

Research article

Insecticide Residue in Food, Some Preharvest and Postharvest Concerns and Impacts

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Abstract

Three groups of pertinence to insecticide use, sellers and companies' staffs; technical experts, and farmers, answered a comprehensive questionnaire of 23 items. The analysis of this task revealed the following results for the three mentioned groups and the collective data analysis, respectively, as follows: 98.6, 60, 80 and 79.5% for the importance of insecticide in crop production; 97.1, 85.7, 80 and 87.6% for selling insecticides according to technical background; 65.7, 48.6, 32.9 and 49% for obeying farmers demands in buying insecticides; 78.6, 65.7, 11.4 and 51.9% agreed with the insecticide selection according to the economies; 97.1, 75.7, 84.3 and 85.7% mentioned their keenness in using the technical dose; 92.9, 57.1, 55.7 and 68.6% followed the dose mentioned on the packet; 35.7, 25.7, 38.6 and 33.3% used their personal view in dose selection, 42.9, 28.6, 61.4 and 44.3% determined the number of sprays personally; 44, 72.9, 45.7 and 54.8% spray according to the economic threshold level (ETL), 55.7, 81.4, 40, and 59% follow the information of the researchers in determining the number of sprays, 94.3, 92.9, 44.3 and 77.1% perform safety period before harvesting; 98.6, 90, 38.6 and 75.7% believe in the importance of safety measures; 75.7, 85.7, 25.7 and 62.4% mentioned that they had training in insecticide safety; 90, 88.6, 84.3 and 87.6% agreed that the insecticide misuse is deleterious; 78.6, 35.7, 50 and 54.8% support the paid spraying by professionals; 81.4, 88.6, 87.1 and 85.7% said that insecticide residues have catastrophic impacts such as cancer, kidney failure and sudden death; 74.3, 82.9, 48.6 and 68.6% said they believe in organic farming whereas 68.6, 57.1, 45.7 and 57.1% mentioned there is a need for it. The significance of all these results is high at 0.05% and only insignificant for personal view in determining the dose, ETL and

the number of sprays, researchers and the number of sprays, insecticide misuse and residues and diseases for all the questioned candidates. Moreover, a majority of 32, 57, and 29% declared that the profit from insecticide use is 10%, 10% and they can't tell about, for the three groups, respectively. On the other hand, a majority of 57, 60, and 51%, respectively, said the insecticide spraying performed in all the cultivated crops. Nevertheless, 32, 32, and 36%, respectively, of the surveyed groups mentioned the protective clothes, all the possible tools of safety and information as a priority for the farmers. Concerning the safety training 24, 38, and 51% of the studied groups showed they received training from NGOs, government, and no training, respectively. In addition, a majority of 38, 29, and 43% believe that the companies care for the profit and their name, care for their profit, and profiteers only, respectively. These results may be beneficial in food safety policies in Sudan.

Keywords: Farmers, insecticide residue, safety, sellers & technical staff.

Introduction

The insect pests of agricultural crops endanger the human and his environment directly by affecting the food security drastically and indirectly through participating in the environmental pollution due to the misuse of insecticides which may result in poisoning of untargeted groups, persistent residues, development of resistance which increases the dosage used and health complications to mankind which may include mutagenesis, resistance suppression, kidney failure, cardiac arrest, sudden death, teratogenesis and cancer. Norman E. Borlaug, the American plant breeder who bred a lot of high yielding wheat varieties, is a Nobel Prize awardee in 1970. This eminent scientist stated it clearly and absolutely "We must feed ourselves and protect ourselves from the dangers that threaten our health. To do this we need chemical products. Without them the people of the earth will starve. He also mentioned that the now USA produces sufficient food from 310 million acres and in the past they couldn't do that from 600 million acres." ^[1]. Internationally big effort is made to safe use of chemicals which identified the elements for the sound management of the chemicals as: adequate legislation; information gathering and dissemination; capacity for risk assessment and interpretation; establishment of risks policy; capacity for implementation and enforcement; capacity for rehabilitation of contaminated sites and poisoned persons; effective education programs and capacity to respond to emergencies. Also legally binding instruments like Rotterdam Convention, Basle Convention, and Vienna Convention are now ratified by many countries ^[2]. However, the pesticide disposal constitute a complicated health and environmental problem in Sudan. That is, a preliminary analysis of the persistent organic pollutants (POPs) pesticides in soil samples from Qurashi and Hesahesa town, in a distance of 0, 10, 50, 100, 250, and 500 meter from the dumping site to the direction to the Blue Nile River, was done using GC with ECD detector. It is indicated that two samples 0 and 10 meter distance from dumping site contained Aldrin in a concentration of 37.4 and 5.4 µg/ kg, the study also showed that four samples were polluted with Endosulfan I and II in high concentration. It is also concluded that POPs pesticides create health risk for both human, animals and had environmental impacts which stimulate further research ^[3]. Sudan is one of the first countries in Africa and Middle East to use the pesticides. DDT, dieldrin aldrin, OPs (99,049 L), pyrethroids (2,590 L), CHCs (6,450 L), CHCs/ OPs mix. (3,864 L), pyrethroid/ OPs mix. (3,900 L), carbamates (2,790 L), mineral oil (22,400 L), anticoagulant (31,135 kg), arsenate (10,000 kg), mercuric (975 kg), sulfur (400 kg), sodium cyanide (400 kg), naphthalate anhydride (21,000 L), and unknowns (128,100 kg &

30,930 L). Several studies were conducted in the Sudan aiming at studying the fate of these compounds in fish, birds, rats and plants (cotton & vegetables). Laws and regulations governing pesticides use are in effect since 1974. The root causes of persistent toxic substance (PTS) related problems in the Sudan are presented [4]. However, despite all these efforts and precautions the pesticide commerce is developing very fast in Sudan which means availability and more use of these chemicals in the environment by the farmers. This produced a lot of environmental complications that can be summarized in the following parameters, 1. The farmers are not trained enough to handle the pesticides, choose or even apply them 2. The agricultural products harvested and sold exhibited no safety period before harvest and after the insecticide application and 3. The inspection and vigilance of the authorities is very limited which lead to a rather riot of fallacies in using these deadly poisons. Nonetheless, the Sudanese National Council of Medicines and Poisons takes a lot of care for the medicines and the law enforcement in handling, selling or using such chemicals is activated to a great extent which is not comparable with the use of pesticides. This situation gave rise to a continuous obsession among consumers about the residues and ailing effect of the sold vegetables and tomato (*Lycopersicon esculentum* L.), the queen of vegetables, in particular. Moreover, the medicines may be used by not more than 10% of the population daily whereas, the insecticides may be taken in the countless food items by all the population. This panorama of ideas provoked the appraisal of the views and opinions of three main categories whose jobs of relevance to insecticide use viz. the farmers, the sellers and companies and the technocrats in that field.

Materials and Methods

A questionnaire of 23 questions (18 closed, yes or no, and 5 open questions) was prepared. A sample of 70 replicates from three selected groups (Farmers, Sellers and Agrochemical Companies and Technical Staffs). The farmers were from Elsororab (Omdurman), 50 Km SW Khartoum Center, Elsaggay, 60 Km North Khartoum Center, (Khartoum North, Behri), Elfeki Hashim, 40 Km North Khartoum Center, (Khartoum North, Behri), Shambat, 7 Km North Khartoum Center, (Khartoum North, Behri) and the Central Fruit and Vegetable Markets (Behri and Khartoum). The agrochemical sellers were from the central fruit and vegetable markets in Khartoum proper, Behri and Omdurman and the company staffs include about 10 company headquarters in Khartoum. The technical staffs included three universities (U. of K, SUST and Elzaem Alazhari University), five research institutes (FRC, IENR, Shambat Research Station, Agricultural Economics and Policy Center and the Biotechnology and Biosafety Center), and the Plant Protection Directorate (PPD) in Khartoum North.

The questions themes were (1) Importance of spraying to production (2) Technical selling of the chemicals (3) Insecticide according to farmer's will (4) Selling and economies (5) Response to technical dose (6) Response to packet's dose (7) Personal view and dose (8) personal view and No. of spays (9) ETL and No. of sprays (10) Research scientists and No. of sprays (11) Safety margin (12) Safety measures (13) Safety training (14) Insecticide misuse (15) Paid spraying (16) Residues and diseases (17) Organic farming and (18) Need for organic farming.

However, the open questions themes were (1) Cost of spraying to the farmers (2) The type of crops sprayed (cash, fruit, vegetables) (3) The safety measure choice (4) the trainers of safety measures and (5) The companies and sellers whether care for their reputation or profiteers only. All these questions were answered and then analyzed using SPSS statistical program.

Results and Discussion

The answers of the questions asked in the survey for the three groups and the overall are displayed in Table 1. The answers about the importance of insecticides in crop production reflected 80, 99, 60 and 80% for the farmers, the seller and company staffs, the technical staffs and the overall, respectively. These results may infer the ideas of each group about insecticide spraying. That is, the farmers may think of it as an important tool for good production but they may dread the cost of that operation and the negative impact as well. Accordingly, this may justify the 20% party of the farmers who object using chemical spraying in crop production. The sellers and the company staffs are merchants, to a great extent, despite their education level and their thoughts, therefore they are supporters of insecticide spraying in essence with 99% whereas the conservative trend of the technical staffs in using insecticides appeared clearly with 40% objecting that husbandry practice in crop production. This may be justified by their endless support to safe and economic use of insecticides. Which may be lacking now. However, two workshops of safe and judicious use of pesticides at Barakat in April 1994 and the other in August 1995 at Elgorashi entitled "Safe use of pesticides and other chemicals were held the former jointly by the WHO, Sudan Gezira Board (SGB) and Ministry of Health Gezira State, and the latter auspiced by the SGB and the State Ministry of Health which both aimed at training trainers in this respect ^[5] & ^[6]. The selling of insecticides following technical guidelines is supported by 81, 97, 86, and 88% for the groups tested and the overall, respectively. This may reflect a relatively high awareness about the importance of the technical knowhow in dealing with insecticides. The priority in selling insecticides according to farmer's demand was supported by 33, 49, 66, and 49% for the farmers, sellers, technical, and the overall, respectively (Table, 1). Therefore, the only group who supports this idea is the sellers which may infer the dominance of the profiteer soul over the technical one considering that rather all the sellers and the company staffs are graduates and bearers of high certificates. The farmers claim that they buy the insecticides they believe in regardless of the cost and/ or the availability (88%) whereas this idea was objected by 79, 66, and 52% of sellers, technical and the overall, respectively (Table, 1). The rest of the surveyed samples agreed to using technical dose of insecticides (84, 98, 76, and 86%) for the farmers, sellers, technical, and the overall, respectively. These findings may reflect a high awareness of the majority of the tested samples about the right dose to use. This is also supported by other answers about using the dose mentioned in the packet with yes %, 56 for farmers, 93 for sellers, and 57% for the technical staffs. The deniers of using the dose determined by mere and personal view reflected a ratio of 61%, 64%, 74%, and 67% for farmers, sellers, technical staffs, and the overall, respectively. However, in Sudan the packet dose is not necessarily the same as the recommended which is determined by a thorough research lead by scientists from the Agricultural Research Corporation (ARC) prior the registration of an imported insecticide ^[7]. The inquiry about the determination of the number of sprays according to the economic threshold level (ETL) revealed 46, 46, 73, and 55% for the farmers, sellers, technical and the overall, respectively. This reflects that the two former groups mentioned less reliance on the insect count before spraying. Nonetheless, the farmers reflected that they depend on their own views in determining the number of sprays (61%) unlike the other groups who denied that 43, 29, and 44% for the sellers, technical staffs and the overall, respectively. This result may be supported by the fact that only 40% of the farmers questioned claimed that they contact the researchers about the dose to spray.

Table 1: Results of the Answers for the Overall Groups (%)

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18																		
Group	Farmers																																			
Answers	Y ¹	N ²	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N		
Result (%)	80	20	81	19	33	67	12	88	84	16	56	44	39	61	61	39	46	54	40	60	44	56	39	61	26	74	84	16	50	50	87	13	49	51	46	54
Group	Sellers and Company Staffs																																			
Answers	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
Result (%)	99	01	97	03	66	34	79	21	98	2	93	07	36	64	43	57	46	54	56	44	94	06	99	01	76	24	90	10	79	21	81	19	74	26	69	31
Group	Technical Staffs																																			
Answers	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
Result (%)	60	40	86	14	49	51	66	34	76	24	57	43	26	74	29	81	73	27	81	29	93	07	90	10	86	14	87	13	36	64	89	11	83	17	57	43
Group	Overall Groups																																			
Answers	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
Result (%)	80	20	88	12	49	51	52	48	86	14	69	31	33	67	44	56	55	45	59	41	77	23	76	24	62	38	88	12	55	45	86	14	69	31	57	43

1. Y = Yes and 2. N = No.

The corresponding answers of the technical staffs and sellers were 81% and 56%, respectively. However, among all the test parameters in this study the safety period before harvest and post insecticide spraying may be the most important of all with respect to the consumer health. That is, 93% and 94% of the sellers and the technical staffs, respectively, declared that they perform this operation, whereas, the corresponding result of the farmers is 40% only. This may raise the alert and ring the bell of risk of insecticide residues. This farmers' attitude pushed a sizeable population in the big Sudanese cities, including the capital Khartoum, to intercept tomato and preach others for that. This developed into an escalating obsession considering tomato as the major reservoir of insecticide residues among all fruits and vegetables. Some information of pertinence is that a scientist succeeded in identifying some eight insecticide residues in a single piece of tomato in Sudan some years ago ^[8]. Concerning the safety measures and training the results of farmers were the least (39 and 26%), respectively, a situation needs a correction by right plans from those in charge to raise their awareness about pesticide safety, generally speaking. The corresponding results for sellers and technical staffs were 99 and 90%, respectively, for the safety measures and 76 and 86% for the safety training, respectively. These results may be intuitive and justifiable by the fact that the training of the technical staffs is a mandatory and a major prerequisite for their promotion and to a lesser extent it is also for the sellers, whereas, the safety measures constitute a major issue for the sellers as an element of promotion and ethics, perhaps. However, the test groups agreed about the issue of insecticide misuse i.e. the positive answers yielded 84, 90, 87, and 88% for the farmers, sellers, technical staffs and the overall. These results may be alerting, annoying and stimulate an urgent need to raise the care to avoid complications arise from the insecticide misuse such as individual and mass poisoning and residue problems, the major consequences ^[9]. However, 87, 81, and 89% of the test groups (farmers, sellers and technical, respectively) displayed positive answers, respectively, to the linkage between the insecticide residues as a possible one of the unknown causes of some diseases spread in the last years (kidney failure, sudden death, cancers, etc.....). Accordingly, a solution to this dilemma may be through spraying insecticides by experts, a suggestion supported by 50% of farmers, 79% of sellers and only 36% of the technical staffs. The latter result of the technical staffs may need a further elucidation, that is, those disagreed with the idea may be due to the expected complications such as the delayed payment and other inconveniences from the farmers' side. Moreover, the simple majority of farmers didn't believe in organic farming (OF), 51%, whereas, 74% and 83% of sellers and technical staffs supported it. This may be a function of literacy and education which is proportional to the test staffs of both the latter two groups. However, astonishing or paradoxical results appeared about the need for OF. That is, 69, 57, and 46% of sellers, technical staffs and farmers, respectively, agreed upon the need for OF. This may be attributed to the highly motivated personnel in the insecticide commercial sector about the importance of that whereas the illiteracy of the farmers and the reluctance of the technical staffs in feeling that it is difficult to adopt and have OF may account for the mentioned results.

The analysis of variance (ANOVA) results of the test data are displayed in Table 2. That is, the statistical significance (at 0.05) between the test groups was reported in all the test parameters except the following, 1. The effect of personal view in determining the insecticide dose (0.687), the ETL influence on the number of sprays (0.981), 3. Consulting the research scientists about the dosage (0.101), 4. The results about misuse of insecticides and the linkage between residues and diseases (0.581).

Table 2: ANOVA Results for the Data of the Three Surveyed Groups

Test Parameter	Stat. Parameter	Degree of Freedom	F	Significance
(1) Spraying and Production	Between Groups	2	14.803	0.000*
	Within Groups	207		
	Total	209		
(2) Technical selling	Between Groups	2	8.242	0.000*
	Within Groups	207		
	Total	209		
(1) Farmers demand	Between Groups	2	11.098	0.000*
	Within Groups	207		
	Total	209		
(2) Selling & Economies	Between Groups	2	71.026	0.000*
	Within Groups	207		
	Total	209		
(3) Technical Dose	Between Groups	2	6.068	0.003*
	Within Groups	207		
	Total	209		
(4) Packet and Dose	Between Groups	2	25.091	0.000*
	Within Groups	207		
	Total	209		
(5) Personal view and Dose	Between Groups	2	0.376	0.687
	Within Groups	207		
	Total	209		
(6) View and No. of sprays	Between Groups	2	5.127	0.007*
	Within Groups	207		
	Total	209		
(7) ETL and No. of sprays	Between Groups	2	0.019	0.981
	Within Groups	207		
	Total	209		
(8) Researchers and No. of sprays	Between Groups	2	2.323	0.101
	Within Groups	207		
	Total	209		
(9) Safety preharvest period	Between Groups	2	48.661	0.000*
	Within Groups	207		
	Total	209		
(10) Farmers & safety measures	Between Groups	2	93.700	0.000*
	Within Groups	207		
	Total	209		
(11) Safety Training	Between Groups	2	30.871	0.000*
	Within Groups	207		
	Total	209		
(12) Misuse of insecticides	Between Groups	2	0.983	0.376
	Within Groups	207		
	Total	209		
(13) Paid spraying to farmers	Between Groups	2	9.600	0.000*
	Within Groups	207		
	Total	209		
(14) Residues and Diseases	Between Groups	2	0.544	0.581
	Within Groups	207		
	Total	209		
(15) Organic farming opinion on	Between Groups	2	7.221	0.001*
	Within Groups	207		
	Total	209		
(16) Need for organic farming	Between Groups	2	5.308	0.006*
	Within Groups	207		
	Total	209		

* The mean difference is significant at 0.05 level.

The results of the open questions in this tests are displayed in Tale 3. The profit from using insecticides 10% of the capital (29%) of the overall sample, whereas 35% of the overall claimed they can't tell. The type of sprayed crops is said to be all by 86% of the overall test samples. Suing of safety measures is not common among all the test samples, yet the protective clothes reflected the highest score (32%) of the overall. However, concerning the trainers the government had the highest score of the overall (54%) then the media (23%, o training received (13%) and then NGOs (10%). Nonetheless, the idea of the different groups about the companies' attitude 40% of the overall claimed they are moderators, 37% thinks they are profiteers and 23% of the overall samples reflected they care about their name and reputation.

Table 3: Results of the Test Open Questions

Test Group	Profit (%)				
	1%	10%	25%	> 25%	Can't Tell
Farmers	3	40	39	18	0
Sellers	16	46	6	7	25
Technicals	0	0	10	9	81
Overall	6	29	18	11	35
Crop Sprayed (%)					
Crop	Cash	Vegetables	Fruits	All	
Farmers	0	27	0	73	
Sellers	3	14	2	81	
Technicals	0	13	1	86	
Overall	1	18	1	80	
Safety Measures					
Type	Prot. Cloth	Antidote	Safety Card	Information	All
Farmers	42	4	3	51	0
Sellers	23	1	1	13	32
Technicals	32	0	2	11	25
Overall	32	2	2	25	19
Trainers Choice (%)					
Trainer	Gov.	NGO	Literature	No Any	
Farmers	13	14	0	73	
Sellers	19	34	19	29	
Technical	54	10	23	13	
Overall	29	19	17	38	
Opinion about Companies					
Description	Name	Profiteer	Moderator		
Farmers	9	61	30		
Sellers	37	9	54		
Technicals	24	41	34		
Overall	23	37	3		

Conclusions

The insecticide misuse is a common practice among farmers and they don't care about the right dose, right spray and right harvest time. Some solutions must be found to avoid complications of insecticide abuse. These solutions may include paid spraying by experts. More extension effort must be taken to erase the illiteracy of farmers about insecticides. The need for organic farming is a necessity.

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