Egypt. J. Agric. Res. , 72 (3), 1994.

REWORKING WATER HARDNESS FOR SUITABILITY TO PESTICIDE DILUTION.

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(Manuscript received 8 August 1992)

Abstract

The results of this study indicated that drainage, lake and sea water possessed the highest degree of total hardness. The hardness of water reached 3200, 2400, 1400 and 520 ppm calcium carbonate for Red sea, Mediterranean sea, Qaroon lake and drainage water, respectively, compared with 160 ppm for Nile water. The addition of sodium carbonate, Zeolite and chelated ferrous to hard water reduced hardness to the level of Nile water. After such additions, pesticides passed successfully emulsion or suspension stability tests.

INTRODUCTION

Dilution of pesticides with hard water in desert, sea, drainage and lake regions for controlling agricultural and medical pests is considered a limiting factor due to the high alkalinity of such waters (Moustafa *et al.*, 1990) Alkaline water increases the hydrolysis of organophosphorus and carbamate pesticides (O'Brien, 1967; Eto, 1974). However, this problem was solved by Chiba (1979) who used potassium dihydrogen phosphate for reworking the alkalinity of hard water. The second problem is the existence of high concentrations of Ca and Mg ions that cause water hardness, as those ions react with emulsifying and suspending agents leading to an unstable emulsion or suspension of diluted pesticides (Clayton, 1943). This results in an unsuccessful control of pests because of the formulation separation(Behrens, 1958; El-Attal *et al.*, 1978). Therefore, the aim of the present study is to rework water hardness in order to become more suitable for pesticides dilution.

MATERIALS AND METHODS

a - Determination of total hardness of water using soap solution and standard calcium chloride.

b - Pesticides used were : Nurelle EC (cypermethrin) at the rate of 300 ml/ feddan, Empire FL (chlorpyrifos + diflubenzuron) at the rate of 1 litre/feddan, and Larvin DF (thiodicarb) at the rate of 0.5kg/feddan.

c. Materials used for reducing the total hardness of water were :

- Sodium carbonate which react with Ca and Mg ions and forms insoluble calcium carbonate and magnesium carbonate.
- Zeolite (ion-exchanger) which exchange Ca and Mg ions present in water instead of sodium ion.

Total hardness of water before and after the addition of reworking material were determined and calculated as calcium carbonate according to the method described by Vogel (1959).

Emulsion stability and suspensibility tests wer determined for pesticides according to WHO (1979) specifications for aircraft dilution rate.

RESULTS AND DISCUSSION

Total hardness of water include temporary hardness (resulting from calcium and magnesium bicarbonate) and permanent hardness (resulting from calcium and magnesium chloride). Total hardness of water was determined as ppm calcium carbonate (Vogel, 1959).

As shown in Table1, there are great differences between total hardness of water taken from different sources; Nile and canals water showed low degree of hardness, drainage water was slightly higher than the Nile water, while lake and sea water showed the highest degree of total hardness. It is clear therefore that high hardness water is not suitable for diluting pesticides especially those containing ionic emulsifiers or suspending agents (Behrens, 1958; El - Attal *et al.*, 1978)

Many trials were made for reworking and reducing the high hardness of water using different materials. Certain weights of sodium carbonate, zeolite or chelated

Table 1. Total hardness of water taken from different sources.

Water source	Governorate	Total hardness (ppm as $CaCo_3$)
- Nile	Cairo	160
- Canals :		
El-Zomor	Giza	160
El-Fashn	Beni-Suef	160
Toukh	Kalubia	200
- Drainages:		
Mehalet Abo Ali	Gharbia	520
Kassab	Sharkia	400
-Qaroon lake	Fayoum	1400
- Red Sea	Suez	3200
- Mediterranean Sea	Alexandria	2400

ferrous were added to 100ml of water of high hardness (3420 ppm). The total hardness of water was determined after the addition of such materials. The resulting reduction in total hardness was correlated to the weight of the materials added. Accordingly it was possible to calculate the amount of material that should be added to reduce the high hardness of water to reach that of the Nile water. For example, it was found that addition of 1 ml . Na_2 Co_3 (25%) to 100 ml hard water had reduced the total hardness from 3420 to 266 ppm. This means that the addition of 0.25 gm Na_2 Co_3 to 100 ml hard water had reduced the total hardness by 3154 ppm . The same test was carried out for the other materials and the weight of each material required to reduce the total hardness was calculated as shown in Table2.

The effect of high hardness on pesticide emulsion or suspension stability is shown in Table 3. It is clear that high water hardness had affected pesticide emul-

Table 2. Weight of materials that should be added to 100 ml water in order to reduce the total hardness of water to 160 ppm.

Source	Total hardness (ppm)	Difference between the source & Nile water hardness	Weight of reagents (g)		
			Na_2Co_3	Zeolite	Chelated ferrous iron
- Drainage Mehalet Abo - Ali	520	360	0.028	0.563	0.011
- Qaroon Lake	1400	1240	0.098	1.938	0.038
- Mediterranean Sea	2400	2240	0.177	3.500	0.070
- Red Sea	3200	3040	0.240	4.750	0.095

sion and suspension stability.When such waters were treated with the different materials , their emulsion or suspension stability with pesticides was greatly improved. It is therfore recommended to add such materials to hard water prevailing in remote areas , and needed for pesticides dilution.

Table 3. Effect of hard and treated hard water on emulsion or suspension stability of pesticides compared with Nile water.

Pesticides	Nile Water	Emulsion (ml cream separation or % suspensibility in															
		M. Abo-Ali drain-age(520 ppm)				Qaroon lake (1400 ppm)				Medit. Sea (2400 ppm)				Red Sea (3200 ppm)			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Larvin Dr (5)	85	77.5	70	70	76	37	70	65		37	78	70	70	40	85	70	72
Empire FL (6)	90	50.0	95	90	85	35	90	95		50	95	90	80	48	90	95	70
Nurelle EC (7)	1	1	-	-	-	1	-	-		1	-	-	-	1	-	-	-

* 1) Untreated water
2) Water treated with sodium carbonate
3) water treated with Zeolite
4) Water treated with chelated ferrous iron
5) and 6) Determined as % suspensibility
7) Determined as emulsion stability } ml cream separation

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علاج المياه شديدة العسر لإستخدامها في تخفيف مبيدات الآفات

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المعمل المركزي للمبيدات - مركز البحوث الزراعية - الدقي

أثبتت الدراسة أن درجة عسر المياه تتزايد من المصارف التي بحيرة قارون الي مياة البحر المتوسط فالبحر الأحمر حيث بلغت ٥٢٠، ١٤٠٠ ، ٢٤٠٠ ، ٣٢٠٠ جزءا في المليون علي صورة كربونات كالسيوم علي التوالي مقارنة بمائة وستين جزءا في المليون لمياه النيل.

هذا الارتفاع في درجة العسر والمتسبب عن أيونات الكالسيوم والمغنسيوم أدي الي عدم اجتياز بعض مستحضرات المبيدات وخاصة تلك المحتوية علي مواد مستحلبة ومعلقة أيونية اختبار ثبات الاستحلاب أو التعلق نتيجة لتفاعل أيونات الكالسيوم والمغنسيوم مع المواد المستحلبة والمعلقة الايونية. ولهذا السبب أجريت دراسة تأثير ثلاثة مواد تعمل بطرق مختلفة لتقليل درجة العسر. والمواد هي:

١ - كربونات الصوديوم التي تتفاعل مع أيونات الكالسيوم والمغنسيوم مكونة كربونات كالسيوم ومغنسيوم غير ذائبة في الماء.

٢ - المبادل الراتنجي (زيوليت) حيث يحدث تبادل أيوني بين أيونات الصوديوم الموجودة علي سطح المبادل وأيونات الكالسيوم والمغنسيوم الموجودة في الماء.

٣ - الحديد المخلبي (حديدوز) الذي يرتبط مع أيونات الكالسيوم والمغنسيوم وبالتالي يلغي دورها في التفاعل مع المواد المستحلبة والمعلقة.

وقد تم حساب الكمية اللازم إضافتها من المواد المختلفة للماء حسب درجة عسره ليصبح مماثلا لعسر ماء النيل. وكان من نتيجة ذلك أن اجتازت مبيدات الارفين ، امباير، نيوزيل إختبار ثبات التعلق أو الإستحلاب في كل أنواع المياه المختبرة (مياه المصارف ، بحيرة قارون والبحر المتوسط والبحر الأحمر).