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OCCUPATIONAL WORKERS UNDERSTANDING OF PESTICIDE LABLES AND SAFETY PRACTICES IN EGYPT

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Abstract

Pesticide labels are the principal contact between the manufacturer and the end-user of the product as they convey essential use recommendations and safety information. So, this study aimed to assess the understanding level of pesticide labels, their field application practices, and observance of safety procedures among farmers, pesticide retailers, and applicators at Dakahlia Governorate, Egypt. The data revealed that, the majority of participants had limited formal education (44.7%), illiterate (15.3%) or did not receive any training or technical backing in the safety of pesticides. Insecticides were the highest used (44.8%) followed by herbicides (27.6%) and fungicides (13.8%).Moderately hazardous compounds were the most frequently in the study area and Chlorpyrifos was the highest used compound by subjects (85%) followed by Lambda-cyhalothrin (71%) then glyphosate (herbicide) (64%).When participants bought pesticides, their choice was mostly based on their experience, the type of pests, effectiveness, recommendations taken from other people, and inexpensiveness. Data indicated also that, pesticide retailers had a crucial role in the spreading of pesticide information among end-users. Our results revealed that, there is a strong correlation between workers' education level and awareness about safety precautions and understanding the instructions of pesticide labels. The awareness of occupational workers and authorities needs to be increased regarding the use of personal protective equipment (PPE) and correct storage procedures, handling, disposing of pesticides and empty containers.

Keywords: Pesticides, farmers, pesticide retailers, pesticide applicators, labels, precautions safety.

Introduction

During 2018, approximately 11,000 tons (active ingredient) of pesticides (2200,4510,and 4290 tons of fungicides, herbicides, and insecticides, respectively)in Egypt were utilized according to Egypt's Agricultural Pesticides Committee (APC) [1].The misuse of pesticides has been connected with environmental contamination and health problems around the world; so, occupational exposure to pesticides receives great attention to identify the hazards of pesticide usage and follow the safe methods for pesticide management [2, 3,4].The use of pesticides has increased many folds during the past few decades. More than 5 billion pounds of pesticides are used worldwide annually, so it is critical to spread the idea of safe use of pesticides, about 250,000 to 370,000 human deaths, most of them were noticed in developing countries [5].The main reason for most

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pesticide poisoning incidents is the misuse of highly toxic pesticides, combined with an absent or weak legislative framework of pesticides handling [6].

Pesticide labels are the primary point of contact between the product's end-user and the manufacturer, conveying crucial safety information and usage recommendations. It is the major source of information to clarify the pesticide's identity and directions for use (where, when, and how it may be used). Besides, the labels in form the end-user about the pesticide's risks and hazards, which would also assist the occupational workers in estimating the actual risk of applying and handling the product under various conditions. A label is an important tool for protecting the environment and human health [7,8]. Higher educated pesticide users could easily access the label information and could understand clearly the risks associated with pesticide handling, as well as how to minimize exposure. Whereas the pesticide users who have received little education may struggle to understand the risk warnings on the pesticide label, as well as how to avoid exposure and follow usage guidelines and safety recommendations [9, 10, 11].Many researchers reported that, the lack of information and illiteracy about the extent that pesticides exhibit risk were the major barriers to farmworkers adopting self-protection behaviours, especially the use of personal protection equipment (PPE)[12,13]. So, workers' understanding of pesticides safety precautions is highly important to provide essential data that aims to avoid or minimize the health and environmental problems associated with pesticides [14].

Pesticides must never be kept in places where they might be mistaken for drink or food; instead, they should be stored in a locked place that is not accessible to unauthorized people or children. Pesticides should be kept away from fires and out of direct sunlight and in a dry place [15]. In developing countries, the worrying and surprising reality is that workers re-use empty containers of the pesticide for different purposes. Moreover, pesticides are stored inside homes or in living rooms. These behaviours led to severe risks for children and their families when they were exposed to pesticide traces or vapours [16, 17]. While control centres have been established in developed nations where pesticide leftovers and empty containers are picked by competent organizations for safe disposal or suitable storage [18, 19].

Therefore, the main objective of this investigation aimed to: 1) Screen the common pesticide types that workers use; 2) Evaluate the perceptions of farmers about pesticides handling, pesticides safety label and spraying field practices that could expose them to chemical risk; 3) Explore storage and disposal of old (expired) pesticide stocks and empty containers; 4) Survey the protective measure which is taken by participants in farms, inside shops, including using personal protective equipment.

Materials & Methods

Study area: the selected area was Dakahlia Governorate that is located east of the Delta region in north Egypt (30.45- 31.60 N; 31.15 – 32.00 E), with a population of approximately 7 million people. Agriculture is the main profession of the majority of the population of the selected location. It is famous for the dense traditional cultivation of a large number of crops (rice, wheat, onion, sugar beets, potatoes, tomatoes, cabbage, alfalfa, corn ... etc.). A large number of pesticides are used annually to control pests attacking these crops.

The basic design and sample size

150 healthy male individuals in the age group of 30-55 years comprising of 100 farmers, 25 pesticide applicators, and 25 pesticide retailers were selected for the present study. The participants chosen had a

history of exposure to pesticides during a period ranging from 5 to 15 years at least.

Field survey

Face-to-face interviews were used to collect data using a questionnaire, the questionnaire contained four sections: 1st) was designed to collect information about pesticides mostly used in the study area, crops were cultivated by study subjects; 2nd) was focused on workers knowledge and understanding pesticide labels; 3rd) was assess the worker's pesticides handling, dispose of empty containers, re-entry period, pre-harvest period; 4th) was evaluating the safety practices during pesticide application such as: eat or smoke during work; protective cloths or equipment. The participants were interviewed in their fields, each interview was taking about 20 -30 min to complete and all were conducted from January - March 2017. The study subjects were asked to report the pesticides by trade names or local names. Data collectors checked the pesticide names from the containers or labels when participants failed to do so.

Ethical statement

This study was approved by the Academy of Scientific Research and Technology, Egypt, and the study protocol was approved by the human and animal ethics committee of the National Research Centre, Egypt. Permission for the study to be conducted was also obtained from the mother villages at Dakahlia Governorate. Participants received explanations of the purpose of the study in the Arabic language (their mother tongue). Informed approval was obtained from study individuals before starting each interview, and no personal identification was registered. We prepared an informed verbal consent that involved the purpose of the research, the expected duration of the interview, and a description that the individuals could withdraw at any time from the interview without any risk and no payment for their recruitment. We read this statement to each study participant before starting the interview and requested their permission to be involved in the study.

Results and Discussion

The workers' profile: All of the workers surveyed in this study were men, whereas, in Egypt farming activities, particularly the application of pesticides and plant protection chemicals, are performed exclusively by men. Data in Table 1 revealed that 15.3% of the individuals who had been studied were illiterate, while 44.7 % of them were achieved elementary education; 34 % got technical secondary education level and 6 % (nine persons of pesticide retailers) accomplished a University degree (agriculture sciences) and received training in pest management. This means that, the majority of respondents had limited formal education or was illiterate (44.7 %&15.3%) and did not receive any pesticides safety technical support or training. The understanding of hazards and warnings of pesticide labels and what to do to follow safety precautions and application guidelines may be affected by the workers' education level. These results accordance with those obtained by Jallow et al. and Al-Zadjali et al. [10, 16] they reported that, the farmworkers were hampered in their ability to comprehend pesticides label concerning the use of pesticides safely, or the written communication exist around about how to prevent pesticides exposure hazards. While Rijal et al. [20] reported that, in Chitwan, Nepal, farmers who go to secondary level of education were more than 40%,whereas 3%, 7%, 22%,27% had University degrees, higher secondary education, literate and illiterate, respectively. In Ekiti State, Nigeria, 26 % of the farmers were capable to writing and reading and were probably able to understand the instructions on the labels of pesticide containers, while, the majority of farmers in the study region depended on explanations they received from other farmers and

pesticide suppliers [21]. In Iran, the education level of farmers in the Moghan region was high (23.7%), diploma (23.3%), elementary (47.5%) while illiterate (5.5%) [11].

Pesticides used in the study region: The results indicated that, a total of 29 pesticide active ingredients were mostly used by the individuals who had been suited (Table 2). About 37.9% (11 out of 29) of the used pesticides are classified by the World Health Organization (WHO)as toxicity class II [22],17.2 % (moderately hazardous), belong to class III and 37.9 % (slightly hazardous) belonged to class U (unlikely to pose an acute hazard in normal use), while 6.9% of the used pesticides are under toxicity class Ib (highly hazardous) (Figure 1).Chlorpyrifos 48 % EC, an organophosphorus compound that recommended to control a wide range of insect pests in foliage or soil in more than one hundred crops [23], was recorded as the most used pesticide by 85 % of the workers in the study area, followed by Lambda-cyhalothrin (71%); glyphosate (herbicide), (64%); acetamiprid (61%) and indoxacarb insecticide (23%). The obtained data also showed that, of the total used pesticides insecticides represents 44.8%, herbicides 27.6%, fungicides 13.8 %, acaricides 6.9%, rodenticides 3.4% and nematicides3.4%and they were different pesticide formulations in the study region (Table 2& Figure 2). Similar results were found in a study conducted in Kuwait by Jallow et al. [10] who reported that, about 47% of the pesticides used in two major agricultural regions, Wafra and Abdally in Kuwait were from the moderately hazardous (WHO toxicity class II) and only 9% of the pesticides used were classified as highly hazardous pesticides (class Ib). Also, 90% of the farmers used moderately hazardous pesticides (class II) and 68% of them used slightly hazardous pesticides (class III), and nearly12%of the users consumed highly hazardous pesticides (class Ib) according to the WHO toxicity classification.

Data present in Fig.3 revealed that, the farmers in this area mostly cultivated rice (18.7 %) followed by wheat (16.7 %), clover (14.0 %), onion (10.7 %), sugar beet (10.7 %), maize (9.3 %), potato (7.0 %), tomato (4 %) and peas (2.6 %).In the study district, such crops are cultivated regularly and proportionate with the customary practice. The data of our survey confirmed that, all of the subjected individuals to the survey used pesticides this year for controlling pests that attack these crops.

Knowledge and understanding of pesticide labels: Data in table 3 revealed that, half of the farmers subjected to the study approximately were followed an agriculture rotation (45 %). We found that, the factors and considerations affecting the participants' decision to purchase a pesticide were; the pest which attacked the targeted crop (90.3%), retailer advice (72.3%), the effectiveness of the pesticide (66.7%), based on recommendations (51.6%) and pesticide affordability (31.0%) (Table3). These results accordance with those obtained by Oztas et al. [24] who reported that, the farmer’s decision of pesticides purchases are mostly based on the type of pest, efficiency, other workers' recommendations, and inexpensiveness. Our results indicated also that, pesticide retailers had a critical role in the spreading of pesticide information, thus the inadequate training to those retailers is considered a vital factor influencing the occupational exposure to pesticide risks; since their role goes beyond pesticides sellers to advisors or consultants for pesticide applicators and farmers [25]. Accordingly, they must at least get fundamental technical training in how to cope with pesticides handling, applications, and potential risks of pesticide. The improvement of retailer knowledge

Table 1: The education level for study individuals

Workers / Education level	Farmers		Applicators		Retailers		Average	
	n. (100)	%	n. (25)	%	n. (25)	%	n. (150)	%
Illiterate*	16	16.0	5	20.0	2	8.0	23	15.3
Elementary level	57	57.0	7	28.0	3	12	67	44.7
Technical Secondary level	27	27.0	13	52.0	11	44	51	34.0
University degree	0.0	0.0	0.0	0.0	9	36.0	9	6.0

*Illiterate or had not completed elementary education

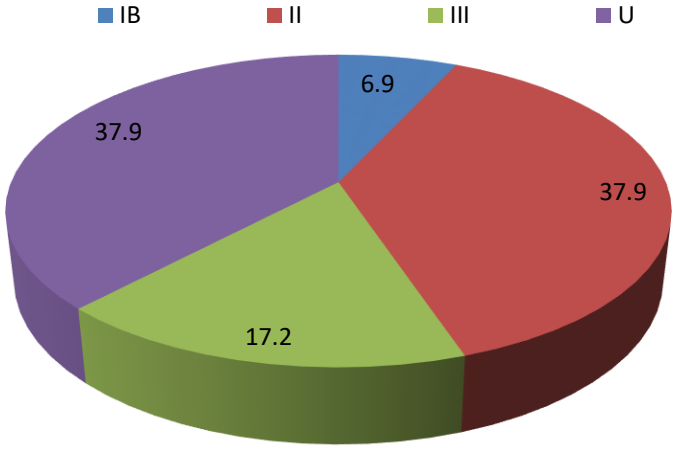

Figure 1): WHO toxicity classification of pesticides mostly used by workers in the study region

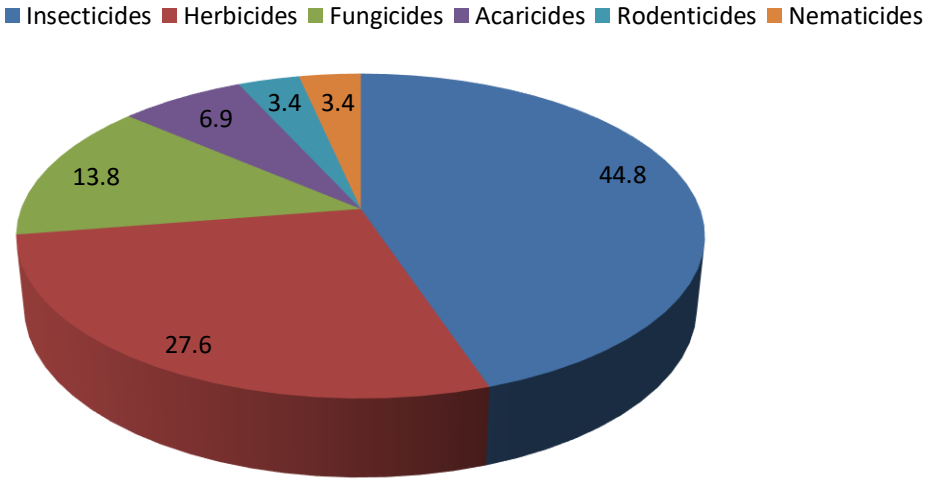

Figure 2): Mostly used pesticides classification according to the type of pest in the study region

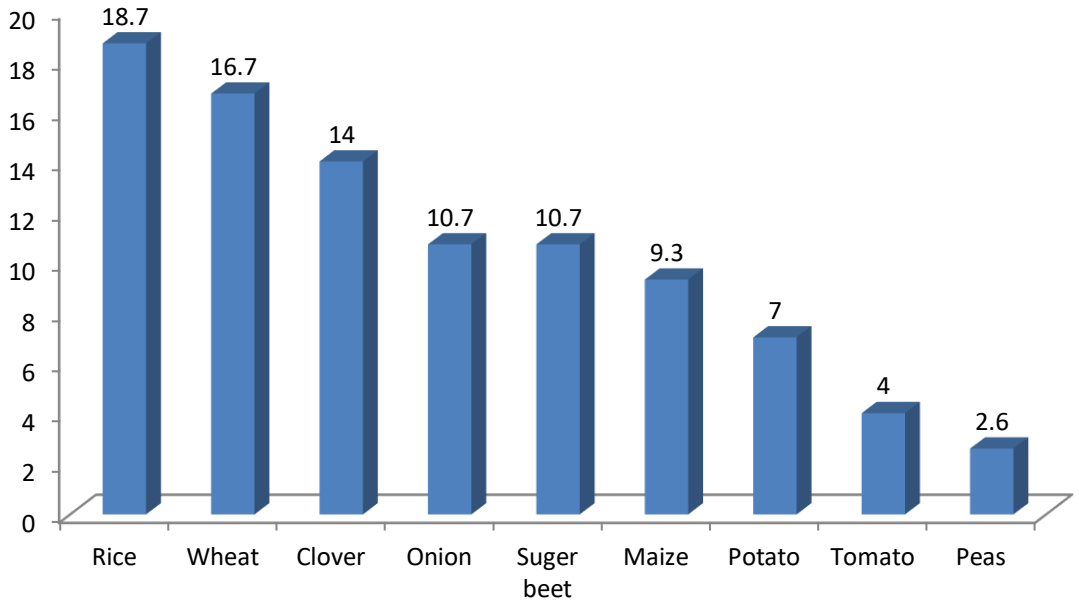

Figure 3: The most cultivated crops (%) in the study area

of pesticides safety and hazards communication as well keeping them updated would ensure that the advice reach to the end-user is precisely the best choice [10, 26].

Pesticide labels serve as the primary point of interaction between the manufacturer and the product's end-user, which is conveying vital safety information and using guidelines [8]. Results of the assessment of workers knowledge on pesticide labels indicated that, the majority of them read the pesticide labels (66.7 %), while 20.7 % did not read it (Table3), because they may be incapable to read and comprehend meanings of the label, the long list of instructions and guidelines were unclear and the font sizes on the labels were hard to read as they were tiny. For these reasons, over, 70 % of farmworkers in Kuwait did not read or follow instructions on the pesticide labels [10]. Also, the data in Table 3 indicated that, 48.7 % read the labels before buying pesticides, 63.0% before application, and 18.1% only before storage. It was noticed that 91.3 % of workers did not know the indication of pesticide label colours (according to WHO pesticide toxicity classification, the label of pesticides highly hazardous (Ib) is red, moderately hazardous (II) is yellow, slightly hazardous (III) is blue, while unlikely to pose an acute hazard in normal use (U) is green, [22]). More than half of the studied individuals use pesticides according to the recommendations rate, while 34 % only chick the expiry date when they purchase pesticides. When workers asked are you bought expired pesticides, (14.6 %) of them replied yes, no (41.3 %), sometimes (15.3 %) and I didn't know (28.6 %) (Table3). .

Workers' practices for pesticide storage, disposal, and containers: Attitudes of workers towards pesticide storage, empty containers, and expired pesticides disposal are represented in Table 4. Unsafe disposal of both old pesticide stocks and empty containers could put the general population and

environment at high adverse effects, data showed that, the majority of workers did not have a special location for pesticides storage, 56.7 % of them stored their pesticides inside the house; 23.3 % stored pesticides in the open field, while 20.0 % of respondents stored their pesticides in agro-chemical (fertilizers and pesticides) storeroom.21.7 % of workers bought pesticides in non-original containers. The stored pesticides inside houses can reach food and drinking water causing contamination and menacing children and exposing them to hazards and health problems. Miyttah et al. [17] reported that, of the total farmers (central region Ghana) stored the pesticides in; their kitchen 16%, in the bush 28 % and 46.7 % in living rooms. On the contrary, in developed nations, crucial control points for pesticide leftovers, empty containers, and other pesticide-related wastes have been established with competent organizations for disposal [18, 19].

When the subjected individuals were asked how they deal with the old pesticide stocks (or expired), 80.0% of them replied that they use them for pest control, 15.3 % answered that they buy the exact amount that they need, and 4.7 % replied that they return them to the retailers (Table4). In the same respect, there are several cases of pesticides misuse through converting the pesticides recommended for controlling cotton pests to another crops or non-crop purposes, such as controlling vegetable pests, eliminating ticks on cattle, domestic animals, and controlling ants. This misuse (the majority of cases) was found to perform extensively during the "off" season as a result of consuming pesticides that remained after the application for the previous agricultural year [9]. Also, Debela et al. [27] noticed that, some participants in northern Ethiopia used expired agricultural pesticides to control mosquitoes and other insects without protective equipment, and most of them used empty pesticide containers haphazardly.

Workers dispose of empty containers in various ways, the majority of them leave the empty containers in the field (53.3 %), 23.3 % re-use them for other purposes, 15.3 % throw them in the canals or drains, while only 8.0 % bury them. Moreover, 4.7 % of the respondents stated that, they collected the empty pesticide containers and sold them to waste buyers (Table 4). This unsafe practice causes adverse effects on the environment by contaminating soil surface, and ground water, and also affecting the non-target organisms [14, 25]. In Iran, the majority of farm-workers either threw the empty pesticide containers into the public trash or sold them to waste buyers. Also, other workers threw the empty containers into irrigation stream or dumped them at the farm. Most farmers neither use empty containers for home purposes nor send containers to recycling or pesticide supply centres [11]. However, in another study in Egypt, more than half of the orchardists were found to dispose of the pesticide empty containers by burying them [28]. Data obtained by Karunamoorthi et al. [6] revealed that the majority of Ethiopian farmers had enough awareness about pesticide impact on human health; however, various hazardous practices have also been documented, while 77.2% of them used the empty containers for different household purposes. The same study also revealed that, there is a strong correlation between the farmer's education level and the reported toxicity symptoms.

77 % of study subjects did not know the re-entry period (the time between pesticides application and the safe entry into the field without wearing protective equipment) and more than half of them (54.3 %) did not know the pre-harvest intervals (PHI)[refers to the time threshold for the first crop harvesting practice after pesticides application (in days)](Table4).

Table 2: The pesticides most frequently used by the subjects in the study area

Pesticide		Group	*WHO Category	Type of use	% **
Common name	Trade name				
Chlorpyrifos	Pestban	Organophosphorus	II	Insecticide	85
Lambda-cyhalothrin	Lambda	Pyrothrid	II	Insecticide	71
Glyphosate	Round up	Glyphosate-diammonium	U	Herbicide	64
Acetamiprid	Mospilan	Neonicotinoid	II	Insecticide	61
Clodinafop-propargyl	Topik	Aryloxyphenoxy-propionate	III	Herbicide	60
Thiamethoxam	Actra	Neonicotinoid	II	Insecticide	58
Flurochloridone	Rainbow	Flurochloridone	U	Herbicide	56
Thiobencarb	SATURN	Thiocarbamate	II	Herbicide	52
Pendimethalin	Stomp	Pendimethalin	III	Herbicide	51
Bispyribac-sodium	Nominee	Bispyribac-sodium	U	Herbicide	46
Malathion	Malathion	Organophosphorus	III	Insecticide	44
Dinotefuran	OSHIN	Neonicotinoid	II	Insecticide	44
Mancozeb	Diathane	Thiocarbamate	U	Fungicide	43
Zinc phosphide	Zinic phosphide	Inorganic compound	IB	Rodenticide	41
Lufenuron	Match	Benzoylurea	U	Insecticide	41
Fenpyroximate	Challenger	Fenpyroximate	II	Acricide	40
Emamectin – benzoate	Proclaim	Avermectin	II	Insecticide	39
Abamectin	plusVertimec	Avermectin	IB	Acricide	38
Maneb	Ridomilmancozeb	Thiocarbamate	U	Fungicide	37
Copper oxychloride	Galben Copper	Inorganic compound	U	Fungicide	35
Carbofuran	Furadan	Carbamate	III	Nematicide	33
Dimethoate	Dimethoate	Organophosphorus	II	Insecticide	32
Teflubenzuron	Nomollt	Benzoylurea	U	Insecticide	31
Profenofos	Selecron	Organophosphorus	II	Insecticide	28
Atrazine	Atrazine	Atrazine	U	Herbicide	27
Fluazifop-ρ-butyl	Fusilade	Aryloxyphenoxypropionate	U	Herbicide	27
Copper hydroxide	Copper	Inorganic compound	III	Fungicide	26
Methoxyfenozide	runner	Diacylhydrazine	U	Insecticide	26
Indoxacarb	Avanut	Pyrothriod	II	Insecticide	23

*WHO (2019) classification: IB = Highly hazardous; II = Moderately hazardous; III = Slightly hazardous; U = Unlikely to pose an acute hazard in normal use. **% = Percent of pesticide most frequently used by the subject

Table 3: Workers knowledge and understanding the pesticide labels

Question	Answer	No.	%
Do you follow an agriculture rotation?	Yes No Sometimes	100 (Farmers)	45.0 50.0 5.0
What the factor effective on your purchasing pesticides?*	Type of pest Retailer experience Their effective Recommendations User experience Being inexpensive Agricultural guide	150	90.3 72.3 66.7 51.6 44.1 31.0 8.0
Do you read pesticide label?	Yes No Sometimes	150	66.7 20.7 12.6
When do you read pesticide label?*	Before buying Before application Before storage	150	48.7 63.0 18.1
Do you know the indication of pesticide labels colour?	Yes No	150	8.7 91.3
Do you use pesticides according to the recommended rate?	Yes No Sometimes	100	52.0 31.0 17.0
Do you check the expiry date?	Yes No Sometimes	150	34.0 46.7 19.3
Are you bought expired pesticides?	Yes No Sometimes Don't know	150	14.6 41.3 15.3 28.6

* Multiple responses allowed

Table 4: Workers Practices on storage of pesticides and disposal of expired compounds and empty containers

Question	Answer	No.	%
Where do you store your pesticides?	In the field In store room Inside house	150	23.3 20.0 56.7
Do you buy pesticides in none original containers?	Yes No Sometimes	150	21.7 39.3 40.0
How do you dealing with old pesticide (expired) stocks?	Use it Return to retailer Buy amount needed only	150	80.0 4.7 15.3
How do you dispose pesticide containers?*	Leave it in the fields Re-use for other purposes Bury on-farm Throw it in the canals and drains Sold it	150	53.3 23.3 8.0 15.3 4.7
Do you know the re-entry period?	Yes No	150	23.0 77.0
Do you know pre-harvest intervals (PHI)?	Yes No	150	45.7 54.3

* Multiple responses allowed

Safety practices, protective clothes, and precautions against pesticide exposure: Data in Table 5 revealed that, most of the farmers and pesticide retailers eat or smoke during work (55% and 68 %, respectively), while 80% of applicators did not. Also, it was noticed that the major of farmers and pesticide applicators were aware of protective equipment that should be used while dealing with pesticides or during agriculture operations after pesticide applications. The most commonly used safety ware by farmers were wearing overall (60 %) and special boots (40%), while, applicators were wearing overall (68%), special boots (56 %), masks (56%), and glasses (12 %), as well, 10 and 8 % of the farmers and the pesticide applicators did not follow any safety precautions during work or spraying pesticides. In this study, 91% and 72 % of the farmers and the pesticide applicators reported using sticks for mixing pesticides, while 9% and 28 % of them use their bare hands for mixing, respectively. At the same respect, most of the pesticide shops contain water supply and had good ventilation (80 %), 12 % of shops had a fire extinguisher, 16 % of pesticide retailers had gloves and 4 % had face masks and glasses, while 12 % of pesticide shops and retailers did not follow safety precautions. On the question of the reason for not using protective equipment during pesticide application, the majority of them answered that, the high cost of protective wear is the main factor. Also, about 32.3 % of the respondents were reluctant to use protective wear due to feeling discomfort especially with increase temperature degrees. These reasons are in accordance with those noticed in a study conducted in Ghana, where 39 % of watermelon farmers did not use protective wear because of the high expense of personal protective gear bursas, while the laziness and discomfort were the answer of 13.3 % of them in particular in the hot and humid weather of the study district [17]. Face masks and gloves (58.48 and 15.79 %, respectively) were the most commonly used safety ware by farmers in Southern India [14], while, 58 % of farm-workers in Kuwait did not use any personal protective equipment [10]. Nearly 42% of farmers in rural irrigation villages in Southwest Ethiopia had never used any personal protective equipment to save themselves against pesticide exposure [29].

Generally, depending on the limited participants' number (150 workers), we can't assume that the results are representative of overall Egypt's pesticide occupational workers. To conduct larger-scale interviews around the country was not feasible at the current circumstance, we aimed to highlight relevant occupational health and pesticide safety issues for the studied participants. Besides, the previous researches and findings that reported the adverse effects of pesticides on workers carried out in Egypt made this study in demand [5, 28, 30, 31, 32]. Farmers, pesticide retailers, and applicators were all found to be using un-safe pesticide handling practices. Despite its limitations, this research adds information about pesticides practice and knowledge of safety between pesticide occupational workers in Egypt and can contribute to policy recommendations and educational aims to avoid or minimize the risks related to pesticides. Consequently, to minimize the adverse effects of pesticides on occupational workers and environmental consequences, educational training programs must be provided regularly to the farmers, pesticide retailers, and applicators through strong policy intervention [17].

Table 5: Safety practices for workers during pesticides application

Question	Answer (Variable)	No.	%
Safety practices for farmers:			
1. Do you eat or smoke during work?	Yes	100	55.0
	No		20.0
	Sometimes		25.0
2. Wear protective clothes or equipment:*	Wear overall	100	60.0
	Special boots		40.0
	Glasses		5.0
	Mask		5.0
	Gloves		0.0
	Nothing		10.0
3. How to mix pesticides?	Bare hands	100	9.0
	Using stick		91.0
Safety practices for pesticide applicators:			
1. Do you eat or smoke during work?	Yes	25	8.0
	No		80.0
	Sometimes		12.0
2. Wear protective clothes or equipment*:	Wear overall	25	68.0
	Special boots		56.0
	Mask		56.0
	Glasses		12.0
	Gloves		8.0
	Nothing		8.0
3. How to mix pesticides?	Bare hands	25	28.0
	Using stick		72.0
Safety practices inside pesticide shops:			
1. Do you eat or smoke inside shop?	Yes		68.0
	No		32.0
2. Safety practices in pesticide shops*:	Water		80.0
	Good ventilation		80.0
	Gloves		16.0
	Fire extinguisher		12.0
	Mask		4.0
	Glasses		4.0
	Nothing		12.0
Why didn't you wear PPE?*	High cost	150	67.7
	Discomfortable		32.3
	Unsuitable		16.3

*Multiple responses (answers) allowed

Conclusion: Creating awareness of safe pesticide handling is remarkably vital and can be achieved through establishing and accessing special orientation programs. The awareness of occupational workers and authorities should be increased regarding the use of PPE and proper procedures of handling, storage, disposal of pesticides, and empty containers. Besides, promoting alternative pest control strategies such as the use of environmentally friendly or green insecticides and integrated pest management (IPM) could be productive. Also, it is vital that pesticide retailers receive training to improve their knowledge of pesticide risk communication and safety; they should have at least one technical advisor who is knowledgeable about pesticide dangers and handling to adequately advise end-users. Also, a stricter application of monitoring and pesticide regulation policies should be established to reduce the threats that occupational workers' current practices pose to their environment and health.

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