Damanhour University

Faculty of Agriculture

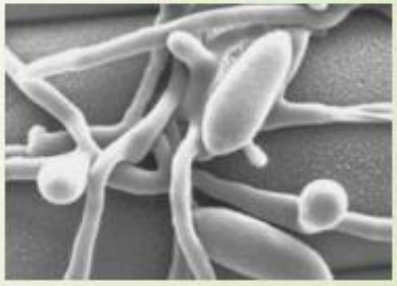
Occupational Poisoning of Pesticides to Spray Workers

Atef K.M. Nassar

Assistant Professor of Pesticide Chemistry and Toxicology,
Plant Protection Department, Faculty of Agriculture
Damanhour University, Egypt

4th International Conference and Exhibition on
Occupational Health & Safety
August 24-25, 2015 Toronto, Canada

Plant Pathogens & Pest Management Methods



Pesticides

- Pesticides applied extensively to control pathogenic pests of various crops
- The intensity of pesticide use has increased considerably by a 15–20-fold worldwide in the last decade
- It help farmers reducing the lose of their crops
- It is a key factor in promoting food security
- Yearly, agricultural producers use pesticides that worth 40 billion USD
- About 998 pesticides are registered in Egypt to control different pests
- However, the use of pesticides on crops had always been a serious concern
- Adverse effects of pesticides on liver, cardiac, kidney function, haematological and biochemical characteristics - all body parameters

Study Rational & Objectives

- In developing countries, farmers are exposed to pesticides due to:
  - The incorrect application techniques,
  - Poor or inappropriate spraying equipment,
  - Inadequate storage practices,
  - Lack of personal protective equipment, and
  - Reuse of old pesticide containers for food and water storage
- Additionally, the application of pesticides on crops was done by non-certified applicators (farmers) using hand held, back held, or motors-drawn sprayers, which put farmers under a huge exposure stress

Study Rational & Objectives

- In 2012, approximately 14,000 tons of pesticides (4,808, 2,809, and 6,374 tons of insecticides, fungicides, and herbicides, respectively) were used in Egypt (FAOSTAT 2015)
- Therefore, the objectives of current study were to:
  - determine the pesticide residues in blood samples of volunteers,
  - assess the adverse effects of pesticide exposure on human health in occupational and residential settings, and
  - use the discriminant analysis to interpret and predict variable(s) that might be used for fast detection of toxicity

Study Design

Three groups of volunteers were recruited:

Treatment	Positive Control	Negative Control
Occupationally -exposed	Indirectly-exposed	Not-exposed
Farmers apply pesticides regularly (once every week at least)	Farmers live in rural area but do not apply the pesticides	City people

Subjects were further categorized based on smoking

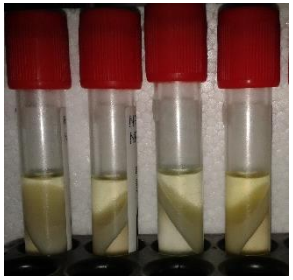
Methodology

Blood Samples Collection

Serum Separation for Hormone Estimation

Blood Samples to be analyzed for pesticide residue and complete blood picture

Determination of Pesticide Residues by GC–MS



Extraction of Pesticide Residues by QuEChERS method

Methodology

Analysis of Blood Picture was done in a certified clinical laboratory

S/L	Parameter	Result	Normal Range / Reference Value	Unit	Group
1	Haemoglobin	15.3	<5 yrs: 11.0 g/dL, 5 to <12 yrs: 11.5 g/dL, 12 yrs to <15 yrs :	g/dL	
2	ESR (Westergreen)		Adult(M:0-10mm,F:0-15mm), Child(0-10 mm) in 1st hr	mm/1st Hour	
3	Total WBC Count	5.21	4 - 11 X 10^3 /uL	X 10^3 /uL	Total Count
4	Neutrophils	3.44	2.16 - 6.04 X 10^3 /uL	X 10^3 /uL	Total Count
5	Lymphocytes	0.02	0.60 - 3.06 X 10^3 /uL	X 10^3 /uL	Total Count
6	Monocytes	0.00	0.00 - 0.60 X 10^3 /uL	X 10^3 /uL	Total Count
7	Eosinophils	1.75	0.00 - 0.40 X 10^3 /uL	X 10^3 /uL	Total Count
8	Basophils	0.00	0.00 - 0.08 X 10^3 /uL	X 10^3 /uL	Total Count
9	Neutrophils	66	Child (25 - 66 %), Adult (40 - 70 %)	%	Differential Count
10	Lymphocytes	0.00	Child (25 - 62 %), Adult (20 - 40 %)	%	Differential Count
11	Monocytes	0.00	Child (02 - 07 %), Adult (02 - 08 %)	%	Differential Count
12	Eosinophils	33.6	Child (00 - 03 %), Adult (00 - 04 %)	%	Differential Count
13	Basophils	0.00	0 - 01%	%	Differential Count
14	Total RBC Count	5.35	3.5 - 5.5 X 10^6 /uL	X 10^6 /uL	RBC Panel
15	HCT	43.4	37.00 - 47.00 %	%	RBC Panel
16	MCV	81.1	76.00 - 96.00 fL	fL	RBC Panel
17	MCH	28.6	27 - 32 pg	pg	RBC Panel
18	MCHC	35.3	32.00 - 36.00 g/dL	g/dL	RBC Panel
19	RDW-SD	42.2	42.5 ± 3.5 fL	fL	RBC Panel
20	RDW-CV	14.4	12.8 ± 1.2 %	%	RBC Panel
21	Total Platelet Count	303	150 - 450 X 10^3 /uL	X 10^3 /uL	PLT Panel
22	MPV	10.5	9- 13 fL	fL	PLT Panel
23	P-LCR	27.7	13 - 43 %	%	PLT Panel

Methodology

Determination of Thyroid and Reproductive Hormones in Serum Samples

- Testosterone hormone was determined using the International Immuno Diagnostics Kits (Granoff and Abraham 1979 and Tietz 1995)
- Triiodothyronine (T3) hormone determination was carried out using the International Immuno Diagnostics (Burke and Eastman 1974)
- T4 hormone was carried out using the International Immuno Diagnostics (Skelley et al. 1973)

Results

Pesticides Residue Analysis Using GC-MS

Common Name	Uses		LOQ (ppb)	Common Name	Uses		LOQ (ppb)
Bifenazate	A	ND	50	Clodinafop	H	ND	25
Dicofol	A	ND	100	Ethofumesate	H	D	50
Hexythiazox	A	ND	25	Flucarbazon	H	ND	50
Chlorpyrifos-methyl	A, I	ND	10	Oxadiazon	H	ND	100
Dimethoate	A, I	ND	50	Pendimethalin	H	ND	50
Diazinon	A, I	ND	10	Aldrin	I	ND	10
Dichlorvos	A, I	ND	5	Azinphos-methyl	I	ND	20
Ethion	A, I	ND	5	a-BHC	I	ND	15
Endosulfan	A, I	ND	15	Bioallethrin	I	ND	50
Malathion	A, I	ND	10	Cadusafos	I	ND	50
Pirimiphos-methyl	A, I	ND	10	Chlorfluazuron	I	ND	50
Phenthoate	A, I	ND	10	Cyfluthrin	I	ND	15
Profenofos	A, I	ND	15	delta-BHC	I	ND	10
Propetamphos	A, I	ND	15	Chlorpyrifos	I	ND	10
Quinalophos	A, I	ND	15	gamma-cyhalothrin	I	ND	5
Triazophos	A, I, N	ND	10	gamma-BHC	I	ND	25
Bromuconazole	F	ND	30	lambda-Cyhalothrin	I	ND	10
Chlorothalonil	F	ND	25	gamma-Chlordane	I	ND	25
Cyflufenamid	F	ND	50	Cypermethrin	I	ND	25
Dicloran	F	ND	20	Deltamethrin	I	ND	15
Difenoconazole	F	ND	20	Dieldrin	I	ND	5
Diniconazole	F	ND	10	op-DDT	I	ND	5
Epoxiconazole	F	ND	20	pp-DDD	I	ND	10
Fenarimol	F	ND	10	pp-DDT	I	ND	10
Fluazinam	F	ND	20	Endrin	I	ND	50
Myclobutanil	F	ND	15	Esfenvalerate	I	ND	10
Propiconazole	F	ND	15	Fenamiphos	I	ND	15
Proquinazid	F	ND	20	Heptachlor	I	ND	10
Penconazole	F	ND	30	Heptachlor-epoxide	I	ND	10
Tetraconazole	F	ND	30	Methoxychlor	I	ND	25
Triticonazole	F	ND	30	Permethrin	I	ND	10
Triforine	F	ND	30	Prothiofos	I	ND	10
Triflumizole	F	ND	50	Tetramethrin	I	ND	20
Acetochlor	H	ND	30	Thiocyclam	I	ND	25
Atrazine	H	ND	10	Thiamethoxam	N, I	ND	50

Effects on White Blood Cell & Platelets Counts and Differentials

Criteria	City Inhabitants (-Control)		Rural Inhabitants (+Control)		Applicators	
	Non-Smoking	Smoking	Non-Smoking	Smoking	Non-Smoking	Smoking
WBC# (X*10^3 µL)	12.80 ^{a}	7.32 ^{c}	9.68 ^{b}	6.82 ^{c}	7.31 ^{c}	6.60 ^{c}
LYM (%)	29.30 ^{ab}	29.41 ^{ab}	33.58 ^{a}	32.38 ^{ab}	31.89 ^{ab}	27.58 ^{b}
MXD# (X*10^3 µL)	0.55 ^{ab}	0.76 ^{ab}	0.88 ^{a}	0.60 ^{ab}	0.42 ^{b}	0.40 ^{b}
PLT (X*10^3 µL)	281.00 ^{a}	276.00 ^{a}	261.25 ^{a}	285.17 ^{a}	157.10 ^{b}	156.00 ^{b}
PDW (fL)	14.10 ^{a}	13.53 ^{a}	13.63 ^{a}	14.68 ^{a}	9.77 ^{b}	9.42 ^{b}
MPV (fL)	10.80 ^{a}	10.73 ^{a}	10.53 ^{a}	10.52 ^{a}	8.31 ^{b}	8.38 ^{b}
P-LCR (%)	32.25 ^{a}	29.32 ^{a}	29.82 ^{a}	27.38 ^{ab}	18.17 ^{c}	19.08 ^{bc}

Within each row, numbers followed by the same superscript letter(s) were not significantly different based on Dunnett's *post hoc* specific comparison ($P < 0.05$)

Adverse Effects on Red Blood Cell Counts and Differentials

Criteria	City Inhabitants (-ve Control)				Rural Inhabitants (+ve Control)				Applicators			
	Non-Smoking		Smoking		Non-Smoking		Smoking		Non-Smoking		Smoking	
RBC (X*10^6 µL)	5.00	ab	4.78	ab	4.14	b	5.19	a	5.18	a	5.08	a
HGB (gdL^{-1})	14.05	abc	13.82	bc	12.32	c	15.10	ab	14.98	ab	15.86	a
HCT (%)	39.05	bc	41.67	ab	35.13	c	43.60	ab	43.69	ab	45.18	a
MCH (pg)	27.30	b	27.37	b	29.93	a	30.42	a	30.38	a	30.66	a

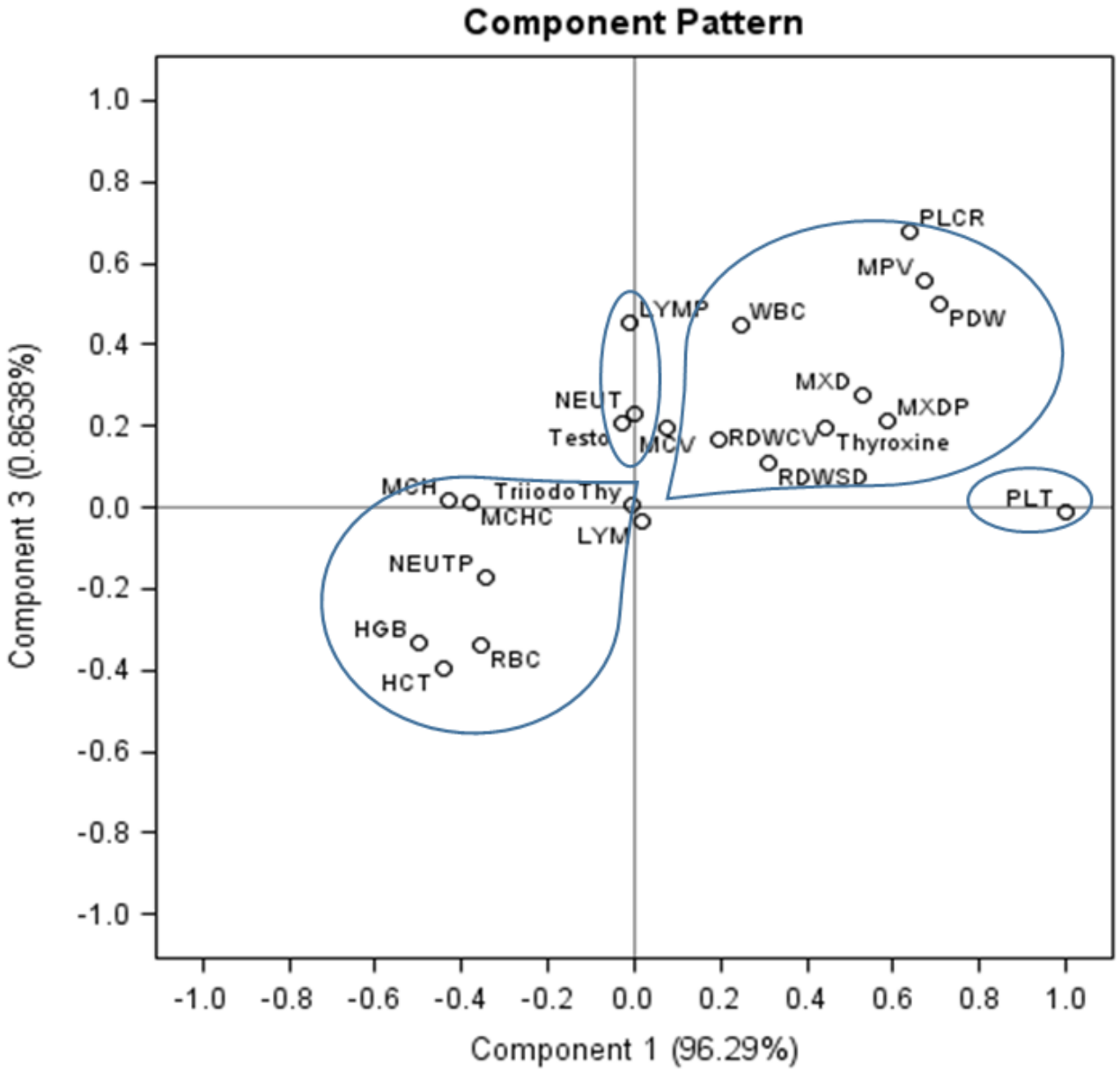
Within each row, numbers followed by the same superscript letter(s) were not significantly different based on Dunnett's *post hoc* specific comparison ($P < 0.05$)

Adverse Effects on Hormones

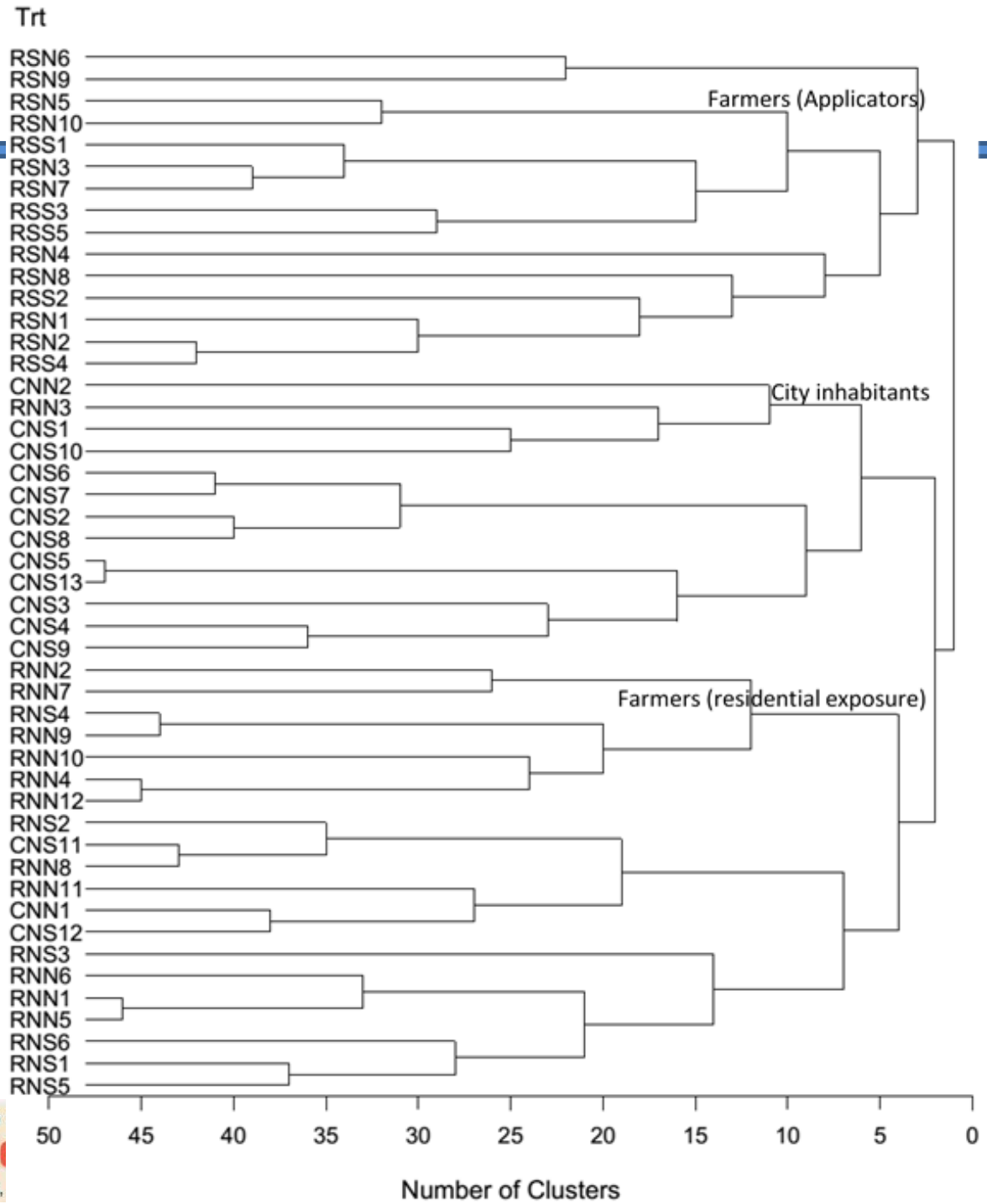
Concentration (ng/ml)	City Inhabitants (-ve Control)				Rural Inhabitants (+ve Control)				Applicators			
	Non-Smoking		Smoking		Non-Smoking		Smoking		Non-Smoking		Smoking	
Testosterone	5.57	a	3.29	ab	2.83	bc	1.54	c	2.46	bc	3.27	ab
Triiodothyronine (T3)	1.52	a	1.09	a	1.49	a	1.14	a	1.34	a	1.41	a
L-Thyroxine (T4)	10.81	a	6.49	b	6.50	b	5.49	bc	3.40	c	5.94	b

Within each row, numbers followed by the same superscript letter(s) were not significantly different based on Dunnett's *post hoc* specific comparison ($P < 0.05$)

Component Pattern Analysis Plot of The PCA



Tree dendrogram of the clustering patterns and their proportion of explained variance



Conclusions

- Lack of the use of personal protective equipment and follow a restrict personal hygiene maximized the pesticide occupational exposure
- Pesticides residues were not detected in the serum samples
- No significant differences between RBC, platelet count and HGB values in blood samples of the sprayer group compared to control groups
- WBC count was significantly decreased in blood samples of pesticide sprayers
- Pesticide exposure has altered the content of the thyroid and reproductive hormones
- Smoking revealed a unique effect on the groups of volunteers and not just pesticide applicators
- Farmers who smoke and were exposed to pesticides were under greater risk than non-smokers

Conclusions

- **Multivariate analysis showed an association between smoking and pesticide occupational exposure**
- **The hierarchical cluster analysis efficiently classified groups of treatments; applicator (smokers or not), farmers (residential exposure; smokers or not), and city residents (control)**
- **The principal component analysis showed that the hematological and hormonal parameters might be good predictor variables in subsequent analyses**
- **Current study highlights the critical need for official regulations and enforced interventions to reduce overexposure of spray workers throughout Egypt**

Personal Protective Equipment

Damanhour University

Faculty of Agriculture