© by PSP Volume 28 – No. 10/2019 pages 7621-7629 Fresenius Environmental Bulletin

DETERMINATION OF THE LEVEL OF AWARENESS OF FARMERS ABOUT THE USE OF PERSONAL PROTECTIVE EQUIPMENT IN PESTICIDE APPLICATIONS

Muge Kantar Davran[1,*], Nigar Yarpuz Bozdogan[2], Ali Musa Bozdogan[3], Burak Oztornaci[1]

[1]Cukurova University, Faculty of Agriculture, Department of Agricultural Economics, Adana, Turkey
[2]Cukurova University, Adana Organized Industry Zone Technical Sciences Vocational School, Adana, Turkey
[3]Cukurova University, Faculty of Agriculture, Department of Agricultural Machinery and Technology Engineering, Adana, Turkey

ABSTRACT

The objective of this study is to determine the level of awareness of farmers about the personal protective equipment used in pesticide applications. The study was conducted in 56 villages in the administrative zone of the central districts of Adana, a southern province of Turkey, during which information was collected from the farmers with the individual interview method. In the individual interviews, demographic properties of the farmers, their behavioural patterns during pesticide applications, general level of knowledge about pesticide applications and level of awareness in the use of personal protective equipment (PPE) were questioned. The farmers included in the scope of the study were 54.14 years old in average and nearly half of them (45.2%) were found to be primary school graduates. The farmers' average history of agricultural activity was 30.19 years, and they had been applying agricultural pesticides for 25.81 years in average. It was determined that 84.7% of the farmers were engaged in arable farming, applying agricultural pesticides 3.15 times a year in average and 88.7% of them had not been informed about the use of PPE. As a result of the study, it was understood that the farmers were not well-informed about the negative effects of pesticides on human health in spite of their significant level of experience in both farming and the use of pesticides, which caused unconsciousness about the use of PPE. In order for the said consciousness to be created, it is important for the relevant institutions to get organized and start field training programs.

KEYWORDS:
Pesticide Applications, Personal Protective Equipment, Farmers, Awareness, Human Health

INTRODUCTION

Pesticides in farming are applied in four stages, namely the preparation of the chemical, filling of it in the tank and mixing, application of it in the field and cleaning after the application. During the said four stages, users may be exposed to pesticides in different ways, which affect them through respiration, direct contact or oral exposure. Accordingly, use of protective gloves and masks is strongly recommended during the stages of pesticide preparation, mixing and filling, non-observance of which would cause exposure in ways of respiration and direct contact. In the survey [1] conducted with cotton producers in the Punjab region of Pakistan, it was found that the highest rate of pesticide contamination was taking place during chemical preparation at 76.4%, while the rates of contamination caused by the use of wrong or low-technology sprayers and application of pesticides in unsuitable weather conditions were 67.5% and 46.5% respectively.

During pesticide applications in the field, meteorological factors should be definitely taken into consideration and application should be made in suitable weather conditions and by use of correct equipment. In addition, users/operators should avoid direct contact with pesticides while the chemical tank is emptied and cleaned.

Use of Personal Protective Equipment (PPE) is recommended during and after the application of pesticides in the field, in order to eliminate risk of being affected by pesticides. PPE is known to help reduce pesticide contamination and protect human health [2, 3, 4, 5]. The PPE used for pesticide application purposes mainly consists of overalls, hat, gloves, glasses, mask and long boots.

PPE is not widely used in Turkey and persons applying pesticides generally do not prefer to use equipment such as overalls, masks and gloves. Especially in hot weather, protective equipment such as overalls, masks and gloves causes additional stress on the user. In a study conducted on "Thermal comfort and personal protective equipment" [6], comparison in which was made between persons who use and do not use PPE, it was found out that 1 °C of body temperature rise occurred in 15 minutes when PPE is used. On the other hand, it is reported that the use of hats is quite common in order to get protected from the sun.

TABLE 1
Districts, Number of Settlements with Village Characteristics and Number of Questionnaires Applied in the Study Area

District name	Number of Settlements with Village Characteristics [1]	Number of villages engaged in agriculture[1]	Number of questionnaire applied
Yüreğir	63	20	45
Sarıçam	57	18	39
Karaisalı	58	18	40
Total	**178**	**56**	**124**

[1]Personal meeting held with the district authorities of the Ministry of Food, Agriculture and Livestock (April, 2018); [8].

Level of pesticide contamination significantly increases for persons who apply pesticides or enter in the fields after pesticide application for various purposes including harvest and maintenance. Previous studies reveal that such direct contact with pesticides may cause skin or eye redness, headache, dizziness and nausea. In the survey conducted in Brazil [7] with 250 producers, it was determined that 92% of them directly worked in contact with pesticides and 59.6% of them suffered pesticide-caused problems. All these negative effects can be reduced by applying pesticides at the correct time and in suitable meteorological conditions, by use of correct agricultural equipment, at the recommended doses, accompanied by PPE [5]. The main problem encountered during pesticide application is the increase in level of contamination as a result of wrong or deficient use of PPE.

In this study conducted in the villages located in the administrative zone of the central districts of Adana, a southern province of Turkey, it was aimed to determine the tendencies of agricultural producers towards the use of personal protective equipment (PPE) during pesticide applications and their level of awareness about PPE.

MATERIALS AND METHODS

The main material of this study is the primary data collected from producers from the villages located in the administrative zone of the central districts of Adana, who grow agricultural crops and apply pesticides.

The study area included the villages located in the administrative zone of the central districts of Adana. Adana province has 5 central districts, namely Çukurova, Seyhan, Karaisalı, Yüreğir and Sarıçam. For determining the villages to be included in the study, personal meetings were held with the district directorates of the Ministry of Food, Agriculture and Livestock, which revealed that Çukurova and Seyhan districts did not have any settlement reflecting village characteristics. For this reason, the study area comprised of Karaisalı, Yüreğir and Sarıçam districts. It was determined that the said 3 districts had 178 settlements with village characteristics in total, while only 56 of them were intensively engaged in agriculture. For being able to represent the whole area, all of these 56 villages were included in the study. A similar sample was also used by other researchers [8] in the same area. In each village, individual interviews were hold with at least two producers and the study population consisted of 112 producers in total. On the other hand, questionnaires were applied to 124 producers to obtain a surplus of 10%. Only voluntary producers were included in the sample ensuring the accuracy and reliability of the information collected. The districts, villages and number of interviews are given in Table 1.

During the interviews with producers, the structured questionnaire form prepared by the authors was used, which included questions regarding the demographic properties (age, level of education, crop types, field of activity, etc.), behavioural attitudes of producers in pesticide application, general level of knowledge regarding pesticide application and level of awareness in the use of PPE. The data collected were analysed by use of the IBM SPSS Statistics 20 software. Percentage distribution and average values were used in the interpretation and evaluation of the data collected from the producers.

FINDINGS OF THE STUDY AND DISCUSSION

Socioeconomic properties of agricultural enterprises. In the study, 8.9% of the producers with whom interviews were made were female, 91.1% of them were male, while 39.5% of them were in the 45-54 age range and their average age was 54.14. There was no illiterate producer and 45.2% of the producers were primary school graduates. Producers mainly engaged in arable farming (58.9%) and the average size of land they cultivated was 207.65 da. While 76.5% of the producers cultivated their own lands, 62.0% of them performed irrigated farming. Socioeconomic properties of the producers are given in Table 2.

According to the last Turkish General Agriculture Census held in 2001, the proportion of agricultural enterprises cultivating 100 da or less was 84.3% and average enterprise size was 61 da [9]. The study area presents quite better conditions when compared to the national averages, in terms of the number of enterprises cultivating 100 da or less (52.4%) and average size of enterprise (207,65 da).

TABLE 2
Socioeconomic Properties of the producers

Indicators	Count	Percentage
Age		
25-34	3	2.4
35-44	10	8.1
45-54	49	39.5
55-64	45	36.3
65- +	17	13.7
Total	124	100.0
Average age	54.14 years	
Level of education		
Literate	21	16.9
Primary school graduate	56	45.2
Middle school graduate	23	18.5
High school graduate	15	12.1
University graduate	9	7.3
Total	124	100.0
Average years of education	6.56 years	
Land type		
Arable farming	73	58.9
Fruit farming	8	6.5
Vegetable farming	11	8.9
Arable + vegetable farming	14	11.3
Arable + fruit farming	12	9.7
Arable + fruit + vegetable farming	6	4.8
Total	124	100.0
Land ownership		
Owned	114	76.5
Rent	26	17.5
Shared	9	6.0
Total	149*	100.0
Land size		
0-50	42	33.9
51-100	23	18.5
101-200	19	15.3
201-300	16	12.9
301-500	15	12.1
501-2000	9	7.3
Total	124	100.0
Average land size	207.65 da	
Irrigated-dry farming conditions		
Irrigated	88	62.0
Dry	54	38.0
	142**	100.0

*Enterprises were engaged in more than one type of land ownership.
** There were enterprises engaged in both irrigated and dry farming.

The enterprises included in the study were seen to apply to a crop pattern of more than one product. Corn, cotton, wheat, barley, sunflower, olives, lemon, beans and pepper were the most prominent crops cultivated by the producers (Table 3).

Pesticide Use Conditions and Pesticide Applications of the Producers. When the use of insecticides, herbicides and herbicides by the enterprises included in the study was examined, it was found that 21.7% of them applied both insecticides and herbicides. On the other hand, rates of the producers using only herbicides and insecticides were 27.4 % 19.4% respectively, and 29,8% of them were applying chemical other than specified here (such as acaricides). The number of annual pesticide applications was 3.15 in average among the producers, 34.7% of whom performed two, 23.4% performed three, 18.5% performed four and 19.4% performed five or more pesticide applications in a year, while the proportion of enterprises performing only one pesticide application during the year was 4.0%. Time of daily average pesticide application was calculated to be 2.69 hours in average.

Pesticide applications were mainly under the responsibility of men and the proportion of enterprises at which the work was performed by fathers and sons was 77.4%, while the whole family took

part in the process at 22.6% of the enterprises. While 67.7% of the producers learnt the methods of pesticide application from their families, 32.2% of them gathered necessary knowledge from the social circle. Average number of years spent in agricultural activities was 30.19 years and the producers had been applying pesticides for 25.81 years in average.

It was seen that 88.7% of the producers did not have any information about the use of PPE in relation to pesticide application, while the remaining producers (11.3%) were informed by different sources.

Pesticide Storage and Usage Habits and Awareness of the Producers. It was reported by the producers that they predominantly stored the packages of remaining pesticides in storerooms located under their houses, storerooms away from their houses or in the farmyards after an application (Table 4).

In the study conducted in Kuwait [10], 20% and 15% of the producers reported that they were storing pesticides in their houses and stables respectively. On the other hand, it is found out in our study that 14.5% of the producers washed the sprayer after an application, 14.5% washed occasionally and 12.1% did not wash at all.

However, it is well-known that sprayers should be definitely washed after a herbicide application, since herbicides are applied against weeds and in case insecticides are to be applied after herbicides, any residue should be removed from the sprayer in order to prevent damage on the green parts of the crop. Among the producers included in the study, 66.9% of them were determined to grow wheat and 21.7% of them were applying both herbicides and insecticides, which requires them to wash their sprayers regularly.

On the other hand, 26.6% of the producers did not use gloves while filling pesticides in the sprayer tank and 28.2% of them did not read the instructions on the pesticide packages. While 79.8% of the producers paid attention to wind direction during pesticide applications, 55.7% of them applied pesticides in the morning hours, 96.0% of them washed their hands, 86.3% of them took a bath and 91.9% of them immediately changed their clothes after an application (Table 5).

TABLE 3
Crop Pattern of the Enterprises

Crop	Count*	Percentage*
Arable farming		
Corn	46	37.1
Cotton	11	8.9
Wheat	83	66.9
Barley	32	25.8
Sunflower	45	36.3
Fruit farming		
Olives	16	12.9
Lemon	13	10.5
Vegetable farming		
Pepper	12	9.7
Tomato	10	8.1
Cucumber	9	7.3
Beans	17	13.7
Gumbo	3	2.4
Lettuce	5	4.0
Cabbage	5	4.0
Marrow-eggplant	8	6.5
Potato	4	3.2
Horse bean	2	1.6
Watermelon	5	4.0
Cauliflower	2	1.6

*Numbers and percentages of the enterprises growing the specified crops among 124 enterprises.

TABLE 4
Storage of pesticides by farmers

Place of pesticide storage	Count	%
In the house	10	8.1
In a store room located away from the house	32	25.8
In a storeroom located under the house	55	44.4
In the farmyard	27	21.8
Total	**124**	**100.0**

TABLE 5
The producers' behavioural attitudes after pesticide application

Behaviour	Count	Percentage
Use of gloves		
Yes	71	57.3
Occasionally	20	16.1
No	33	26.6
Total	124	100.0
Reading instructions on the package		
Yes	61	49.2
Occasionally	28	22.6
No	35	28.2
Total	124	100.0
Attention to wind direction		
Yes	99	79.8
Occasionally	11	8.9
No	14	11.3
Total	124	
Time of application		
Morning	69	55.7
Noon	23	18.5
Late afternoon	26	21.0
Morning and late afternoon	4	3.2
No difference	2	1.6
Total	124	100.0
Washing hands		
Yes	119	96.0
Occasionally	3	2.4
No	2	1.6
Total	124	100.0
Taking a bath		
Yes	107	86.3
Occasionally	12	9.7
No	5	4.0
Total	124	100.0
Changing clothes		
Yes	114	91.9
No	10	8.1
Total	124	100.0

When the smoking habits of the producers were questioned, 24.2% of them were found to smoke cigarettes in their daily lives, 50.0% of whom smoked during pesticide applications as well. While 91.1% of the producers did not eat anything during pesticide applications, 8.9% of them reported to eat.

Health problems encountered in relation to pesticide application. While 83.1% of the producers in the study area knew that pesticides had adverse effects on human health, 16.9% of them were unaware. According to the research conducted in Greece [11], 99% of the producers believe that pesticides have adverse effects on human health.

In case where necessary protective measures are not taken during pesticide applications, chemicals may reach different parts of the human body with the effects of meteorological factors and the spraying equipment. After an intensive pesticide application, some producers report irritation and redness in the eyes and on the skin. As a result of the spray drift effect, airborne pesticide particles are able to penetrate in the human body through respiration and acute poisoning may occur when the threshold values are exceeded. In the questionnaire applied, body parts exposed to pesticides during the application were examined, results of which are given in Table 6.

In the study area, 91.1% of the producers reported to have health problems in relation to the use of pesticides. Encountered during an application in particular, redness and irritation in the eyes and on the skin, headache and dizziness are the most prominent complaints. 35.4% of the farmers reported irritation in their eyes and 26.5% of them reported irritation on the skin after a pesticide application (Table 6).

TABLE 6
Health problems encountered during pesticide applications

Health problem	Count	Percentage
Irritation in the eyes	40	35.4
Headache and dizziness	30	26.5
Difficulty in breathing	9	8.0
Irritation on the skin	30	26.5
Fever	4	3.5
Total	**113**	**100.0**
Producers with complaints	11	8.9
Producers with no complaint	113	91.1
Grand total	**124**	**100.0**

TABLE 7
Use of PPE by the farmers based on the equipment types

PPE	Use of PPE							
	Using		Not using		Occasionally using		Total	
	Count	%	Count	%	Count	%	Count	%
Hat								
Using	35	46.7	28	37.3	12	16.0	75	100.0
Not using	4	15.4	17	65.4	5	19.2	26	100.0
Occasionally using	0	0.0	13	56.5	10	43.5	23	100.0
Gloves								
Using	36	54.5	15	22.7	15	22.7	66	100.0
Not using	3	7.3	34	82.9	4	9.8	41	100.0
Occasionally using	0	0.0	9	52.9	8	47.1	17	100.0
Mask								
Using	33	58.9	14	25.0	9	16.1	56	100.0
Not using	6	13.6	36	81.8	2	4.5	44	100.0
Occasionally using	0	0.0	8	33.3	16	66.7	24	100.0
Long-sleeved shirt								
Using	36	37.1	37	38.1	24	24.7	97	100.0
Not using	3	21.4	9	64.3	2	14.3	14	100.0
Occasionally using	0	0.0	12	92.3	1	7.7	13	100.0
Glasses								
Using	26	78.8	4	12.1	3	9.1	33	100.0
Not using	13	16.9	48	62.3	16	20.8	77	100.0
Occasionally using	0	0.0	6	42.9	8	57.1	14	100.0
Long boots								
Using	26	57.8	11	24.4	8	17.8	45	100.0
Not using	10	17.5	41	71.9	6	10.5	57	100.0
Occasionally using	3	13.6	6	27.3	13	59.1	22	100.0
Enclosed shoes								
Using	34	34.0	49	49.0	17	17.0	100	100.0
Not using	5	45.5	4	36.4	2	18.2	11	100.0
Occasionally using	0	0.0	5	38.5	8	61.5	13	100.0
Flippers/sandals								
Using	8	50.0	3	18.8	5	31.3	16	100.0
Not using	31	29.8	53	51.0	20	19.2	104	100.0
Occasionally using	0	0.0	2	50.0	2	50.0	4	100.0

Farmers' health can be negatively affected by pesticides. Pesticides can cause different diseases such as various types of cancer, skin allergies, asthma, and others [12, 13, 14]. In a study conducted in the USA [15], it was found out that associated health problems including headache, asthma and allergy can be reduced by use of PPE during pesticide applications.

Use of PPE by the farmers. In this study, 46.8% of the farmers reported that they did not use PPE during pesticide applications, while 31.5% and 21.8% of them reported to use protective clothes regularly and occasionally respectively. It can be suggested that the producers do not fully know or understand the notion of PPE, since some of the producers who reported not to use PPE were actually understood to use certain PPE, or the vice versa, in the cross analyses (Table 7).

TABLE 8
Use of PPE by the producers

PPE	Using		Not using		Occasionally using		Total	
	Count	%	Count	%	Count	%	Count	%
Hat	75	60,5	26	21,0	23	18,5	124	100,0
Gloves	66	53,2	41	33,1	17	13,7	124	100,0
Mask	56	45,2	44	35,5	24	19,4	124	100,0
Long-sleeved shirt	97	78,2	14	11,3	13	10,5	124	100,0
Glasses	33	26,6	77	62,1	14	11,3	124	100,0
Long boots	45	36,3	57	46,0	22	17,7	124	100,0
Enclosed shoes	100	80,6	11	8,9	13	10,5	124	100,0
Slippers/sandals	16	12,9	104	83,9	4	3,2	124	100,0

TABLE 9
Reasons of not wearing of PPE during pesticide applications

Reasons	Count	%
Hot weather	35	28,2
Lack of comfort	33	26,6
High cost	26	21,0
Thinking that PPE does not protect from pesticides	17	13,7
Thinking that the use of PPE is unnecessary	13	10,5
Total	124	100.0

As an example, when the hat usage habits of the producers are examined in consideration of Table 7, it is seen that 28 of them actually used hats, although they reported not to use PPE. Similarly, among the producers who reported no to use PPE, 37 of them are seen to wear long-sleeved shirts and 49 are seen to wear enclosed shoes. These findings can be considered normal, when it is thought that 88.7% of the producers did not receive any training about PPE. In a study [16] conducted about the awareness of Indonesian melon producers in the use of PPE, it was found that the producers were totally aware of the importance of using PPE including hats, masks, gloves, boots and glasses, while only 3.8% and 1.9% of them of them were wearing glasses and boots respectively. In another study done in Iran with producers who do not use PPE, it was understood that 36.7% of them were unwilling to use PPE and 25.2% of them were indecisive [17].

General distribution of PPE use among the farmers is given in Table 8. According to the table, while a significant part of the producers used hats, long-sleeved shirts and enclosed shoes, the rate of use of gloves, masks, glasses and long boots is quite low. Similarly, only a small proportion of the producers used slipper or sandals. It is also stated in another study [17] that the rate of PPE use among producers is low.

When Table 8 is examined, it is seen that the results are similar to the findings of [16]. However, Vidal et al. [18] reported that legs are the body parts exposed to highest level of contamination during pesticide applications in greenhouses. In the study conducted in greenhouses [19], the body parts with highest level of contamination were pointed out to be left hand, feet and ankles. It is reported that the use of PPE reduces exposure to pesticides during the application [20, 21, 17]. Thus, producers should definitely wear PPE during pesticide applications in order to reduce exposure and contamination.

When the producers were asked about the reason why they did not wear personal protective clothes, 28.2% of them asserted hot weather, while 26.6% and 21.0% presented the lack of comfort and high costs as the main reasons respectively (Table 9).

In another study [22] it was reported the PPE was thought to be uncomfortable, expensive and time-consuming.

On the other hand, 93.9% of the producers (104 persons) were determined to change their clothes at the end of the day during which pesticides are applied. When the habits of changing clothes after pesticide application were questioned, 64.4% of the producers who had the habit to change clothes declared that they do it just after the pesticide application, while 35.6% did it when they returned home in the evening. Similarly, when it was asked when the producers washed their clothes after pesticide applications, it was found out that 70.2% of them did it after every application, 19.4% after a few uses and 10.5% only when intensive contamination takes place on the clothes.

The clothes worn during pesticide applications are predominantly washed by women (88.7%), while men, agricultural workers and women and men together take the same responsibility in proportions of 6.5%, 2.4% and 2.4% respectively.

The clothes worn during pesticide applications are washed by hand or by use of automatic washing machines. Among the producers, 40.3% of them stated that these clothes were washed by hand and separate from other clothes, 29.8% of them stated separate machine washing, 23.4% stated that they are hand washed together with other clothes and 6.5% stated that all clothes are washed together in the machine.

As a result of the study, it was observed that nearly half of the producers did not use PPE during pesticide applications. Mostly preferred PPE, namely hats, enclosed shoes and long-sleeved shirts is actually used by the producers in their daily lives as well. Thus, it can be suggested that they do not pay necessary attention during pesticide applications and instead do the work with their daily clothes. It was determined that a very significant part of the producers (88.7%) did not receive any information from any source about the use of PPE, which makes us think that it would not be fair to expect high level of awareness among the producers, considering their average level of education. In particular, it can be argued that they do not understand what is exactly meant with the notion PPE, since a certain part of the producers who claim not to use PPE actually use them. On the other hand, a significant part of the producers stated that they were aware of the negative effects of pesticides on human health. However, when the general tendency was reviewed, it was concluded that they did not have the necessary level of awareness from the point of the negative effects caused by pesticides during the application. Although 91.1% of the producers declared to experience serious health problems after pesticide applications, nearly one third of them did not change their clothes just after the application. Also nearly one third of them changed clothes after every 2 or 3 applications, or even worse, only when the clothes got very contaminated. In a similar way, the storage of pesticides by the producers is seen to be problematic. While 44.4% of the producers store pesticides under their houses, 21.8% of them use the farmyard for the same purpose. In other words, pesticides are stored in ways that may damage human and animal health.

The reasons asserted by the producers for not using PPE can be mainly classified as unconscious excuses including hot weather and lack of comfort, when the scale of the current health problems is considered. The primary disadvantages in changing these habitual patterns are the high average age and low educational level of producers.

In conclusion, although the producers in the study area have a serious level of experience in agricultural activities and use of pesticides, it can be said that they are not well-informed about the harms of pesticides on human health and that they are unconscious regarding the use of PPE as a result. When their average ages and educational levels are taken into consideration, in order for the said consciousness to be created, it is important for the relevant institutions to get organized and start field training programs. Similar results related with unconsciousness of farmers were found to be also in other studies [23, 24, 25], conducted in same areas and educational activities were offered by the researchers. The awareness of the local people engaged in agriculture should be raised and the use of PPE should be encouraged by use of visual-based trainings explaining the negative effects of pesticides on human and environmental health. In addition, the importance of the area as a basin of agriculture and the presence of a prominent faculty of agriculture in the area would be an advantage for the training programs to be developed and implemented. Students of the said faculty should be also educated on the matter from the point of view that they will serve the area and the whole country in the near future.

CONCLUSION

As a result of this study, in which the level of awareness of producers in the use of personal protective equipment during pesticide application was tried to be determined, it was understood that producers are not at the desired level of awareness on the subject matter. In addition, their current knowledge and awareness are limited and actually originate from habitual patterns. Taking into consideration that the study area is one of the most ancient and critical agricultural basins of the country, it is thought that the lack of necessary awareness in spite of the presence of an important faculty of agriculture should be seriously discussed.

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Received: **11.12.2018**
Accepted: **12.07.2019**

CORRESPONDING AUTHOR

Muge Kantar Davran
Çukurova University,
Faculty of Agriculture,
Department of Agricultural Economics,
Adana – Turkey

e-mail: mkantar@cu.edu.tr