RISK ASSESSMENT OF PESTICIDES ON APPLICATORS AND FARM WORKERS USING DIFFERENT SPRAYERS IN COTTON SEASON

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Abstract

Fakous province in Sharkia Governorate constitutes one of the largest agricultural areas in Egypt. The majority of people in this province rely on agricultural activities for subsistence. In cotton cultivation season continuous application of pesticides are commonly used according to Schedule of pest management. In this study the health effects of pesticides on some biochemical criteria were assessed among a cohort of 210 intensive agricultural pesticides applicators and farm workers from Sawada and Akyad Elkepplia villages in Fakous province according to the type of spraying equipments they used. Conventional motor (300 L / Feddan) and knapsack motor sprayer (20 L / Feddan) were commonly used. Contamination on head, body (thorax / abdomen) and legs was detected among 85 applicators (knapsack motor sprayers) and among 75 applicators (conventional motor sprayers)agricultural workers compared with an age and sex matched control group(60 subjects) selected from the general population. The recorded results revealed that contamination with pesticides due to knapsack motor sprayers was 0.76 % on head, 4.8 % on body and 5.8 % on legs. However, conventional motor sprayer induces higher contamination than knapsack with 3.6 % on head, 23.7 % on body and 29.1 % on legs. Several criteria for estimating pesticide contamination by the previous expressed machines were used. The most important one being serum cholinesterase (AChE) as a reference biomarker was depression with two types of sprayers. Applicators expressed changes in serum glucose level with two types of sprayers presented as well as, reduced glutathione level (GSH) in erythrocytes. However, an increase in each of total serum protein and albumin was recorded also, elevation in lipid peroxidation biomarker malondialdehyde (MDA) was recorded. Changes in serum biochemistry namely enzymes reflecting cytotoxicity were recorded, an inhibition in alanine aminotransferase (ALT) and glutathione–s-transferase (GST). An increase in aspartate aminotransferase (AST) and glutathione reductase (GR) was observed. The most pronounced results were observed in conventional motor sprayers. Changes in enzymes activities found in this study are linked to the adverse health effects related to chronic pesticide toxicity that may led to pathophysiological diseases, cancer or neurodegenerative

disorders, are attractive hypothesis that warrants further investigations.
Key Words: Risk Assessment, Spraying Equipments, Applicators, Biochemical Changes.

INTRODUCTION

Cotton played an important and vital role in the political and economic history of Egypt. Egyptians have pride in their cotton because it affects their everyday life and is considered a pillar in their culture. It is because of that they seek its uniqueness and quality. Cotton plantations are highly important in Egypt, covering between 400 000 and 500 000 ha, 1/6 of all cultivated land (Nassar, 1994). In 2007 Fakous province in Sharkia Governorate in Egypt cultivated more than 2000 feddan with cotton. This crop is a vital source of foreign currency revenue through exports, and their state of health is therefore permanently under close surveillance. Egyptian cotton is vulnerable to dozens of insect pests and diseases especially Egyptian cotton worm (Spodoptera littoralis Boisd – Lepidoptera, Noctuidae (Moritz Schanz, 1913), making it the most pesticide-intensive crop grown on the planet. Today cotton farmers from as far apart as Egypt, India, Peru and Australia spend a total of US$ 2 billion on agricultural pesticides every year, of these chemical applications at least US$ 819 million are toxic enough to be classified as hazardous by the World Health Organization (WHO) such as deltamethrin and endosulfan, which are the two most widely used insecticides on cotton (WHO, 2005). Pesticides action is affected by several interfering factors, e.g spray quality and the contact between deposited droplets and the target pest these factors depends upon the type of spraying equipments. Different types of spraying equipments were used in pesticides application for example: Knapsack motor sprayer (Kubota) at 35,55,85, 105 and 120 L / Fadden and conventional motor sprayer at 600 L / Fadden (Megahed *et al.*, 2004**).** In the field operations smaller droplets drifting away from application area, In many cases pesticides not only affect the physiology of the pest species they are intended to control, but also impact upon the well-being of human adults and children. This phenomenon is particularly associated with insecticides, many of which are designed to interfere with biological systems common throughout much of the animal kingdom, such as the nervous and reproductive systems (Zahm 1997).

Nearly 99 % of the world's cotton farmers live and work in the developing world where low levels of safety awareness, lack of access to protective apparatus, illiteracy, poor labelling of pesticides, inadequate safeguards, and chronic poverty each exacerbate the damage caused by cotton pesticides to low income communities. Developing world farmers are responsible for producing 75 % of global cotton

production. Farmers have numerous opportunities for exposure to pesticides, including those during planting and cultivation of crops, pesticides application to crops, mixing and preparing pesticides for application, loading and cleaning application equipments (Perry and Layed, 1998). A higher proportion of pesticide poisoning and illness in Egypt occurs in remote agricultural areas where there are inadequate occupational safety standards, insufficient enforcement of pesticide-related legislation, poor labeling of pesticide containers, illiteracy, inadequate protective clothing and washing facilities, and user's lack of knowledge of pesticide hazards (Dogheim *et al.,* 1990).

The purpose of this research was twofold: (1) to assess dermal exposure to pesticides induced by two types of spraying equipments on the applicators and the farmers. (2) To estimate the potential health risks associated with pesticides exposure.

MATERIALS AND METHODS

2.1. Pesticide Application

The pesticide applications for the cotton crop are highly regulated in Egypt and the Ministry of Agriculture has specific guidelines that are followed throughout the country. Each cotton field in Egypt is subject to four application cycles per season and each application lasts 5 – 11 days: Cycle (1) Bacillus thuringiensis (a natural occurring bacterium that is harmful to insects but not humans), Cycle (2) Pestban (chlorpyrifos) OP application, Cycle (3) Pyrethrins or a less potent carboxylate, and Cycle (4) Dursban (another formulation of chlorpyrifos). There is approximately a week of no spraying between the four application periods and this schedule of pest management has been followed rigidly for over 10 years. The typical workday was from 8:00 a.m. to 12:00 p.m. and then from 3:00 p.m. to 7:00 p.m., 6 days per week. Organophosphate pesticides were applied during the second and fourth cycles.

2.2. Subject Study:

210 male subjects with age between 20 - 60 years were recruited to participate in the study based on their type of equipment used in pesticide application. About 80 subjects using knapsack motor sprayer (20 L / Feddan) and 70 subjects using conventional motor sprayers (300 L / Feddan) . Subjects in the present study worked and resided in Sawada and Akyad Elkepplia villages, Fakous province in Sharkia Governorate during July – September 2007. Every subject was asked to fill out a questionnaire concerning his health status, the use of medications, occupational history periods of pesticides exposure, type of pesticides, smoking habit and use of protective equipments. Based on the questionnaire, subjects with history of diabetes mellitus, hypertension, liver disease, anemia, kidney disease, cancer and other chronic

illnesses, cigarette smoking, use of drugs or history of radiotherapy were excluded from the study. Control group consisted of 60 male subjects ranging in age between 23 - 55 years who were not performing spraying activities with pesticides or directly exposed to them. In order to avoid differences in environmental exposure to pesticides residues and in their socio-economic and nutrition status, they were from the same geographical setting than applicators.

2.3. Equipment Assessment and Dermal Exposure Assessment:

Two types of ground sprayers were used for pesticides application: Knapsack motor sprayer and conventional motor sprayer their technical data were defined by Gabir *et al.* (1982) and Mathews & Thornhill (1994). Droplets were received on sensitive cards from Ciba - Gaeigy Company, distributed randomly on plant and ground. Estimation of dermal exposure of pesticides on applicators (one on forehead, two on right and left of thorax / abdomen and two on right and left legs) this study was conducted according WHO protocol (1975). Number and size of spray deposit on cards were measured with a special scaled monocular lens (struben ® with a magnification of x15. the spread factor of used sensitive paper was 2.2 (Ciba - Geigy 1990).

Percent of droplets of pesticides received on plants, land and on applicators were determined as follows:

$$\% \text{ of droplets on plant} = \frac{\text{No. of droplets on plants}}{\text{(Plant + Land losses + applicators parts)}}$$

$$\% \text{ of droplets losses on land} = \frac{\text{No. of droplets on Land}}{\text{(Plant + Land losses + applicators parts)}}$$

$$\% \text{ of droplets on applicators in different parts} = \frac{\text{No. of droplets on applicators parts}}{\text{(Plant + Land losses + applicators parts)}}$$

2.4. Sample Collection:

10 ml of venous blood samples from all study subjects were collected and divided into non heparinized vacutainers to get serum and heparinized vacutainers. The blood was centrifuged at 3000 rpm for 15 minutes to separate serum. Serum was kept at -20C for further biochemical assays. 200 µl of heparinized blood was added to a precipitate solution for measuring RBCs membrane bound parameters.

2.5. Biochemical Assays:

Total reduced glutathione (GSH) was determined in erythrocytes by the method of Beutler *et al.,* (1963) based on the development of a yellow color when DTNB is added to the supernatant of the precipitated RBCs containing sulfhydryl groups. Malondialdehyde (MDA) occurs in lipid peroxidation and was measured according to Ohkawa *et al.*, (1979) in serum after incubation at 95 ^{o}C with thiobarbituric acid in aerobic conditions (pH 3.4). The pink color produced by these reactions was measured spectrophotometrically at 532 nm to measure malondialdehyde (MDA) levels. The glutathione S-transferase (GST) activity was determined in serum by the method described by Habig *et al.*, (1974) 1-chloro–2,4-dinitrobenzene (CDNB)-GSH conjugate formed at 37^{o}C was spectrophotometrically assayed at 340 nm. Glutathion reducrase (GR) was measured according Goldberg &Spooner (1983) cholinesterase (ChE) was assayed by the method of Ellman *et al.*, (1961). Markers for liver damage were determined using the commercial diagnostic kit of Stanbio Co., Spain. Serum transaminases (AST and ALT) activities were determined according to Reitman and Frankel (1957). Serum albumin and total protein were carried out according to Dumas *et al.*, (1971) and Weichselbaum (1946). Serum glucose level was estimated according to Trinder (1959).

2.6. Statistical Analysis:

Statistical analyses were based on comparing the values of control group as compared to the exposed groups according the mode and the duration of exposure. The results are expressed as means ± SD. The statistical signicance of the data has been determined using one way analysis of variance (ANOVA - LSD) using SPSS statistical software package version 10. The level of significance was taken as $p < 0.05$. Correlation coefficients were calculated using the procedure of Pearson.

RESULTS

3.1. Technical Data of the Equipments Used:

Conventional pesticide application involves chemicals diluted in large amount of water 300 L / Feddan. So that, it produce large spray droplets volume in diameter but small number of droplets on plant and applicators and high rate of flow as depicted in Table (1). However, knapsack motor sprayers contain the same amount of chemical diluted with small amount of water to get a total volume 20 L / Feddan. Knapsack motor sprayers distinguished with small size of droplets, large number of droplets / cm^2 on plant and on applicators, reduction in the rate of flow 0.960 L / minute (Table 1).

Table 1. Technical Data of the Equipment Used in Cotton Plantation.

Parameters	Conventional motor sprayer	Knapsack motor sprayer (Solo)
Spray volume (L / Feddan)	300	20
Swath width (m)	2	5
Mean working speed (Km/h)	2.4	2.4
Flow rate (L / min)	5.714	0.960
Spray height(m)	0.5	0.5

Mean working speed ± 5.

3.2. Assessment of Contamination Percentage with Pesticides on Cotton Plants and Land.

Assessment of the percentage of pesticides cover the plant and lost on the land as well as that dermally deposited on the skin of the applicator during application were expressed by Figures 1 and 2. Percent of pesticide cover the plant by conventional motor sprayer 20.14 %, however 86 % of plant were covered by pesticide when knapsack motor sprayer was used. Meanwhile, 24 % of pesticides lost on land when conventional motor sprayer was used compared with 2.6 % lost on land by knapsack motor sprayer (Table 2).

3.3. Assessment of Contamination Percentage with Pesticides on Dermal of Applicators.

As a whole the results indicated a generally poor personal hygiene regimen, evident with the self reported questionnaire and in the quantitative results, non using of protective clothes, accumulation of the pesticides on their clothes are potentially the significant source of dermal absorption. Percentages of contamination induced by the two equipments on the applicators' heads, thorax / abdomen and legs were demonstrated in Table (2) and Figures 1&2 which revealed that conventional motor sprayer induce high and pronounced percentage of contamination on different parts of applicators more than knapsack sprayer.

Fig. 1. Conventional Motor sprayer 300 L / Feddan

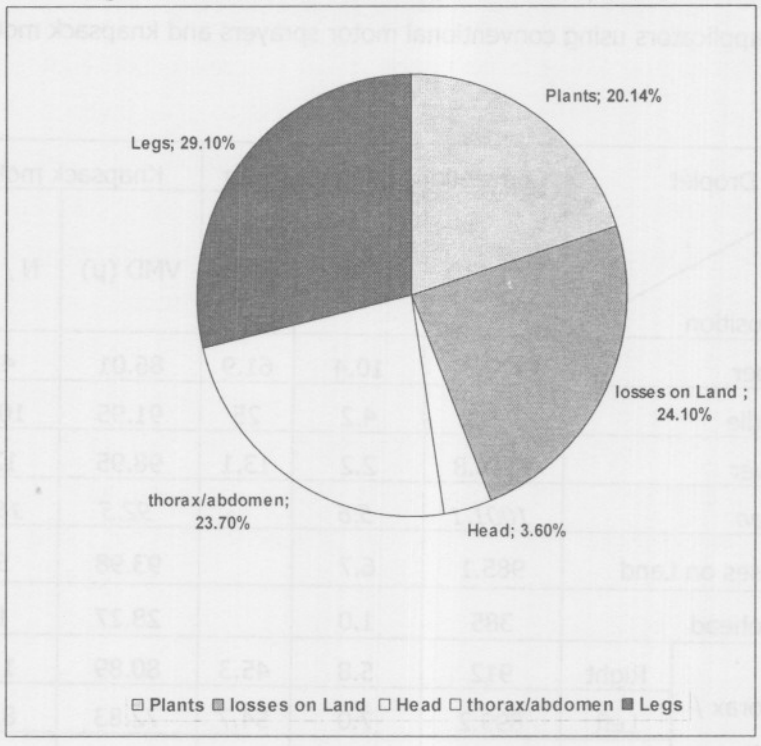

Fig. 2. Knapsack Motor Sprayer 20 L / Feddan.

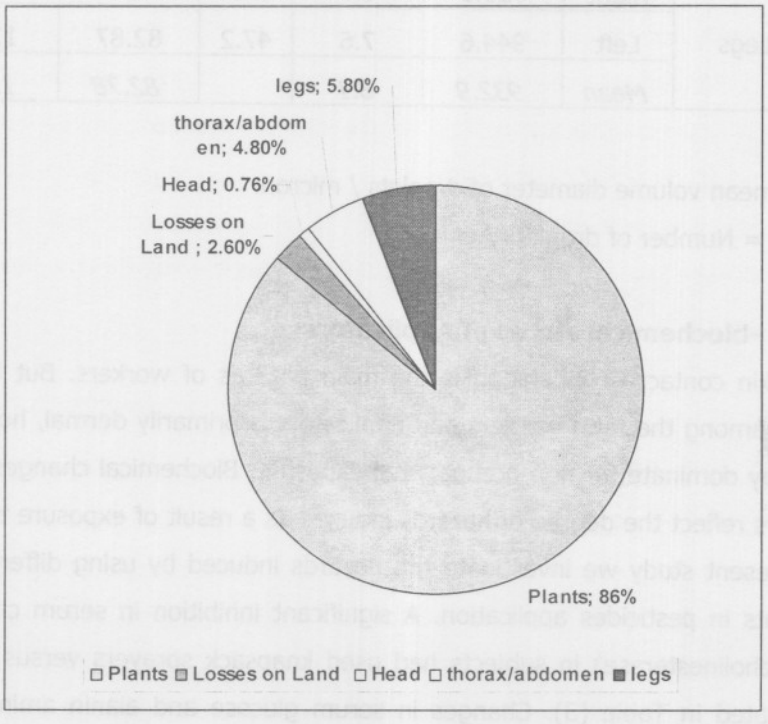

Table 2. Assessment of pesticides exposure on cotton plant and dermal exposure on applicators using conventional motor sprayers and knapsack motor sprayer.

Droplet spectrum / Target & Position			Conventional motor sprayer			Knapsack motor sprayer		
			VMD (μ)	N / cm^2	% N	VMD (μ)	N / cm^2	% N
Cotton Plant	Upper		970.3	10.4	61.9	86.01	425	77.8
	Middle		989.2	4.2	25	91.95	108.5	19.9
	Lower		1043.8	2.2	13.1	98.95	12.8	2.3
	Mean		*1001.1*	*5.6*		*92.3*	*182.1*	
	Losses on Land		985.1	6.7		93.98	5.6	
Contamination of	Forehead		385	1.0		28.27	1.6	
	Thorax / abdomen	Right	912	5.8	45.3	80.89	11.3	56.1
		Left	899.2	7.0	54.7	72.83	8.86	43.9
		mean	*905.6*	*6.4*		*76.86*	*10.1*	
	Legs	Right	921.2	8.5	52.8	82.7	12.1	50.6
		Left	944.6	7.6	47.2	82.87	12.1	49.4
		Mean	*932.9*	*8.1*		*82.78*	*12.3*	

VMD = mean volume diameter of droplets / micron.

N / cm^2 = Number of droplets / cm^2

4. Clinco -biochemical status of Applicators:

Skin contact or inhalation is the main hazards of workers. But the route of exposure among the farm workers and applicators is primarily dermal, however other routes may dominate for non occupational exposure. Biochemical changes in blood of applicators reflect the degree of hazards induced as a result of exposure to pesticides. In the present study we investigate the hazards induced by using different types of equipments in pesticides application. A significant inhibition in serum cholinesterase (pseudo cholinesterase) in subjects had used knapsack sprayers versus control was demonstrated in Table (3). Changes in serum glucose and alanin aminotransferase (ALT) were recorded in the two examined groups but the changes up and down the normal range. On the other hand, a significant increase in serum aspartate aminotransferase (AST) enzyme versus control ($p < 0.003$) was recorded in each of

the examined groups. Significant increase in serum total protein was recorded in knapsack motor sprayer group versus conventional sprayer group ($p<0.001$), however, non significant increase was noticed in serum albumin level. As depicted in Table (3), oxidative stress biomarker malondialdehyde (MDA) in serum of the exposed subjects recorded increase versus control in the two investigated machines. It must be noted that there is significant increase in serum MDA level in applicators using conventional sprayer as compared to the other machine and control group Elevation in oxidative stress biomarker concurrent with slight significant decrease versus control in total reduced glutathione (GSH) in blood of the exposed subject.

Table 3. Clinco-Biochemical Status of Pesticides Applicators using Conventional or knapsack equipments.

Parameters	Control	Conventional motor sprayer	Knapsack motor sprayer (Solo)	P
AChE mmol / min / ml	2070. 98 ± 116.64	1678.77 ± 56.34	1550. 59 ± 66.47*	0. 002
Glucose mg / dl	106. 53 ± 9.45	92. 09 ± 7.96	78.57 ± 6.19	0.187
ALT U / l	19.59 ± 4.27	15.87 ± 1.31	16.94 ± 1.23	0.795
AST U / l	25.24 ± 7.07	56.02 ± 3.59*	51.12 ± 4.38*	0.003
Total protein g / dl	5.72 ± 0.35	5.45 ± 0.16	6.43 ± 0.18 #	0.001
Albumin g / dl	3.37 ± 0.16	4.63 ± 0.96	5.01 ± 0.15	0.680
MDA mmol / dl	5.36 ± 0.99	12.60 ± 1.26*	9.50 ± 0.76* #	0.007
GSH mg / dl	17.27 ± 1. 32	12.59 ± 0. 60*	12.96 ± 0. 53*	0.003
GST mmol / min / ml	678.89 ± 93.44	588.80 ± 43.96	631.31 ± 48.64	0.630
GR mmol / min / ml	0.144 ± 0.010	0.210 ± 0.021	0.261 ± 0.036	0.143

All data were expressed as mean ± SD.

* Significance difference versus control at $P < 0.05$

Significance difference versus conventional motor sprayer at $P < 0.05$

Slight Changes in detoxifying enzymes biomarkers glutathione -s-transferase (GST) and glutathione reductase (GR) to be up and down nearly to the control level were observed in both examined groups as demonstrated in Table (3). Taking in consideration the duration of exposure to pesticide, statistical analysis revealed that chronic exposure to pesticides for > 20 years induced significant reduction in serum AChE with respect to the controls in each of the two types of spraying equipments. Meanwhile, serum aspartate aminotransferase (AST) recorded significant elevation versus control at $P < 0.022$ as demonstrated in Table (4). Assessment for chronic exposure to pesticides for > 20 years declared significant elevation in serum MDA and significant reduction in total GSH level in the pesticides applicator groups with respect to controls (Table 4). Changes in detoxifying enzymes GST and GR were strongly associated with pesticide exposure. The person correlation analysis showed significant correlation between most of the studied parameters as depicted in Table (5), where AChE correlated significantly with GSH and MDA. ALT significantly correlated with AST and GST. Also, total protein correlated with GST. An opposite correlation between GSH and MDA was depicted in Table (5).

Table 4. Changes in biochemical parameters in serum of Subjects Using Conventional Motor sprayer and Knapsack Motor Sprayers for > 20 years.

Parameters	Control	Conventional motor sprayer > 20 y.	Knapsack motor sprayer > 20y.	P
AChE mmol / min / ml	1954.62 ± 156.28	1640.03 ± 49.34*	1610. 43 ± 87.77*	0. 05
Glucose mg / dl	105. 27 ± 8.55	87. 26 ± 6.91	82.95 ± 6.56	0.421
ALT U / l	16.66 ± 3.93	16.43 ± 1.07	16.51 ± 1.84	0.977
AST U / l	30.36 ± 8.14	54.25 ± 3.29*	51.80 ± 5.47*	0.022
Total protein g / dl	5.75 ± 0.35	5.78 ± 0.16	6.15 ± 0.26	0.451
Albumin g / dl	3.56 ± 0.249	3.85 ± 0.385	4.51 ± 0.22	0.767
MDA mmol / dl	5.62 ± 0.928	11.59 ± 0.911*	10.51 ± 1.77	0.042
GSH mg / dl	16.96 ± 1. 22	12.82 ± 0. 502*	12.50 ± 0. 721*	0.004
GST mmol / min / ml	706.14 ± 87.90	595.86 ± 39.10	621.38 ± 59.46	0.526
GR mmol / min / ml	0.166 ± 0.024	0.227 ± 0.024	0.241 ± 0.039	0.514

All Data were expressed as Mean ± SD * Significance difference versus control at $P < 0.05$.

Table 5. Overall correlation among studied parameters.

	Age	Glucose	ALT	AST	T.P	Alb	MDA	GSH	GST	GR
AChE	-	-	-	-	-	-	0.224*	-0.250**	-	-
Glucose	-	-	-	-	-	-	-	-	-	-
ALT	-	-	-	0.293**	-	-	-	-	0.230*	-
AST	-	-	-	-	-	-	-	-	-	-
T.P	-	-	-	-	-	-	-	-	0.284**	-
Alb	-	-	-	-	-	-	-	-	-	-
MDA	-	-	-	-	-	-	-	- 0.343**	-	-
GSH	-	-	-	-	-	-	- 0.277*	-	-	-
GST	-	-	-	-	-	-	-	-	-	-
GR	-	-	-	-	-	-	-	-	-	-
Duration of exposure	0.655**	-	-	-	-	-	-	-	-	-

Person correlation values:

0.0 - 0.2 weak correlation.

0.3 - 0.5 moderate correlation.

0.5 - 1.0 high correlation.

DISCUSSION

Agriculture is the biggest employer in Egypt employing nearly 40 % of the Egyptian workforce (Anderson, 2003). Cotton crop is the primary agricultural product and highly regulated by Egyptian ministry of Agriculture (Rizk, 1999). Pesticides, including organophosphorus pesticides (Ops) are used in Egypt on cotton crop with large quantities being applied relative to other crops (Mansour, 2004). Different types of equipments were used for pesticides application. It is generally considered that operator exposure has some relation to the amount of pesticides handled and applied , which may be related to the applied dose, area treated, type of equipment used and duration of work task (Kangas and Sihvonen 1996). The route of exposure for farm

workers is primarily dermal, however other routes may dominate for non occupational exposure (Barr *et al.,* 2006). Previous study on the dermal and inhalation exposure to pesticides revealed that inhalation exposure was insignificantly when compared to dermal exposure, they also added that 60 - 90% of the total exposure could be attributed to skin absorption (Stewart *et al.,* 1999). Pesticides absorbed dermally were nearly twice as long as the half – life of the compounds after oral exposure both for absorption related phase of the time course and for the elimination phase (Griffin *et al.,* 1999). As regards to the assessment of dermal exposure in the present study, the total exposure for spray operators of the legs 29.10% of the total pesticides droplets in conventional sprayer subjects compared to 5.80% in knapsack sprayers subjects. That may be resulted from the accidental self spraying and spillage of the dilute spray formulation (Chester and Woollen, 1981). Dermal exposure of pesticides solutions may have a variety of fates when in contact with the skin, they may begin to evaporate, a fraction may permeate the skin, some may be absorbed into clothing and remain in contact with the skin, they may be washed or removed or redeposit on skin with different permeation resistance (Schneider *et al.,* 1999). The present study revealed that certain serum enzymes AChE and AST as well as serum components total protein and MDA and total blood component from GSH levels are to some extent influenced by each of the modes and the duration of exposure. The study therefore highlights the need to properly evaluate and control the potential health effects due to exposure to toxic substances among subjects employed in intensive agriculture application of pesticides can result in exposure by either the dermal or respiratory route, and can produce illness even with low – grade depression in cholinesterase (Gorden and Richter, 1991). Inhibition of RBCs or serum cholinesterase activity is a biomarker of organophosphorus and carbamate pesticides exposure (Padilla *et al.,* 1994). Tolerance to the cholinergic over stimulation may be observed following repeated exposure to cholinesterase inhibiting chemicals. But the cellular mechanisms responsible for the development of other effects (Bushnell *et al.,* 1991). It must be noted here that the inhibition in AChE significantly correlated with the increase in serum MDA a lipid peroxidation biomarker and has a negative correlation with the decrease in erythrocytes GSH. Previous studies have reported that exposure to different categories of pesticides (Organophosphates, carbamates, organochlorines, pyrethroids, etc.) leads to oxidative stress in pesticide applicators (parkasam *et al.,* 2001). Accumulation of oxygen free radicals in erythrocytes and other cells, leading to tissue damage as a result of oxidative binding of key intracellular molecules containing thiol groups like GSH and lipid peroxidation of biological membranes, which might be greatest importance in the cytotoxicity of pesticides and can be eventually responsible

for cellular death (Lopez *et al.,* 2007). Defense mechanisms against free radical induced oxidative damage include GSH that prevents the oxidation of protein thiol groups, either directly by reacting with reactive species or indirectly through glutathione-S-transferase (GST) (Pastore *et al.,* 2003). Slight non significant increase in the activity of glutathione reductase (GR) supported with the previous explanation recorded by (Banerjee *et al.* 1999) knowing that GR is the key enzyme for the generation of reduced glutathione from its oxidized form GSSG, it is most surprising that an increase in GR activity should challenge the compensatory mechanism for replenishing the GSH concentration inside the erythrocytes. It is possible that chronic exposure to pesticide may exert a direct effect on GR (Lopez *et al.,* 2007). Despite the presence of the cell's antioxidant defense system to counteract oxidative damage from ROS, oxidative damage accumulates during the life cycle, and radical-related damage to DNA, proteins and lipids has been proposed to play a key role in the development of age-dependent diseases such as cancer, arteriosclerosis, neurodegenerative disorders and other conditions (Alavanja *et al.,* 2004, Valko *et al.,* 2007). It appears possible that the observed oxidative stress in a population long-term exposed to pesticides could contribute to lifetime accumulation of oxidative damage and, therefore, may play a relevant role in the pathogenesis of some of these disorders which have also been associated with chronic pesticide toxicity. This may explain the observable changes in different studied parameters e.g. AST, ALT as well as total protein.

CONCLUSION

Our results revealed that the importance of the well performing sprayers which minimize hazards for operators and the continuous maintenance keep it work well so it decreases the drift of chemicals on applicators and in environment. Also, the results indicated that dermal exposure to the pesticides through application process induced inhibition in AchE accompanied with generation of reactive oxygen species (ROS). Accumulation of free radicals induced deterioration in proteins, lipids, carbohydrates and DNA which may play a role in induction different chronic disease with long term exposure. So that, a requirement to control contamination of surface and for an increase in workers awareness of the importance of personal hygiene during and following their use of pesticides must be increased.

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تقييم المخاطر الناتجة من استخدام أنواع مختلفة من الآت الرش على عمال رش المبيدات أثناء التطبيق المكثف للمبيدات فى موسم القطن

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يعتبر مركز فاقوس احد مراكز محافظة الشرقية بمصر ذات المساحة الزراعية الكبيرة، إذ يعتمد سكان هذا المركز على الزراعة اعتماداً كبيراً. نظراً للاستخدام المكثف للمبيدات فى موسم زراعة القطن بآلات رش مختلفة طبقا لعمر النبات ونوع الآفة المراد مكافحتها، لذا كانت هذه الدراسة والتى قمنا فيها بدراسة مخاطر التعرض للمبيدات على ٢١٠ (١٥٠ معرضون و ٦٠ غير معرضون) عامل من عمال الرش والفلاحين اللذين يعملون فى مجال الزراعة من قريتى سوّادة وإكياد القبلية التابعتين لمركز فاقوس شرقية، قسمت العمال إلى مجموعتين بناء على نوع آلة الرش المستخدمة والمتمثلة فى موتور الرش التقليدى (٣٠٠ لتر للفدان) وموتور الرش الظهرى (٢٠ لتر للفدان). ولتقدير مخاطر التعرض للمبيدات قمنا بما يلى:

أولاً: تقدير مستوى التلوث بقطرات المبيدات المتساقطة من تلك الآلتين على رأس وجسم (الصدر والبطن) وأرجل العمال. وأوضحت النتائج أن نسبة التلوث الناتجة من موتور الرش الظهرى كانت كما يلى: ٠,٧٦ % على الرأس، و ٤,٨ % على الجسم، و٥,٨ % على الأرجل، فى حين كانت من موتور الرش التقليدى أعلى من موتور الرش الظهرى كما يلى: ٣,٦ % على الرأس و٢٣,٧ % على الجسم و ٢٩,١ % على الأرجل.

ثانياً: تقدير مخاطر التعرض على الصحة العامة للعمال من خلال تقدير عدة معايير إكلينيكية، أهم هذه المعايير هو مستوى إنزيم اسيتيل كولين استيراز AChE فى سيرم دم العمال – الذى يعتبر دليل ومرجع حيوى – إذ حدث تثبيط للإنزيم فى عمال آلتى الرش، كما حدثت تغيرات معنوية فى مستوى جلوكوز الدم، وأيضاً انخفض مستوى الجلوتاثيون الكلى GSH فى كرات الدم الحمراء. ومن الناحية الأخرى فقد ارتفع مستوى الألبومين والبروتين الكلى، والمعايير الخاصة بالأكسدة الفوقية MDA . كما حدثت تغيرات بيوكيمائية فى الإنزيمات الدالة على حدوث السمية الخلوية إذ حدث تثبيط لإنزيمى الأنين امينوترانسفيراز ALT والجلوتاثيون اس ترانسفيراز GST، فى حين ارتفع مستوى إنزيمى اسبارتيت امينوترانسفيراز AST و الجلوتاثيون ريداكتيزGR وكان هذا الارتفاع واضح فى العمال الذين يستخدمون موتور الرش التقليدى.

مما سبق يمكن القول أن التغيرات التى حدثت فى نشاط الإنزيمات تدل على التأثيرات الصحية الضارة للمبيدات الناتجة عن السمية المزمنة والتى قد تؤدى بدورها إلى أمراض مرضية فسيولوجية أو السرطان أو اضطرابات عصبية، مما يحتم علينا المزيد من الدراسات البيئية المهتمة بمخاطر التعرض المهنى.