study was conducted in the province of Çanakkale in Türkiye. The province is located between 25-35 and 27-45 east (°E) longitudes and 39-30 and 40-42 north (°N) latitudes. It has an average altitude of 2 m (Figure 1). Face-to-face interviews were made with the participant farmers to gather data through a structured questionnaire between May 2022 and January 2023. The structured questionnaire contained questions on socio-demographic and economic characteristics of farmers, pest control methods, measures to be taken in case of poisoning, storage and disposal of pesticides, personal protective equipment, attitudes towards the hazardous effect of pesticides, farmers' practices in applying pesticides and health problems.

Figure 1.

Determination of sample size

In survey studies, the sample size, i.e. the number of farmers to be interviewed, should be able to represent the study area. Statistical methods compatible with the nature of the data should be used for this purpose. In this study, the method of "Simple Random Sampling Based on Means" was used to determine the sample size (Collins 1986, Erdil and Tiryaki 2020, Miran 2003). Following equation was used to calculate sample size (Eq.1):

$$n = \frac{(Z\alpha/2)^2 \times p \times (1-p)}{d^2} \quad 1$$

where;

n=sample size (number of farmers)

$Z_{\alpha/2}$= The tabulated value (Zα/2) corresponding to the desired confidence level (90%, $Z_{\alpha/2}$=1.645)

p= Estimated proportion of the population that presents the characteristic (p=0.5)

d= Tolerated margin of error (0.05)

$$n = \frac{(1.645)^2 \times 0.5 \times (1-0.5)}{0.05^2} = 270.61$$

The number of farmers to be surveyed was calculated as 270 with a tolerated error of 0.05 and a 90% confidence interval. If the P value is unknown, 0.5 is an accepted value for high sample size (Collins 1986, Eryılmaz et al. 2018, Niyaz and Inan 2016).

With this approach, a survey was conducted among 270 farmers in 164 villages in 12 districts of Çanakkale province. The number of farmers to be surveyed in each district was calculated by the proportional distribution of villages in each district according to the total population (149.893). The number of farmers to be interviewed in the villages was calculated using the same method. Table 1 shows the number and distribution of the number of farmers surveyed in Çanakkale province by districts.

Data analyses

The data obtained from the questionnaires were assessed through Likert Scale and Chi-Square Independence Test.

Likert scale

The data were also evaluated proportionally with tables and graphs. Farmers' awareness of pesticide use was evaluated with the scores given to the answers to questions. The evaluation was based on the positive answers given by the farmers to the survey questions. The answers received were grouped using a four-point Likert Scale (Likert 1932). In accordance with this rating, a farmer can get a maximum of 96 points. Accordingly, the score ranges that determine the pesticide use consciousness level are as follows:
Max score: 96 points
Scale ranges: 0-96 points
Low: 0-40 points
Medium: 41-60 points
High: 61-80 points
Very high: 81-96 points

Chi-square (x^2) test of independence

The significance of the relationship between farmers' consciousness of pesticide uses and other parameters was assessed with the Chi-Square (x^2) Independence Test (Eq.2) and P values were also found (Düzgüneş et al. 1983).

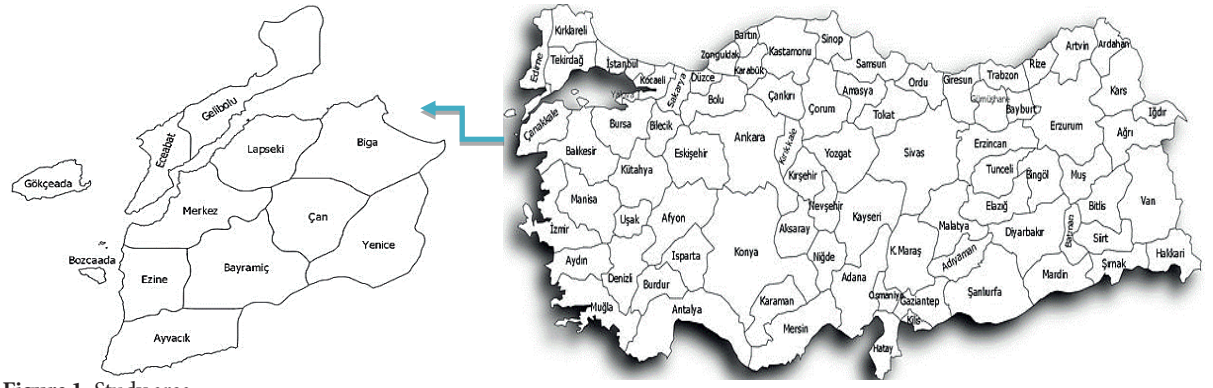

Figure 1. Study area

$$x^2 = \sum \frac{(Oi-Ei)^2}{Ei} \quad 2$$

x^2: Chi-Square test

O_i: Observed value of *i*

E_i: Expected value of *i*

If the critical x^2 value [0.05 Significance level (α) and determined Degrees of Freedom (df)] is less than the calculated one, there is a significant relationship between the two variables. The parameters investigated in relation to the level of pesticide use awareness are as follows: Education, age, farming experience, land size and type of farming (irrigated or dry farming)

Coefficient of Contingency (CC), indicating the degree of significance of the relationship between the variables, was also calculated with the use of Eq. 3 (Düzgüneş 1983).

$$CC = \sqrt{\frac{x2}{N+x^2}} \quad 3$$

CC:Coefficient of Contingency

x^2: Khi-Kare

N: Number of farmers surveyed

Cronbach's alpha co-efficient

Cronbach's alpha coefficient was calculated with the use of Eq. 4.

$$\alpha = \frac{K}{K-1} * \left(\frac{1-\sum_{i=1}^{K} \sigma^2_{yi}}{\sigma^2_{yi}}\right) \quad 4$$

where;

Yi = Observed values of question *i*

$X = Y_1 + Y_2 + \ldots + Y_K$ = Sum of observed values

σ^2_{yi} = Variance of question *i*

K = Number of questions

$\sum_{i=1}^{K} \sigma^2_{yi}$ = Sum of variance of questions

σ^2_X= Variance of total score.

Coefficients range between 0 - 1. The reliability of the scale is accepted as good if the coefficient is ≥0.70. The closer the Cronbach's alpha coefficient is to 1.0, the greater the internal consistency of the scale items (Forst 2023, Gliem and Gliem 2003). George and Mallery (2003) indicated the reliability of Cronbach's alpha coefficients as ">9 – Excellent, > 8 – Good, > 7 – Acceptable, > 6 – Questionable, > 5 – Poor, and < .5 – Unacceptable."

RESULTS AND DISCUSSION

Cronbach's reliability test

The overall Cronbach's alpha coefficient was calculated as 0.7563. Since the reliability of the scale is accepted as good (George and Mallery 2003, Özsayın and Everest 2019), no changes were made in the survey questions, and the evaluations were made based on the answers given to these questions.

Likert scale and assessment of pesticide use consciousness

Farmers' awareness of pesticide use was calculated by giving points to the responses received, and assessments were made over a four-point Likert scale. Farmers' awareness was assessed as low for 1.85%, moderate for 25.18%, high for 66.29%, and very high for 6.67% of participant farmers (Table 2). Kızılaslan and Kızılaslan (2005) reported farmers' awareness of pesticide use as low at 27.45%, moderate at 49.02% and high at 23.53%, Akar and Tiryaki (2018) reported the ratios as 13.5%, 28.3%, and 58.2%, respectively and Erdil and Tiryaki (2020) reported as 10.9%, 25.3%, and 63.8%, respectively.

Five parameters (education, age, farming experience, land size, and type of farming), which contributed to the level of pesticide use awareness, were also assessed with Chi-Square Independence Test (Eq. 2). Pesticide use awareness level of the farmers based on their education level is given in Table 2. Based on Chi-Square test, the relationship between these 2 parameters was found to be significant. As the education level increases, the awareness level of the farmers also increases. The Coefficient of Contingency (CC) was calculated as 0.467 (Eq.3). The highest level of awareness (76.19%) was among university graduates.

Pesticide use awareness of farmers based on their age is given in Table 3. There was no significant relationship between these parameters. However, the highest level of awareness (91.68%) was found in 25-34 years age group.

Similarly, there was no significant relationship between farmers' awareness of pesticide use with farming experience (Table 4) and type of farming (Table 5). The highest level of awareness was seen in farmers with 21-30 years of farming experience (75.75%) and farmers dealing with mixed farming (67.09%).

Although the relationship was found to be significant between the land size and awareness level, $x^2_{critical}$ (21.026) and $x^2_{calculated}$ (21.024) values were very close to each other (Table 6). Indeed, Kızılaslan and Kızılaslan (2005) could not find a relationship between the level of awareness and land size.

Table 2. The relationship between the pesticide use awareness level and education

Education	Pesticide use awareness level										
	Low		Moderate		High		Very high		Sum, Σ		
	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Survey basis*
illiterate	0 (0.00)	0.02	1(100.00)	0.25	0	0.67	0	0.07	1 (100)	1	0.37
literate	0 (0.00)	0.04	1 (50.00)	0.50	1 (50.00)	1.32	0	0.13	2 (100)	2	0.74
primary school	2 (1.55)	2.40	45 (34.88)	32.49	76 (58.91)	85.52	6 (4.65)	8,60	129 (100)	129	47.78
secondary school	1 (2.00)	0.92	11 (22.00)	12.59	36 (72.00)	33.15	2 (4.00)	3.33	50 (100)	50	18.52
high school	2 (2.98)	1.24	10 (14.92)	16.87	50 (74.62)	44.42	5 (7.46)	4.47	67 (100)	67	24.82
university	0 (0.00)	0.39	0 (0.00)	5.29	16 (76.19)	13.92	5 (23.81)	1.4	21 (100)	21	7.78
Master or Ph D	0 (0.00)	0	0 (0.00)	0	0 (0.00)	0	0 (0.00)	0	0 (0.00)	0	0
Sum, Σ	5 (1.85)	5	68 (25.18)	68	179 (66.29)	179	18 (6.67)	18	270 (100)	270	100.00
Null hypothesis (H_0): No relation between two variables $x^2_{critical}$=28.87 with the df=18 and α =0.05 $x^2_{calculated}$=76.39											
$x^2_{calculated} > x^2_{critical}$ H_0:reject											
p=0.009 CC=0.467											

*1x100/270=0.37

Table 3. The relationship between the pesticide use awareness level and age

Age, year	Pesticide use awareness level										
	Low		Moderate		High		Very high		Sum, Σ		
	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Survey basis*
25-34	0 (0.00)	0.44	1 (4.17*)	6.04	22(91.68)	15.911	1 (4.16)	1.60	24 (100)	24	8.89**
35-44	1 (2.22)	0.83	17 (37.77)	11.33	25(55.55)	29.833	2 (4.44)	3.00	45 (100)	45	16.67
45-54	1 (1.47)	1.26	18 (26.47)	17.12	46(67.64)	45.081	3 (4.41)	4.53	68(100)	68	25.18
55-65	2 (2.08)	1.78	21 (21.87)	24.18	66(65.75)	63.644	7 (7.29)	6.40	96 (100)	96	35.56
66≥	1 (2.70)	0.68	11 (29.72)	9.32	20(54.05)	24.529	5 (13.51)	2.47	37 (100)	37	13.70
Sum, Σ	5 (1.85)	5.00	68 (25.18)	68.00	179 (66.29)	179.000	18 (6.67)	18.00	270 (100)	270	100.00
Null hypothesis (H_0): No relation between two variables $x^2_{critical}$ =21.026 with the df=12 and α =0.05											
$x^2_{calculated}$ =18.95 $x^2_{calculated} < x^2$critical H_0:accept											
p=0.177 CC=0.256											

*100x1/24=4.17
**24x100/270=8.89

Table 4. The relationship between the pesticide use awareness level and farming experience

Farming experience, year	Pesticide use awareness level										
	Low		Moderate		High		Very high		Sum, Σ		
	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Survey basis*
1.0-10	0 (0.00)	0.65	7 (20.00*)	8.81	26 (74.28)	23.20	2 (5.72)	2.33	35 (100)	35	12.96**
11-20	2 (3.38)	1.09	14 (23.72)	14.86	38 (64.40)	39.11	5 (8.47)	3.93	59 (100)	59	21.85
21-30	1 (1.52)	1.22	14 (21.21)	16.62	50 (75.75)	43.75	1 (1.52)	4.40	66 (100)	66	24.44
31-40	0 (0.00)	1.28	21 (30.43)	17.38	42 (60.86)	45.74	6 (8.69)	4.60	69 (100)	69	25.55
41≥	2 (4.87)	0.76	12 (29.26)	10.32	23 (56.10)	27.18	4 (9.75)	2.73	41 (100)	41	13.70
Sum, Σ	5 (1.85)	5.00	68 (25.18)	68.00	179 (66.29)	179.000	18 (6.67)	18.00	270 (100)	270	100.00
Null hypothesis (H_0): No relation between two variables $x^2_{critical}$ =21.026 with the df=12 and α =0.05											
$x^2_{calculated}$ =14.30 $x^2_{calculated} < x^2$critical H_0:accept											
p=383 CC=0.224											

*100x1/24=4.17
*35x100/270=12.96

Table 5. The relationship between the pesticide use awareness level and the type of farming

Type of farming	Pesticide use awareness level										
	Low		Moderate		High		Very high		Sum, Σ		
	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Survey basis*
Dry	0 (0.00)	1.20	16 (24.61*)	16.37	42 (64.61)	43.09	7 (10.77)	4.33	65 (100)	65	24.07**
Irrigated	1 (2.00)	0.92	14 (28.00)	12.59	33 (66.00)	33.15	2 (4.00)	3.33	50 (100)	50	18.52
Mixed	4 (2.58)	2.87	38 (24.51)	39.04	104 (67.09)	102.76	9 (5.80)	10.33	155 (100)	155	57.41
Sum, Σ	5 (1.85)	5.00	68 (25.18)	68.00	179 (66.29)	179.000	18 (6.67)	18.00	270 (100)	270	100.00
Null hypothesis (H_0): No relation between two variables $x^2_{critical}$ =12.59 with the df=6 and α =0.05 $x^2_{calculated}$ =5.41 $x^2_{calculated} < x^2$critical H_0:accept p=0.644 CC=0.140											

*100*16/65=24.61

**65x100/270=24.07

Table 6. The relationship between the pesticides use awareness level and land size

Land size, da	Pesticide use awareness level										
	Low		Moderate		High		Very high		Sum, Σ		
	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Observed (%)	Expected	Survey basis*
1-50	2 (1.88*)	1.96	35 (33.02)	26.70	63 (59.43)	70.274	6 (5.66)	7.066	106	106	39.26**
51-150	1 (1.01)	1.83	23 (23.23)	24.93	70 (70.70)	65.633	5 (5.05)	6.600	99	99	36.67
151-350	2 (4.76)	0.78	7 (16.66)	10.58	28 (66.66)	27.844	5 (11.90)	2.800	42	42	15.55
351-500	0 (0.00)	0.26	3 (21.42)	3.52	9 (64.28)	9.281	2 (14.28)	0.933	14	14	5.18
501≥	0 (0.00)	0.17	0 (0.00)	2.27	9 (100.00)	5.966	0 (0.00)	0.600	9	9	3.33
Sum, Σ	5 (1.85)	5	68 (25.18)	68.00	179 (66.29)	179	18 (6.67)	18.00	270 (100)	270	100.00
Null hypothesis (H_0): No relation between two variables $x^2_{critical}$ =21.026 with the df=12 and α =0.05 $x^2_{calculated}$ =21.04 $x^2_{calculated} < x^2$critical H_0:reject p=0.205 CC=0.268											

*100*2/106=1.88

**106x100/270=39.26

Akar and Tiryaki (2018) reported significant correlations only between pesticide use awareness and farming experience. In another study, relationship between the knowledge level and education was found to be significant and coefficient contingency was 0.344 (Erdil and Tiryaki 2020). Kızılaslan and Kızılaslan (2005) reported significant correlations of farmers' awareness with age and education.

Proportional assessment

Demographic characteristics of the participant farmers were calculated proportionally and evaluated in tables. Considering the parameters with the maximum % value, 47.78% of the participant farmers were primary school graduates (Table 2), 35.56% were in the 55-65 years age range (Table 3), 25.55% had 31-40 years of farming experience (Table 4), 57.41% applied mixed farming (Table 5) and 39.26% owned 1-50 da land area (Table 6). Information about the farmers' farming experience and land size is given in Table 7. The average farming experience of the farmers was determined as 13 years and the average land size was 140 da. In addition, the smallest farming experience is 2 years and the largest is 55 years, and the standard deviation is calculated as 13 years. As to land size, the smallest land amount is 3 da and the largest land is in 2.000 da, and its standard deviation is 217 da.

Table 7. Descriptive statistics of farmers

Statement	Lowest	Highest	Mean	Standard deviation
Farming experience (year)	2	55	29	13
Land size (da)	3	2000	140	217

Farmers' opinions on the environmental impacts of pesticides are given in Table 8-A. Of the participant farmers, 72.23% indicated that pesticides polluted lakes/streams, 73.70% indicated that pesticides can be harmful to beneficial insects or bees and 72.23% indicated that pesticides could be harmful to birds. Farmers' opinions on effects of pesticides

on human health are provided in Table 8-B. Of the participant farmers, 7.03% were strongly disagree with the carcinogenic effects of pesticides, 8.15% were undecided (no opinion), 31.12% were mostly agree, 53.70% were strongly agree. When asked "Pesticides can cause diseases we do not know about", 10.74% disagreed, 26.30% were undecided, 32.22% mostly agreed and 30.74% totally agreed.

Farmers' opinions on empty pesticide containers were shown in Table 9-A. Of the producers, 48.89% stated that they burned empty pesticide containers, 40.74% left them into garbage bin, 6.30% threw them into the environment, and 4.07% buried them in the ground. Of the farmers, 41.85% stated that they disposed of leftover pesticide solutions at the edge of agricultural fields, 27.04% sprayed them on

Table 8. Farmers' opinions on impacts of pesticides on environment and human health

Statement	Disagree		Indecisive /no opinion		Mostly agree		Totally agree	
	Number	%	Number	%	Number	%	Number	%
A) Farmers' opinions about environmental effects of pesticides								
Creates pollution in lake and rivers	18	6.66	13	4.81	44	16.30	195	72.23
Harmful to beneficial insects or bees	15	5.56	13	4.81	43	15.93	199	73.70
Harmful to birds	18	6.66	14	5.18	43	15.93	195	72.23
Harmful to reptiles	18	6.66	14	5.18	43	15.93	195	72.23
Harmful to mammals	18	6.66	14	5.18	43	15.93	195	72.23
B) Farmers' opinions about the effects of pesticides on human health								
Causes short-term toxicity	19	7.02	24	8.88	82	30.40	145	53.70
It has a carcinogenic effect	19	7.03	22	8.15	84	31.12	145	53.70
Irritate to the skin	16	5.92	26	9.63	82	30.37	146	54.08
Causes some unknown diseases	29	10.74	71	26.30	87	32.22	83	30.74

Table 9. Farmers' opinions and behaviours about pesticide residues and remaining pesticide solutions, and their disposal methods

Statement	Number of responder	%
A) Methods of disposal of empty pesticide containers		
Destroying by burning	132	48.89
Leave into garbage box	110	40.74
Throw out to the environment	17	6.30
to bury in the ground	11	4.07
Sum	270	100.0
B) Farmers' behaviours on remaining pesticide solutions		
to dispose on the edge of agricultural fields	113	41.85
to spray on a uncultured field	73	27.04
to pour into the canal	8	2.96
Discharge into an irrigation canal or river	50	18.52
Others	26	9.63
Sum	270	100.0
C) Farmers' opinions on pesticide residues in agricultural products		
Some pesticides have residue on the product	10	3.70
Pesticide residues can be eliminated by washing process	10	3.70
There are no pesticide residues in the products	192	71.11
I have no idea about the pesticide residues	58	21.49
Sum	270	100.0

uncultivated fields, 2.96% poured into the canal, and 18.52% discharged them into irrigation canal or river (Table 9-B). Of the producers, 3.70% stated that pesticide residues can be eliminated by washing process, 71.11% were no pesticide residues in the products, and 21.49% had no idea about the pesticide residues (Table 9-C).

Farmers' opinions about pesticide application are given in Table 10-A. Of the participant farmers, 18.89% stated that they sprayed pesticides when there was no pest, 46.67% indicated that they have knowledge about special signs and warnings on pesticide labels, 69.63% indicated that they cared about PHI, 78.89% stated that they changed their clothes after spraying, 45.18% indicated that they used protective equipment during pesticide application, 7.78% stated that they eat or drink while spraying. Farmers' opinions about pesticides and environmental behaviours are provided in Table 10-B. Of the participant farmers, 3.33% stated that they used empty pesticide packages for other purposes, and 15.92% stated that they had knowledge about MRLs.

Table 10. Farmers' opinions about pesticide applications and environmental behaviours

Question	Yes		Mostly/*not remember**		Sometime/*No idea**		No	
	Number	%	Number	%	Number	%	Number	%
A) Farmers' opinions on the pesticide applications								
Do you apply pesticides when there are no pests?	51	18.89	32	11.85	26	9.63	161	59.63
Do you read the label (special signs, warnings, instructions, expiration date, dosage, registration) before spraying?	126	46.67	69	25.55	33	12.22	42	15.56
Do you pay attention to the PHI?	188	69.63	39	14.44	20	7.41	23	8.52
Do you record the time of use and the amount of pesticide used?	52	19.26	16	5.92	16	5.92	186	68.90
Do you take protective measures while spraying and cleaning the materials?	122	45.18	40	14.81	45	16.68	63	23.33
Have you ever sprayed the pesticides with your hand?	68	25.18	43	15.93	64	23.70	95	35.19
Do you change your clothes after the spraying?	213	78.89	25	9.26	8	2.96	24	8.89
Do you ventilate where you store pesticides?	120	44.44	71	26.30	28	10.37	51	18.89
Do you spray when you are tired or sweaty?	46	17.04	45	16.65	67	24.81	112	41.50
Do you eat or drink (cigarettes, etc.) while spraying?	21	7.78	21	7.78	46	17.04	182	67.40
Do you take a bath after pesticide application?	242	89.63	24	8.89	2	0.74	2	0.74
Do you take break frequently while spraying?	28	10.37	36	13.33	85	31.50	121	44.80
Do you spray in windy weather?	0	0	2	0.74	30	11.11	238	88.15
Do you have someone with you during the application?	72	26.67	53	19.63	54	20	91	33.70
B) Farmers' opinions about pesticides and environmental behaviours								
Do you act carefully to avoid harmful effects on the environment at the time of spraying?	222	82.22	31	11.48	6	2.22	11	4.08
Do you believe that pesticides harm the environment?	219	81.11	25	9.26	9	3.33	17	6.30
Do you know that excessive pesticide consumption has a negative impact on the country's economy?	221	81.85	13	4.81	11	4.07	25	9.25
Do you check the presence of animals in the environment before spraying?	154	57.05	22	8.16	29	10.7	65	24.09
Do you use empty pesticide packages for other purposes (water transport)?	9	3.33	0	0	11	4.07	250	92.60
Did you hear the term of "maximum residue limit"?	43	15.93	19	7.03	34	12.59	174	64.45

* "not remember" and "no idea" alternatives are related to "Farmers' opinions on pesticide residues and environmental behaviours" section of table.

Survey studies are used to reveal the behaviour of producers during the pesticide use process. Although the present findings showed that farmers' awareness of pesticide use was not significantly related to age and farming experience, awareness of pesticide use was high among young farmers (25-34 years old). Likewise, the awareness levels of farmers with 21-30 years of farming experience were high. The relationship between education and pesticide awareness level was found to be significant. As the education level increases, the awareness level of the farmers also increases. With this result, the importance of education, as in most disciplines, has once again become clear. The awareness level of well-educated farmers with many years of farming experience was quite high. Although 66.29% of farmers have a high knowledge level, only 53.70% of them agreed that pesticides had a carcinogenic effect, 46.67% cared about the information on pesticide labels, 45.18% used protective equipment during spraying, 69.63% cared about PHI, 15.92% had knowledge about MRLs and 41.85% disposed remaining pesticide solutions to the edge of agricultural fields. The present results suggest that farmers need to be seriously educated about the use of pesticides and the potential effect of pesticides on human health and the environment.

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Author's Contributions

Authors declare the contribution of the authors is equal.

Statement of Conflict of Interest

The authors have declared no conflict of interest.

ÖZET

Tarım alanlarında karşılaşılan zararlı organizmalara karşı pestisitler giderek daha fazla kullanılmaktadır. Ancak bilinçsiz pestisit kullanımı insan ve çevre sağlığını tehdit etmektedir. Bu nedenle pestisitlerin olumsuz etkilerini azaltmak için çaba harcanmalıdır. Bu çalışmanın amacı, Çanakkale ili tarım alanlarında çiftçilerin pestisit kullanımı konusundaki farkındalıklarını değerlendirmektir. Örnek büyüklüğü "Oran Ortalamalarına Dayalı Basit Rastgele Örnekleme" yöntemi kullanılarak hesaplanmıştır. Anket 270 çiftçi ile yapılmıştır. Katılımcı çiftçilerin %25.55'i 31-40 yıllık çiftçilik tecrübesine sahip, %47.78'i ilkokul mezunu ve %35.56'sı 55-65 yaşındadır. Çiftçilerin pestisit kullanımına ilişkin bilgi düzeyleri Likert Ölçeği ile değerlendirilmiştir. Çiftçilerin bilgi düzeylerinin eğitim, yaş, çiftçilik deneyimi, arazi büyüklüğü ve tarım türü ile ilişkisini araştırmak için Khi-Kare testi kullanılmıştır. Sadece eğitim düzeyi önemli bulunmuştur. Eğitim düzeyi arttıkça bilgi düzeyi de artmaktadır. Çiftçi davranışları açısından bakıldığında, çiftçilerin %78.89'u ilaçlamadan sonra kıyafetlerini değiştirdiğini, %46.67'si pestisit etiketlerindeki bilgileri önemsediğini, %45.18'i ilaçlama sırasında koruyucu ekipman kullandığını, %69.63'ü PHI (hasat aralığı/Son uygulama ile hasat arası geçmesi gereken süre)'yı önemsediğini, %15.92'si MRL (Maksimum Kalıntı Limiti) hakkında bilgi sahibi olduğunu belirtmiştir. %41.85'i kalan pestisit solüsyonlarını tarım alanlarının kenarlarına, %40.74'ü çöpe ve %6.3'ü çevreye atmaktadır. Bu bulgulara dayanarak, çiftçilerin pestisit kullanımı ve pestisitlerin insan sağlığı ve çevre üzerindeki potansiyel etkileri konusunda ciddi eğitime ihtiyaçları olduğu sonucuna varılmıştır.

Anahtar kelimeler: çiftçilerin bilinç düzeyi, Cronbach alfa katsayısı, çevre, Likert skalası, anket, pestisit

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