

## **CORRELATION BETWEEN HIGH DENSITY/POLYETHYLENE PACKAGES AND PHYSICO-CHEMICAL PROPERTIES OF SOME PESTICIDES IN LIQUID FORMULATION UNDER TROPICAL STORAGE CONDITIONS**

**El-Kady, A.M.A.**

**Central Agricultural Pesticides Laboratory, Agric. Res. Center, Dokki-Giza, Egypt**

### **ABSTRACT**

Three pesticides in liquid formulation were collected in their commercial packages (high density/polyethylene) (HD/PE) and stored under tropical conditions at ( $54\pm 1^{\circ}\text{C}$ ) for three days. The effect of these packages on physico-chemical properties of tested pesticides and their spray solution compared with that stored in glass container was studied. The tested pesticides were : benthocarb EC (Saturn), glyphosate SL (Glialka), and glyphosate SL (Pilarsato). The obtained results clearly shows that, the physico-chemical properties of tested pesticides and their spray solutions influenced with (HD/PE) packages through storage under tropical conditions ( $54\pm 1^{\circ}\text{C}$ ) for three days compared with glass container. This influencing was recorded as changes in one or more of physico-chemical properties of these pesticides or their spray solutions upwards of that stored in glass container. On the other hand, these changes were between improvement effect and bad effect. The bad effect in case of tested pesticides formulation was noticed only in case of physico-chemical properties that were unstable before storage (foam of glyphosate SL "Pilarsato" 48 % and emulsion stability of benthocarb EC 50 %). The above indication was not noticed in case of spray solution of these pesticides. Although the stored of benthocarb (Saturn) and glyphosate (Pilarsato) in (HD/PE) packages showed several improvement effect on physico-chemical properties of this pesticides and their spray solutions upwards of glass container, it did not pass successfully through physico-chemical properties tests.

With other view, the effect of (HD/PE) packages depending on component of tested formulations as recorded with glyphosate SL 48 % that produced by two companies in two different formulations. The common name of the first one was Glialka SL 48 % produced with Cardl-Agro Co. and the second was Pilarsato SL 48 % produced with Acta Co. There are no bad effect was noticed from tested packages on the first one, and their spray solutions, while bad effects were noticed with the second one as increase in foam %.

### **INTRODUCTION**

In the last few years, much progress has been made in the design and development of new formulation and packaging systems towards meeting requirement for safe and convenient use and reduction of packaging wastes (Frei and Schmid, 1996). Biological activity of pesticides after storage and transport of their formulations are affected by many factors such as package type and their lining layer and storage climate conditions (Seiz, 1953). A useful metaphor for packaging as (bridge) between the formulated active ingredient and its ultimate application to the target. This metaphor requires that we view both the formulation-packaging and packaging-application relationships (Gleich, 1996).

According to WHO (1979) specifications for the pesticides in EC formulations; emulsion stability after 30 minutes under soft and hard water separation should not exceed than two ml, free acidity or alkalinity being should not exceed than 0.3 % for organic phosphate. On the other hand, the specification of SL formulation according to WHO (1979) and Egyptian Ministry of Agriculture (1968) indicated that, the successful soluble formulation should be complete soluble when diluted in water at field dilution rate without showing any precipitation or separation. It should pass through foam test, its acidity or alkalinity should not exceed than 0.3, in both cold and hot stability.

The objective of this study is to evaluate the role of interaction between tested pesticides and commercial packages under tropical storage conditions ( $54\pm 1^{\circ}\text{C}$ ) on physico-chemical properties of these pesticides and their spray solution.

## **MATERIALS AND METHODS**

Three liquid pesticides namely; benthocarb EC, glyphosate SL (Glialka), and glyphosate SL (Pilarsato) were collected from Egyptian pesticides market in high density/polyethylene packages (HD/PE) (commercial packages). The collected pesticides were stored in their commercial packages and glass container under tropical storage conditions ( $54\pm 1^{\circ}\text{C}$ ) for 72 hours. The physico-chemical properties of these pesticides and their spray solution were evaluated.

Informations about tested pesticides were illustrated in Table (1). Heat stability test at ( $54\pm 1^{\circ}\text{C}$ ) for three days was carried out according to method described with WHO (1979) on tested pesticides in glass container and commercial packages. Physico-chemical properties such as % spontaneity, % foam, emulsion stability, miscibility and free acidity or alkalinity for tested pesticides formulation were determined before or after storage in (HD/PE) packages or glass container according to method of WHO (1979). The following properties were determined for spray solution of pesticides : pH value using Schott Great pH-meter and surface-tension using Du Nouy tensio-meter where dyne/cm is the unit of surface-tension measurement. Conductivity and salinity was measured using conduct-meter YS1 model 35S-C-T (mMHOs) is the unit of electrical conductivity measurement.

## **RESULTS AND DISCUSSION**

Data presented in Table (2) indicated that, storage of tested pesticides in (HD/PE) packages under tropical conditions ( $54\pm 1^{\circ}\text{C}$ ) for three days caused changes in one or more of physico-chemical properties of these pesticides compared with glass container. These changes were between improvement effect and bad effect. On the other hand, the bad effect was noticed only in case of physico-chemical properties that was unstable before storage as shown with foam percentage of glyphosate SL 48 % (Glialka) that was found as traces in hard and soft water before storage and changed to 3 % and 1 % with glass container and then to 5 % and 10 % with (HD/PE) package. Also, the same indication was noticed in case of

cream layer of benthocarb EC that was 2 ml in hard and soft water before storage and changed to 0.0 and 5 ml with glass container and then to 1 and 4 ml with (HD/PE) package. With other view, the improvement effect was recorded as decreasing in free acidity of all tested pesticides that stored in (HD/PE) packages upwards that stored in glass container, whereas it recorded as increasing in % spontaneity of benthocarb with (HD/PE) package upwards of glass container in soft water and upwards of before storage in hard water.

The effect of (HD/PE) depend on the component of formulation as found with glyphosate SL 48 % that produced by two companies in two different formulations. The common name of the first one was Glialka SC 48 % and the second was Pilarsato SL 48 %. There are no bad effect was noticed from tested package on the first formulation, while the bad effect was recorded on the second formulation as increasing in foam percentage in hard and soft water.

Data presented in Table (3) indicated that, the effect of (HD/PE) packages on tested pesticides spray solution as resulting to storage under tropical conditions ( $54\pm 1^{\circ}\text{C}$ ) for three days compared with storage in glass container under the same conditions. The obtained results clearly show that, except spray solution of benthocarb EC in soft water, there are slight decrease was recorded in pH values of all spray solutions in soft and hard water of tested pesticides that stored in (HD/PE) packages upwards that stored in glass container. Also, surface tension of spray solution of benthocarb EC and glyphosate SL (Pilarsato) that stored in the same packages decreased upwards of that stored in glass container. On the other hand, no effect was noticed between storage in (HD/PE) packages and glass container on conductivity of benthocarb EC spray solution in hard and soft water, whereas the conductivity of glyphosate SL 48 % (Pilarsato) spray solution in hard water increased from 2500 in case of glass container to 2700 with (HD/PE) packages, whereas it increased from 2000 with glass container to 2100 in (HD/PE) with glyphosate SL 48 % (Glialka).

According to foregoing results, it could be concluded that the physico-chemical properties of tested pesticides and their spray solutions influenced with (HD/PE) packages through storage under tropical conditions ( $54\pm 1^{\circ}\text{C}$ ) for three days compared with glass container. This influencing was recorded as changes in one or more of physico-chemical properties of these pesticides, or their spray solution upwards of that stored in glass container. On the other hand, these changes were between improvement effect and bad effect. The bad effect in case of tested pesticides formulation was noticed only in case of physico-chemical properties that were unstable before storage (foam of glyphosate SL 48 % "Pilarsato" and emulsion stability of benthocarb EC. The above indication was not noticed in case of spray solution of these pesticides. Depending on WHO (1979) and Egyptian Ministry of Agriculture (1968), although the storage of the above two pesticides in (HD/PE) packages showed several improvement effects on physico-chemical properties of this pesticides and their spray solution upwards of glass container, it did not pass successfully through physico-chemical properties tests.

***El-Kady, A.M.A.***

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With other view, the effect of (HD/PE) packages depended on component of tested formulation as recorded with glyphosate SL 48 % that produced by two companies in two different formulation. The common name of the first one was Glialka SL 48 % produced with Cardl-Agro Co. and the second was Pilarsato SL 48 % produced with Acta Co. There are no bad effect was noticed from tested packages on the first one and their spray solution, while the bad effect was noticed with the second one as increase in foam %.

So, the effects of (HD/PE) packages on tested pesticides formulation and their spray solution under tropical storage condition may be due to the role of raw material of these packages on component of each formulation such as wetting agent, emulsifying agent and antifoam agent. On the other hand, the changes that noticed in conductivity and pH values of tested pesticides spray solution may be due to the effect of this packages raw material on ion exchange between water and its soluble materials.

From above results, it could be concluded that, (HD/PE) packages cause changes in physico-chemical properties of tested pesticides and their spray solutions. These changes were between improvement effect and bad effect depending on component of each formulation. So the relationship between this packages and physico-chemical properties of pesticides formulation should be studied under tropical storage conditions before packaging to determine if this packages was useful for packaging or not.

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العلاقة ما بين عبوات البولي إيثيلين على الكثافة والصفات الطبيعية والكيميائية لبعض مستحضرات المبيدات السائلة تحت ظروف التخزين الحار  
أشرف محمود عبد الباسط القاضي  
المعمل المركزي للمبيدات، مركز البحوث الزراعية، الدقى - الجيزة، مصر

فى هذه الدراسة، تم جمع ثلاث مبيدات فى شكل مستحضرات سائلة معبأة فى عبواتها التجارية "HD/PE" (high density/polyethylene) من سوق المبيدات المصرية .. لدراسة تأثير هذه العبوات على الصفات الطبيعية والكيميائية لهذه المستحضرات ومحاليل رشها تحت ظروف التخزين الحار ( $1\pm 54^\circ\text{C}$ ) لمدة ثلاث أيام بالمقارنة بالتخزين فى الحاويات الزجاجية تحت نفس الظروف.

وقد كانت المبيدات المختبرة هى : بنثيوكارب مركز قابل للإستحلاب EC ، جليفوسات مركز قابل للذوبان SL تحت إسم تجارى "جليكا" وكذلك جليفوسات مركز قابل للذوبان SL تحت إسم تجارى "بيلاساتو".

أوضحت النتائج المتحصل عليها، أن الصفات الطبيعية والكيميائية للمبيدات تحت الإختبار ومحاليل رشها قد تأثرت بعبوة الـ (HD/PE) أثناء التخزين تحت الظروف الحارة ( $1\pm 54^\circ\text{C}$ ) لمدة ثلاث أيام وذلك بالمقارنة بنفس المبيدات عند تخزينها فى حاويات زجاجية تحت نفس الظروف. وقد سجلت هذه التغيرات فى واحدة أو أكثر من الصفات الطبيعية والكيميائية لهذه المبيدات وكذلك محاليل رشها. وقد تراوحت هذه التغيرات ما بين تغيرات محسنة للصفات الطبيعية والكيميائية أو تغيرات متلفة لها. وقد لوحظ أن التغيرات المسنولة عن إتلاف الصفات الطبيعية والكيميائية قد سجلت فى حالة ظهور عدم ثبات فى هذه الصفات قبل التخزين (الرغاوى مع مبيد الجليفوسات SL "بيلاساتو" وثبات الإستحلاب مع مبيد بنثيوكارب). بينما لم يلاحظ هذا المؤشر مع محاليل الرش لنفس المبيدات. وبالإعتماد على توصيات منظمة الصحة العالمية (1979) WHO وكذلك توصيات وزارة الزراعة المصرية (1990) فبالرغم من أن التخزين فى عبوة (HD/PE) قد قلل من التأثير السئ للتخزين على بعض الصفات الطبيعية والكيميائية لمستحضرات ومحاليل رشها إلا أن كل من مستحضر الجليفوسات SL (بيلاساتو)، البنثيوكارب EC لم تنجح عند تقييم بقاء الصفات الطبيعية والكيميائية لها أو لمحاليل رشها.

ومن ناحية أخرى، فقد توقف تأثير عبوة الـ HD/PE على نوع المكونات داخل كل تجهيزة، كما لوحظ فى حالة مبيد الجليفوسات SL والذى أنتج بواسطة شركتين مختلفتين، وكان الإسم التجارى للتجهيزة الأولى هو "جليكا" والثانية "بيلاساتو". وقد لوحظ أنه ليس هناك تأثير سئ على الصفات الطبيعية والكيميائية للتجهيزة الأولى نتيجة للتخزين فى عبوة الـ HD/PE ، بينما ظهر تأثير سئ على التجهيزة الثانية فى صورة زيادة فى نسبة الرغاوى نتيجة للتخزين فى نفس العبوة. مما سبق يتضح أن عبوة الـ HD/PE تسبب تغيرات فى واحدة أو أكثر من الصفات الطبيعية والكيميائية للمبيدات المخزنة بها تحت ظروف التخزين الحار على ( $1\pm 54^\circ\text{C}$ ) لمدة ثلاث أيام، وأن هذا التغير يكون ما بين تأثير محسن لهذه الصفات أو تأثير متلف لها، ويتوقف هذا من ناحية أخرى على المكونات المستخدمة فى تجهيز كل مركب. لذلك يجب دراسة تأثير هذه العبوة على الصفات الطبيعية والكيميائية للمبيدات التى سوف تعبأ بها تحت ظروف التخزين الحار لتحديد ما إذا كانت هذه العبوة مناسبة أم لا.



**Table (1). Tested pesticides corresponded with their packages.**

Trade name	Common name	Chemical name	Type of formulation	Package	Source of package
Saturn	Benthiocarb	S-4-chlorobenzyl diethyl thiocarbamate.	EC 50 %	HD/PE	KZ Company
Glialka	Glyphosate	N-(phosphoromethyl) glycine isopropyl ammonium	SC 48 %	HD/PE	Samtrade
Pilarsato	Glyphosate	N-(phosphoromethyl) glycine isopropyl ammonium	SL 48 %	HD/PE	Acta

**Table (2). Effect of (HD/PE) packages on physico-chemical properties of tested pesticides under tropical storage conditions.**

Common name (Trade name)	Type of formulation	Conditions of storage	Physico-chemical properties								
			% Spontaniety		% Foam		Emulsion stability		% Miscibility		Free acidity as % H <sub>2</sub> SO <sub>4</sub>
			Hard water	Soft water	Hard water	Soft water	Hard water	Soft water	Hard water	Soft water	
Benthiocarb (Saturn)	EC 50 %	Before storage	45 %	50 %	0.0	0.0	2 C.L	2 C.L	-	-	0.49
		Stored according WHO	60 %	50 %	0.0	0.0	0.0	5 C.L	-	-	0.39
		In commercial package	55 %	60 %	0.0	0.0	1 C.L	4 C.L	-	-	0.20
Glyphosate (Glialka)	SC 48 %	Before storage	-	-	0.0	0.0	-	-	M	M	2.80
		Stored according WHO	-	-	0.0	0.0	-	-	M	M	2.90
		In commercial package	-	-	0.0	0.0	-	-	M	M	2.40
Glyphosate (Pilarsato)	SL 48 %	Before storage	-	-	Tr	Tr	-	-	M	M	3.30
		Stored according WHO	-	-	3.0	1.0	-	-	M	M	2.50
		In commercial	-	-	5.0	10.0	-	-	M	M	1.70

		package								
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Tr : traces      C.L. : cream layer      M : miscible

**Table (3). Effect of (HD/PE) packages on physico-chemical properties of tested pesticides spray solutions under tropical storage conditions.**

Common name (Trade name)	Type of formulation	Conditions of storage	Physico-chemical properties							
			Conductivity		pH		Surface tension		Salinity	
			Hard water	Soft water	Hard water	Soft water	Hard water	Soft water	Hard water	Soft water
<b>Benthiocarb (Saturn)</b>	<b>EC 50 %</b>	<b>Before storage</b>	1000	330	7.61	7.92	29.5	30.3	1	0.5
		<b>Stored according WHO</b>	900	180	7.69	7.98	28.1	28.1	1	0.2
		<b>In commercial package</b>	900	180	7.64	8.20	27.4	27.4	1	0.2
<b>Glyphosate (Gialka)</b>	<b>SC 48 %</b>	<b>Before storage</b>	2800	2200	5.23	5.30	37.2	36.0	2	1.5
		<b>Stored according WHO</b>	2600	2000	5.26	5.33	37.2	36.0	2	1.5
		<b>In commercial package</b>	2600	2100	5.23	5.32	37.2	36.0	2	1.5
<b>Glyphosate (Pilarsato)</b>	<b>SL 48 %</b>	<b>Before storage</b>	2800	2300	5.45	5.49	34.8	33.9	2	2.0
		<b>Stored according WHO</b>	2500	2000	5.46	5.52	34.9	34.9	2	1.5
		<b>In commercial package</b>	2700	2000	5.44	5.51	28.8	28.1	2	1.5