

Comparative studies on the stability of methomyl, carbofuran and abamectin from different companies under environmental factors

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ABSTRACT

The persistence of methomyl, carbofuran and abamectin under different environmental conditions was studied. The compounds were divided into three groups (group 1: methomyl, group 2: carbofuran and group 3: abamectin), each group contain five formulations and technical from various sources (A, B, C, D and E). The present study was planned to study the following: Stability of active ingredient in the tested pesticides under direct sunlight, ultraviolet rays and storage on nude surface for four weeks in winter, two weeks in summer and accelerated storage in oven temperatures (14 days at 54 °C and 3 days at 72 °C). The physical properties for each un-stored and stored pesticides were studied such as melting point, emulsion test, cold test, flash point. pH and alkalinity or acidity. Also, studied the chemical properties of the previous compounds by HPLC. The results obtained could be summarized as follows: Data showed that photodecomposition are positively correlated with exposure period. Also, the decomposition percentage of the tested pesticides, B, D, E from the tested groups 1-3, respectively showed higher rapid degradation than other tested pesticides. While tested pesticides D, C, C showed more stable than other tested pesticides when exposed to UV rays. Also, methomyl group showed more rapid degradation than other tested groups, while carbofuran group exhibited more stable than the other tested groups. The tested pesticides E, D, E from groups 1-3, respectively showed more rapid degradation than the other tested pesticides, while tested pesticides D, C, C showed more stable than the other tested pesticides. When exposed to direct sunlight. Also, the second tested group of pesticides showed more rapid degradation than other tested groups, while the first tested group showed more stable than other tested groups. The previous compounds when exposed to different kinds of storages uncovered surface and accelerated storage at different temperatures. The data showed that the physical and chemical properties for tested pesticides were not affected.

Keywords: Persistence, methomyl, carbofuran, abamectin, formulations, physical and chemical properties

INTRODUCTION

Methomyl was introduced as an insecticide in 1966 and used for the control of large variety of insects on a wide range of crops through out the world. It is particularly active on many lepidopterous insects. It acts by direct contact and following ingestion, through the stomach. Treated crops include the control of flies in animal houses and dairies, EPCS (1986) and ACGIH (1994-1995).

The photolysis of methomyl was studied under different factors: sunlight, ultraviolet, soil at pH5, pH7 and pH 9. The hydrolysis product was MHTA. Methomyl degraded to acetonitrile (40 %), dimethyl sulfoxide (30 %), acetone (15 %) and N-ethylidene methylamine (5 %), Bromilow *et al.* (1986) and Miles and Oshiro (1990).

Carbofuran is an insecticide and nematicide, first brought on to the market in 1965. Archer (1976) and EC/A (1987). Carbofuran is moderately persistent in soil, with half-life from 30-120 days depending on conditions. It is degraded by chemical hydrolysis and biodegradation. It is highly mobile in soil and is soluble in water. Carbofuran has high potential for ground water contamination, and has been detected in aquifers and surface water (Nigg *et al.*, 1984). It has been demonstrated that UV and sunlight exerts chemical changes on carbofuran. Several types of photodecomposition such as hydrolysis, of the ester bond leading to the release of carbofuran phenol and release of the carbonyl moiety that quickly degrades to generate carbon dioxide (NRCOC, 1979 and JukeS and SuEtt, 1992).

Abamectin is a macrocyclic lactones product, which has common name for Avermectin B1a, a naturally occurring nematocide / insecticide, derived from soil microorganism, *Streptomyces avermitilis* (Albers-SchOnberg *et al.*, 1981). The pesticidal activity of abamectin is related to the interaction with the nerve transmitter, gamma amino butyric acid. A break down product (a delta 8, 9-isomer) of abamectin is formed in plants by a reaction with sunlight, and this compound has similar toxicological properties as

abamectin (Bull, 1985). In addition, the potential combined exposure to abamectin from averts and a specific food commodity was evaluated. These commodities include cotton speed, celery, head lettuce, strawberries and pears (Campbell and Benz, 1984; Merck Sharp and Dohme, 1985-1988 and CDFA, 1991).

Photodegradation is prominent and toxicologically significant process in the transformation of abamectin, the delta 8, 9-isomer of avermectin B1a, which one of the photodegradation products, has similar qualitative and quantitative toxicological properties to the parent compound (Ku and Jacob, 1983a). The half-life of avermectin B1a in aqueous solution and on soil surface was 18 hrs (Maynard and Ku, 1982). The degradation was enhanced by sunlight. Avermectin B1a applied to soil surfaces under simulated field conditions (out door tanks) was found to degrade rapidly when exposed to sunlight (Wisloch, 1986). The half-life of avermectin B1a on soil under these conditions was 5-10 hrs. The half-life of avermectin B1a in aqueous suspensions and then soil plates exposed to sunlight were 3.5 - 12 hrs and 21 hrs, respectively (Ku and Jacob, 1983b and Halley *et al.*, 1993). The non-polar photodegradation products consisted of the delta 8, 9-isomer of B1a and an unidentified, moderately, polar isomer of avermectin B1a (WHO 1990, 1991, 1993a and 1993b).

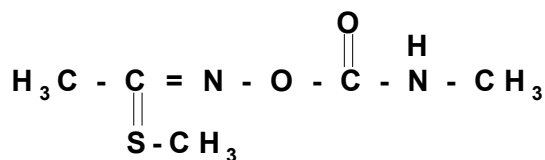
The aim of this paper was carried out to compare the persistence between five pesticide formulations and technical from different companies; methomyl, carbofuran and abamectin under the effect of some environmental factors (ultraviolet rays, direct sunlight, storage on exposed surface in winter for 4 weeks and in summer for 2 weeks and accelerated storage test by heating oven at 54 °C for 14 days and 72 °C for 3 days were studied. Physical properties (emulsion test, acidity or alkalinity, cold test, specific gravity, pH, flash point and melting point), and chemical analysis (active ingredient %) for tested and untested pesticides (technical and formulations) for methomyl, carbofuran and abamectin were determined.

MATERIAL AND METHODS

I. Pesticides used: - Three pesticides were used in the present study. Their properties, common, trade and chemicals names, formulation types used, formulae uses and manufactures are shown as follow:

1- Methomyl: -

Chemical Structure:



Molecular formula: C₅H₁₀N₂O₂S

Relative Molecular Mass: 162.2

Common name: Methomyl

IUPAC Chemical name: - S-methyl-N- [(methyl-carbmoyl) oxy] thioacetimidate.

CAS RN: 16752-77-5

Shape: - White crystalline solid

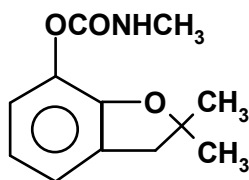
Melting point: 77 ° C

Class :-carbamate.

Formulation (SP) Trade names used: Lannate (A), Agrinate (B), Kuik (C), Nudrin (D), Pilarmate (E) and methomyl technical (97 % purity).

2- Carbofuran: -

Chemical Structure:



Molecular formula: C₁₂H₁₅NO₃

Relative Molecular Mass: 221.3

Common name: Carbofuran

IUPAC Chemical name: - 2,3-dihydro-2,2 dimethyl benzofuran-7ylmethyl carbamate.

CAS RN: 1563-66-2

Shape: - colorless crystals.

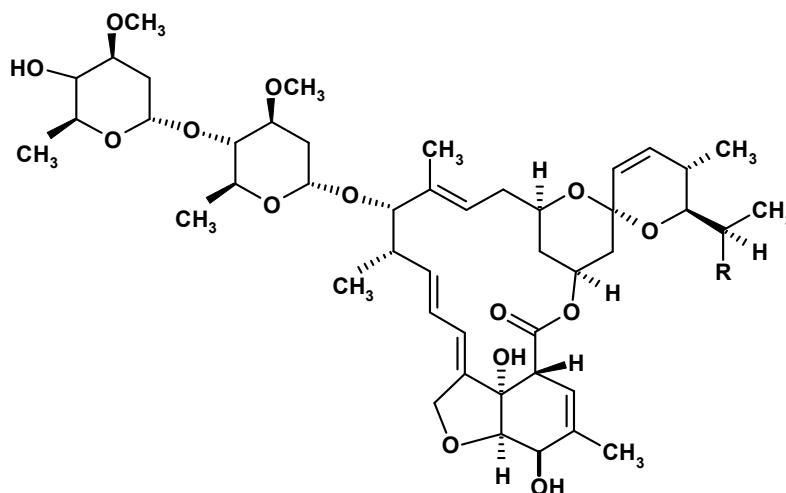
Melting point: 153-154 ° C

Class: - carbamate.

Formulation (GR) Trade names used: Curatan (A), Furadan (B), Furazd (C), carbofuran (D), furan (E) and carbofuran technical (75 % purity)

3- Abamectin: -

Chemical Structure:



i) R=CH₂CH₃ (avermectinB_{1a})

ii) R=CH₃ (avermectinB_{1b})

IUPAC name (10*E*, 14*E*, 16*E*,22*Z*)-(1*R*,4*S*,5'*S*,6*S*,6'*R*,8*R*, 12*S*, 13*S*,20*R*,21*R*,24*S*)-6'-[(*S*)-sec-butyl]21,24-dihydroxy-5',11,13,22-tetramethyl-2-oxo-3,7, 19- trioxatetracyclo[15.6.1.1^{4,8}.0^{20,24}]pentacosa10, 14,16,22-tetraene-6-spiro-2'-(5',6'-dihydro-2'H-pyran)-12-yl 2,6-dideoxy-4-O-(2,6-dideoxy-3-O methyl- α -L -arabino-hexopyranosyl)-3-O-methyl-a-L -arabino-hexopyranoside (i) mixture with (10 *E*, 14*E*, 16*E*,22*Z*)-(1 *R*,4*S*,5'*S*,6*S*,6'*R*,8*R*, 12*S*, 13*S*,20*R*,21 *R*,24*S*)-21,24-dihydroxy-6'-isopropyl 5', 11, 13,22-tetramethyl-2-oxo-3, 7, 19-trioxatetracyclo [15.6.1.1^{4,8}.0^{20,24}]pentacosa-10,14, 16,22-tetraene6-spiro-2'-(5',6'-dihydro-2' H-pyran)-12-yl 2,6-dideoxy-4-O-(2,6-dideoxy-3-O-methyl-a-L -arabino-hexopyranosyl)-3-O-methyl-a-L-arabino-hexopyranoside (ii) (4: 1)

Chemical Abstracts name 5-0-demethylavermectin A1a (i) mixture with 5-0-demethyl-25-de(1methylpropyl)-25-(1-methylethyl)avermectin A1a (ii)

Other names avermectin B1 CAS RN [71751-41-2*J* (abamectin); [65195-55-3*J* (i); [65195-56-4*J* (ii) EC no. 265-610-3 (avermectin B1a); 265-611-9 (avermectin B_{1b})

Shape: - colorless pale yellow crystals.

Melting point: 169 ° C

Class: -insecticide, a acaricide.

Formulation (EC) Trade name used: Vapcomic (A), Vertimec (B), Abamex (C), Abalon (D), Killmite (E) and Abamectin technical (95 % purity).

II. Effect of certain environmental condition on the fate of methomyl, carbofuran and abamectin groups:

1. Effect of UV rays and sunlight: This experiment was carried out according to method described by Hegazy (1979); Soliman (1994); Shokr (1997) and Barakt *et al.*, (1999); One ml acetone containing 540 or 500-ug a.i for each tested pesticides was spread on the surface of Petri dishes (5 cm i.d). The acetone solvent was left to dry at room temperature. Treated Petri dishes were exposed to short wave of ultraviolet lamp (254 nm) at a distance of 12 cm for 0, 15, 30, 60 and 120 mins. The other treated were exposed to direct sunlight for 0, 1, 2, 4 and 6 hours. Dominating temperature was ranged between 32 and 38 °C. Residues of the tested pesticides, which were remained on exposed surface, were quantitatively transferred to standard glass stopper test tubes with dichloromethane and the solvents was evaporated to dryness and then the residues were determined by HPLC.

2. Storage on exposed surface (FAO/WHO 1992): Winter for four weeks and summer for two weeks. Determine the active ingredient in each sample by HPLC.

3. Accelerated storage tested by heating: In an oven at 54 ° C for 14 days and at 72 °C for 3 days.

III. Physical properties (WHO 1985; FAO 1995 and CIPACF 1995):

- a) Emulsion test (for EC)
- b) Acidity or alkalinity
- c) Cold test (EC)
- d) Flash point (EC)
- e) Melting point
- f) Density and specific gravity
- g) pH

IV. Active ingredient determination (AOAC 1992; USEPP 1992 and CIPACF 1995): Determination of active ingredient % in samples and technical for 5 random samples (untested and tested) for each methomyl, carbofuran and abamectin by analysis using HPLC

HPLC Conditions: The chromatographic system consisted of Jusco HPLC, diodearray detector Model 12015, and intelligent quaternary pump Model Pu-2089. A C₁₈ stainless column (4.6 mm id x 25 cm) and the column temperature was 40 °C. Methomyl, carbofuran and abamectin were eluted isocratic with acetonitril- methanol – water (60:35:5 v/v), at the rate of 0.9 ml / min. under these conditions. The retention time (R_t) for both methomyl, carbofuran and abamectin were 2.8, 3.8 and 6.8 minutes, respectively. The results of tested pesticides were quantitatively determined by comparison with the standard under the identical HPLC conditions.

RESULTS AND DISCUSSION

I-Effect of some environmental factors: -

1. Ultra-violet rays: The effect of ultra violet (UV) light on pesticide is a considerable interest to the research workers of pesticides. It has been demonstrated that UV rays exert chemical changes on a large number of pesticides. Several types of photodecomposition such as hydrolysis, oxidation and isomerization may occur.

The data in Table (1) showed that the decomposition percentage of tested sample B was more rapid than other tested samples, while the tested sample D was more stable than the other tested samples.

Table (1): Effect of UV-rays (254 nm) on the dissipation of group I (methomyl).

Time of exposure (hrs)	I A		I B		I C		I D		I E	
	ug	% loss	ug	% loss	ug	% loss	ug	% loss	ug	% loss
0	540.00	0.00	540.00	0.00	540.00	0.00	540.00	0.00	540.0	0.00
0.25	449.68	16.72	436.91	19.09	449.19	16.82	449.92	16.68	449.94	16.68
0.5	443.50	17.87	398.56	26.19	449.15	16.82	448.7	16.91	449.12	16.83
1	435.36	19.37	392.28	27.35	448.44	16.95	448.11	17.02	410.31	24.02
2	425.25	21.25	329.06	39.06	373.49	30.83	423.06	21.66	397.55	26.38

A (Lannate), B (Agrinate), C (Kuik), D (Nudrin) and E (Pilarmate).

The data in Table (2) showed that the decomposition percentage of the tested sample D was more rapid than other tested samples, while the tested sample C was more stable than the other tested samples.

Table (2): Effect of UV-rays (254 nm) on the dissipation of group II (carbofuran).

Time of exposure (hrs)	II A		II B		II C		II D		II E	
	ug	% loss	ug	% loss	ug	% loss	ug	% loss	ug	% loss
0	500.00	0.00	500.00	0.00	500.00	0.00	500.00	0.00	500.0	0.00
0.25	499.87	0.026	499.868	0.026	449.88	0.024	499.86	0.028	499.87	0.025
0.5	499.73	0.052	499.73	0.053	449.76	0.048	499.72	0.056	499.75	0.05
1	499.48	0.105	499.47	0.106	449.52	0.096	499.472	0.112	499.50	0.10
2	498.53	0.294	498.52	0.295	498.66	0.267	498.438	0.312	498.60	0.28

A (Curatan), B (Furadan), C (Furazd), D (Carbofuran) and E (Furan).

The data in Table (3) showed that the decomposition percentage of tested sample E was more rapid than other tested samples, while the tested sample C was more stable than the other tested samples. On the other hand, it could be concluded that the decomposition percentages of the methomyl group samples were more rapid than other tested group samples, while carbofuran group samples were more stable than the other tested groups when exposed to UV rays.

Table (3): Effect of UV-rays (254 nm) on the dissipation of group III (abamectin).

Time of exposure (hrs)	III A		III B		III C		III D		III E	
	Ug	% loss	ug	% loss	ug	% loss	ug	% loss	ug	% loss
0	540.00	0.00	540.00	0.00	540.00	0.00	540.00	0.00	540.0	0.00
0.25	538.11	0.35	539.83	0.032	539.86	0.026	536.95	0.56	535.42	0.85
0.5	499.69	7.46	495.45	8.25	534.93	0.94	499.69	7.47	496.51	8.054
1	424.75	21.34	407.94	24.45	442.13	18.12	398.34	26.23	403.14	25.344
2	359.70	33.39	337.46	37.51	322.19	40.34	323.03	40.18	325.88	39.65

A (Vapcomic), B (Vertimec), C (Abamex), D (Abalon) and E (Killmite).

The results in Tables (1, 2 and 3) clearly showed that the rate of degradation of 15 tested pesticide groups; A, B and C according to the source of formulation as follow.

EC-Emulsifier blend, non polar hydrocarbon solvents such as xylene, C₅-C₁₀ solvents, naphtha, kerosene and surfactant emulsifier.

GR- granules substrate e.g. sand, sticker such as pvp solution, resin or polymer. Adsorbent carrier, adsorptive capacity of the carrier is an important parameter e.g. silica talc 30, walnut shell 30, calcite, oil adsorption and granule carrier. SL- soluble powder: wetting agent 3 – 10 %, anti freeze 5 – 10 %, solvent nonylphenol or amino ethonlate.

The obtained results are in agreement with that reported by Caro *et al.* (1973); Bhattachar *et al.* (1975); Hegazy (1979); Bromilow *et al.* (1986); Halley *et al.* (1993); Soliman (1994); Shokr (1997) and Barakt *et al.* (1999). They stated that all the above parameters differ from company to another as purity-quality, chemical structure and time of exposure.

2. Effect of direct sunlight: Data presented in Tables 4, 5 and 6 showed that the decomposition percentages of 15 tested samples for each parent compounds of methomyl, carbofuran and abamectin groups after being exposed to sunlight increased gradually. It is clearly correlated with the exposure period. It could be concluded that the residues of all the tested samples greatly deteriorated when exposed to direct sunlight especially for long periods.

Table (4): Effect of direct sun light on the methomyl dissipation.

Time of exposure (hrs)	I A		I B		I C		I D		I E	
	Ug	% loss	ug	% loss	ug	% loss	ug	% loss	ug	% loss
0	540.00	0.00	540.00	0.00	540.00	0.00	540.00	0.00	540.00	0.00
1	373.66	30.8	449.79	16.71	352.35	34.75	537.04	0.548	185.3	65.69
2	350.63	35.07	449.53	16.75	206.12	61.83	534.95	0.936	125.88	76.69
4	247.57	54.15	342.57	36.56	140.82	73.92	533.93	1.123	74.52	86.60
6	188.16	65.15	315.16	41.64	93.64	82.66	269.22	50.144	64.65	88.03

A (Lannate), B (Agrinate), C (Kuik), D (Nudrin) and E (Pilarmate).

Table (5): Effect of direct sun light on the carbofuran dissipation.

Time of exposure (hrs)	II A		II B		II C		II D		II E	
	ug	% loss	ug	% loss	ug	% loss	ug	% loss	ug	% loss
0	500.00	0.00	500.00	0.00	500.00	0.00	500.00	0.00	500.00	0.00
1	88.89	82.22	84.3	83.14	132.7	73.46	75.25	84.95	110.80	77.84
2	79.8	84.04	76.95	84.61	125.7	74.86	68	86.40	103.93	79.21
4	75.15	84.97	71.25	85.75	121.15	75.77	63.45	87.31	97.08	80.59
6	58.50	88.30	53.35	89.33	102.35	79.53	44.70	91.06	80.40	83.92

A (Curatan), B (Furadan), C (Furazd), D (Carbofuran) and E (Furan).

Table (6): Effect of direct sun light on the abamectin dissipation.

Time of exposure (hrs)	III A		III B		III C		III D		III E	
	Ug	% loss	ug	% loss	ug	% loss	ug	% loss	ug	% loss
0	540.00	0.00	540.00	0.00	540.00	0.00	540.00	0.00	540.00	0.00
1	483.27	10.5	535.51	0.83	535.98	0.744	451.79	16.33	408.50	24.35
2	334.28	38.1	311.16	42.37	514.15	4.78	334.66	38.02	318.50	41.01
4	277.55	48.6	241.68	55.24	319.89	40.76	217.54	59.71	228.50	57.68
6	192.89	64.27	157.14	70.9	133.49	75.27	135.22	74.96	138.50	74.35

A (Vapcomic), B (Vertimec), C (Abamex), D (Abalon) and E (Killmite).

The data in Table (4) showed that the decomposition percentage of tested sample E was more rapid than other tested samples, while the tested sample D was more stable than the other tested samples. The data in Table (5) showed that the decomposition percentage of tested sample D was more rapid than other tested samples, while the tested sample C was more stable than the other tested samples. The data in Table (6) showed that the decomposition percentage of tested sample E was more rapid than other tested samples, while the tested sample C was more stable than the other tested samples. It can be concluded that the decomposition percentages of the carbofuran group samples were more rapid than other tested group samples, while methonyl group samples were more stable than the other tested groups when exposed to direct sunlight.

Considering the time of exposure to sunlight, it is obvious that 6 hrs, seemed to be the critical interval in determining the degradation percent. Sensitivity to sunlight limits the use of some potential pesticides classical approaches to over come this obstacle have involved chemical modification

of the molecular structure of the pesticide or the use of UV-absorbing materials in pesticide formulations or components of the formulation. However, both methods suffered from serious drawbacks since chemical modification may affect the pesticide activity of the compounds or their biodegradability may introduce ecological problems related to environment pollution (Rozen and Margulies, 1991). The radiation energy of the sunlight might be absorbed by pesticide molecule principally at a given wavelength. The energy might increase the transitional, vibration or electronic energy of the molecule. If enough energy was absorbed to interact with the electrons of the molecules electronically excited molecule would result. Energy might be disappeared or changed from the molecule in a number of ways, one of which is chemical reaction (Plimmer, 1970). From the above results, it can be observed that sunlight is more effective than UV –rays in accelerating the photodecomposition of methomyl, carbofuran and abamectin. This may be due to thermal, evaporation and light intensity consideration as stated by several investigators (Caro *et al.*, 1973; Harvey and Pease, 1973; Hegazy, 1979; Freeman and Dipmen, 1984; Nigg *et al.*, 1984; Bull, 1985; Moye *et al.*, 1987; Soliman, 1994; Shokr, 1997 and Barakt *et al.*, 1999).

The results in Table (7) clearly showed that:

- Acidity or Alkalinity around neutral, 0.049 g/kg and 0.147 g/kg.
- pH around 6.66 – 6.99- 7
- M.P around 86 – 92
- % a.i around 89.11 – 89.95

All the above results accepted.

The results in Table (8) clearly showed that:

- acidity or Alkalinity around neutral
- pH around 6.88 – 7.31
- % a.i around 9.88 – 9.99

All the above results accepted.

The results in Table (9) clearly showed that:

- acidity or Alkalinity around 0.34 g/kg – 3 g/kg
- pH around 4.33 – 5.94
- % a.i around 1.76 – 1.79

All the above results accepted.

3. Effect of storage on the active ingredient and physical properties of group samples:

Table (7): Effect of storage on the active ingredient percentages and physical properties of methomyl.

Pesticide	Type of storage	% a.i	Acidity or alkalinity	pH	M.P
Technical		96.95	Neutral	7	86
IIIA	Un storage	89.97	Neutral	6.9	88
	Storage: Winter	89.96	Neutral	6.9	88
	Summer	89.9	Neutral	6.9	88
	14 days 54 °C	89.92	Neutral	6.8	88
	3 days 72 °C	89.93	Neutral		
I B	Un storage	89.95	0.049 g/kg	6.84	88
	Storage: Winter	89.19	0.049 g/kg	6.8	88
	Summer	89.87	0.049 g/kg	6.8	88
	14 days 54 °C	89.85	0.147 g/kg	6.64	88
	3 DAYS 72 °C	89.94			
I C	Un storage	89.94	Neutral	6.98	88
	Storage: Winter	89.90	Neutral	6.99	88
	Summer	89.92	Neutral	6.99	88
	14 days 54 °C	89.91	0.049 g/kg	6.85	88
	3 days 72 °C	89.94			
I D	Un storage	89.98	0.049 g/kg	6.69	92
	Storage: Winter	89.89	0.049 g/kg	6.7	92
	Summer	89.89	0.049 g/kg	6.7	92
	14 days 54 °C	89.88	0.0147 g/kg	6.39	92
	3 days 72 °C	89.89			
I E	Un storage	89.98	0.049 g/kg	6.72	87
	Storage: Winter	89.89	0.049 g/kg	6.7	87
	Summer	89.92	0.049 g/kg	6.7	87
	14 days 54 °C	89.92	0.049 g/kg	6.66	87
	3 days 72 °C	89.98			

A (Lannate), B (Agrinate), C (Kuik), D (Nudrin) and E (Pilarmate).

Table (8): Effect of storage on the active ingredient percentages and physical properties of carbofuran.

Pesticide	Type of storage	%a.i	Acidity or alkalinity	pH
Technical		74.99	Neutral	7.0
IIA	Un storage	9.99	Neutral	7.1
	Storage: Winter	9.96	Neutral	7.11
	Summer	9.98	Neutral	7.1
	14 days 54 °C	9.88	Neutral	7.16
	3 days 72 °C	9.97	Neutral	7.13
IIB	Un storage	9.99	Neutral	7.3
	Storage: Winter	9.95	Neutral	7.3
	Summer	9.95	Neutral	7.31
	14 days 54 °C	9.90	Neutral	7.29
	3 DAYS 72 °C	9.89	Neutral	7.27
IIC	Un storage	9.99	Neutral	7.26
	Storage: Winter	9.93	Neutral	7.26
	Summer	9.93	Neutral	7.28
	14 days 54 °C	9.89	Neutral	7.27
	3 days 72 °C	9.78	Neutral	7.25
IID	Un storage	9.99	Neutral	7.29
	Storage: Winter	9.95	Neutral	7.33
	Summer	9.95	Neutral	7.31
	14 days 54 °C	9.89	Neutral	7.29
	3 days 72 °C	9.88	Neutral	7.2
IIE	Un storage	9.99	Neutral	7.05
	Storage: Winter	9.79	Neutral	7.09
	Summer	9.79	Neutral	6.99
	14 days 54 °C	9.77	Neutral	6.89
	3 days 72 °C	9.70	Neutral	6.88

A (Curatan), B (Furadan), C (Furazd), D (Carbofuran) and E (Furan).

Table (9): Effect of storage on the active ingredient percentages and physical properties of abamectin.

Pesticide	Type of storage	%a.i	Acidity or alkalinity	Cold test _a	pH	Flash point	Emulsion	Density g/cm ³
Technical		94.78	Neutral	-	7.0	-	-	-
IIIA	Un storage	1.78	0.34	Accepted	5.94	Accepted	Accepted	1.19
	Storage:	1.78	0.34	Accepted	5.9	Accepted	Accepted	1.12
	Winter	1.78	0.34	Accepted	5.9	Accepted	Accepted	1.12
	Summer	1.78	1.91	Accepted	4.95	Accepted	Accepted	0.896
	14 days	1.78	2.02	Accepted	4.57	Accepted	Accepted	0.899
	54 °C							
	3 days							
	72 °C							
IIIB	Un storage	1.76	2.04	Accepted	4.83	Accepted	Accepted	1
	Storage:	1.76	2.04	Accepted	4.8	Accepted	Accepted	1
	Winter	1.76	2.04	Accepted	4.87	Accepted	Accepted	1
	Summer	1.76	3.0	Accepted	4.4	Accepted	Accepted	0.987
	14 days	1.76	2.9	Accepted	4.33	Accepted	Accepted	1.0
	54 °C							
	3 days							
	72 °C							
IIIC	Un storage	1.77	1.42	Accepted	5.04	Accepted	Accepted	1.18
	Storage:	1.77	1.42	Accepted	5.1	Accepted	Accepted	1.18
	Winter	1.77	1.42	Accepted	5.15	Accepted	Accepted	1.15
	Summer	1.77	2.2	Accepted	4.55	Accepted	Accepted	0.894
	14 days	1.77	2.2	Accepted	4.5	Accepted	Accepted	0.889
	54 °C							
	3 days							
	72 °C							
IIID	Un storage	1.77	2	Accepted	4.95	Accepted	Accepted	0.97
	Storage:	1.77	2.04	Accepted	7.87	Accepted	Accepted	0.97
	Winter	1.79	2.04	Accepted	4.85	Accepted	Accepted	0.97
	Summer	1.77	3.18	Accepted	4.35	Accepted	Accepted	0.875
	14 days	1.77	3.18	Accepted	4.31	Accepted	Accepted	0.875
	54 °C							
	3 days							
	72 °C							
IIIE	Un storage	1.76	2.1	Accepted	4.77	Accepted	Accepted	0.999
	Storage:	1.76	2.1	Accepted	4.75	Accepted	Accepted	0.987
	Winter	1.76	2.1	Accepted	4.78	Accepted	Accepted	0.989
	Summer	1.76	2.34	Accepted	4.4	Accepted	Accepted	1.0
	14 days	1.76	2.34	Accepted	4.28	Accepted	Accepted	0.955
	54 °C							
	3 days							
	72 °C							

A (Vapcomic), B (Vertimec), C (Abamex), D (Abalon) and E (Killmite).

Notes: In Table (9) during storage in oven at 72°C, the tested samples (abamectin group III) decomposed after 10 min., but the result of percent of a.i of the tested samples was not affected.

Data present in Tables (7, 8, 9) showed that the results of storage on exposed surface in winter for 4 weeks, summer for 2 weeks, accelerated storage test at 54 °C for 14 days or 72 °C for 3 days and physical properties (emulsion test, acidity or alkalinity, cold test, specific gravity, pH, flash point and melting point for 15 samples of methomyl, carbofuran and abamectin. The final results showed that the active ingredient present at the end of storage on the exposed surface (winter and summer), accelerated storage test (14, 3 days) not affected and the same percent of main pesticides.

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