Chapter 3: Results and Discussion

I-1- The physico-chemical properties of the commercial formulation insecticides, Chlorpyrifos, as 48% EC

According to WHO (1979) and FAO/WHO (2002) recommendations[28], the successful EC should passed successfully through several tests such as emulsion stability test, where no oil separation should be occurred and cream separation or precipitation should be more than 2 ml in soft and hard water at the rate of 5%, the volume of foam should not exceed than 60 ml since foam is a nuisance in pesticidal sprays because it cause a false volume of spray solution also unhomogenous distribution over the sprayed crop [21, 92], it is flash point should not be lower than 22.8°C, the free acidity or alkalinity should be less than 0.3%, where the emulsifiable concentrate should not show any solid or oil separation when it cooled at 0°C for seven days, and when it subjected to tropical storage at 54 °C for 14 days should be chemically and physically stable to ensure that the EC which pass this test will have a reasonable life under different storage conditions.

I-1-1- Emulsion stability test

Results obtained in Table (1) showed that all commercial formulation insecticides passed successfully through emulsion stability test, since no oily separation, cream separation or sedimentation occurred when it added at 5% in both soft and hard water and these results agree with FAO/WHO (2002) recommendations [28].

I-1-2- persistent Foam

As shown in Table (1) the commercial insecticides give foam volume which varied from one to each other, where Helban had the lowest volume of foam in soft and hard water and Pestiban had the highest volume of foam in soft and hard water, respectively. These found results comply with FAO/WHO (2002) recommendations [28].

I-1-3-Free acidity and alkalinity

Results obtained in Table (1) indicated that all commercial insecticides had a slight acidity, where Helban gave the lowest acidity value as H_2SO_4 0.03% and Pestiban had the highest acidity value as % H_2SO_4 0.059, but this result agree with WHO (1979) [27].

I-1-4- Flash point

As shown in Table (1) it was found that the flash point varied from one commercial formulation to other, where Pestiban had the highest value of flash point (39°C), followed by Pyriban A (35°C) and Helban had the lowest flash point (32°C). These results agree with WHO (1979) specification [27], where flash point must be more than 22.8°C.

I-1-5- Cold stability test

Results obtained in Table (1) indicated that all commercial insecticides passed successfully in cold test since they did not give any separation or sedimentation comply with FAO/WHO (2002) recommendation [28].

I-1-6- Accelerated storage

Result in Table (1) showed that Helban and Pyriban A had no oil separation or precipitation in the emulsion stability test when the formulation stored at 54°C for 14 days, where Pestiban had 0.5 ml precipitation in soft water and 1ml in hard water. Also all stored insecticides was slightly acidic, where Helban and Pyriban A had no change in their acidity values after heat storage, while Pestiban had slight increase in acidity value. This result comply with FAO /WHO (2002) recommendations [28].

According to the results in Table (1), it could be considered that these commercial formulation insecticides (Helban, Pyriban A and Pestiban) are successful in the physico-chemical properties according WHO (1979) and FAO/WHO (2002) recommendations [27, 28], while there were differences in the physical phenomenon between these insecticides as:

I-1-7 Surface tension: As shown in Table (1), it was found that Helban had the lowest surface tension (33.5 dyne/ cm), followed by Pyriban A (34.6) and Pestiban had the highest surface tension value (35.2 dyne/ cm).

I-1-8-Viscosity: Results obtained in Table (1) showed that Pestiban had the highest viscosity value (10.27 centipoise) and Helban had the lowest viscosity value (8.13 centipoise).

I-1-9- Refractive index: As shown in Table (1) it was found that Pestiban had the highest refractive index value (1.5130) followed by Pyriban A (1.5104) and Helban (1.5102)

I-1-10- Density and specific gravity: Result obtained in Table (1) showed that Pestiban had the highest values of density and specific gravity 1.07 and 1.08

gm/cm^3, respectively, followed by Pyriban A where it is density and specific gravity values were (1.066 and 1.07 gm/cm^3). It could be said that the differences between commercial formulations in physical phenomenon is attributed to the use of different adjuvant materials (solvent, emulsifiers…, etc) from one commercial formulation to the other.

Table 1: The physico-chemical properties of the commercial formulation insecticides, Chlorpyrifos, as 48% EC

Physical properties \ Commercial Formulation			Helban	Pyriban A	Pestiban
Emulsion Stability (ml. precipitation)		Soft Water	0.0	0.0	0.0
		Hard Water	0.0	0.0	0.0
Foam Test (ml.)		Soft Water	3	3	4
		Hard Water	3	5	5
Free Acidity As % H_2SO_4			0.064	0.04	0.059
Flash Point (°C)			32	35	39
Cold Storage			passed	passed	passed
Accelerated Storage	**Emulsion Stability** (ml. precipitation)	Soft Water	0.0	0.0	0.5
		Hard Water	0.0	0.0	1
	Free Acidity As % H_2SO_4		0.064	0.04	0.088
Physical Phenomenon	**Surface Tension** (dyne/cm)		33.5	34.6	35.2
	Viscosity (centi poise)		8.13	9.96	10.27
	Refractive Index		1.5102	1.5104	1.5130
	Density (gm/cm^3)		1.06	1.066	1.07
	Specific Gravity (gm/cm^3)		1.07	1.07	1.08

I-2- The physico-chemical properties of the spray commercially formulated insecticides, Chlorpyrifos, as 48% EC at the field dilution rate

I-2-1- Surface tension

Surface tension of the spray solution of commercial formulation was determined at field dilution rate (0.5%) in tap, soft and hard water at room temperature. As shown in Table (2), Helban showed the lowest value of surface tension (33.6, 33 and 32.5 dyne/ cm) followed by Pyriban A 33, 33.5 and 33.5 dyne/ cm) and Pestiban (34, 34.5 and 34). This decrease in surface tension of spray solution give a prediction of increasing its wettability and spreading on the treated plant surface, then increasing pesticidal efficiency [21, 54].

I-2-2- Viscosity

Results in Table (2) showed that Pestiban had the highest value of viscosity in tap, soft and hard water (2.11, 2.10 and 2.11 centipoise) followed by Pyriban A (2.05, 2.01 and 2.02 centipoise) and Helban (1.87, 1.85 and 1.91 centipoise).This increase in viscosity of spray solution would increase the deposition on the treated plant leaves, reduce the drift and increase the efficiency of insecticides [76].

I-2-3- Electrical conductivity

As shown in Table (2) Helban had the highest conductivity values in tap, soft and hard water (315, 305 and 810 μmohs), followed by Pestiban (300, 290 and 740 μmohs) and Pyriban A (280, 265 and 690 μmohs). The increase of electric conductivity of insecticidal spray solution would lead to deionization o insecticides and increase the insecticidal efficiency [81].

I-2-4- pH value

Data obtained in Table (2) showed that Helban had the lowest pH value in tap, soft and hard water (6.42, 6.40 and 6.47) followed by Pyriban A (6.57, 5.59 and 6.63) and Pestiban (6.69, 6.62 and 6.59). This decrease in pH value of insecticide spray solutions indicates an increase in positive charge of spray solution leading to increasing attraction between spray solution and the treated plant leave surface, which have negative charges then will increase the insecticidal efficiency [85].

Table 2: The physico-chemical properties of the spray solution of the commercial formulation insecticides, Chlorpyrifos, at the field dilution rate

	Helban			**Pyriban A**			**Pestiban**		
	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water
Surface Tension (dyne/cm)	32.6	33	32.5	33	33.5	33.5	34	34.5	34
Viscosity (centi poise)	1.87	1.85	1.91	2.05	2.01	2.02	2.11	2.10	2.11
Conductivity (μmohs)	315	305	810	280	265	690	300	290	740
pH value	6.42	6.40	6.47	6.57	6.59	6.63	6.69	6.62	6.59

II-1- The physico–chemical properties of the commercial formulation insecticides, Methomyl, as 90% SP

According to WHO (1979) and FAO/WHO (2002) recommendations[27, 28], the successful SP should passed successfully through several tests as solubility test, where no any precipitation or flocculating should be occurred when SP diluted in soft and hard water at field dilution rate, the foam should not exceed than 60 ml after one minute of field dilution rate, the free acidity or alkalinity should not exceed than 0.3%, the bulk density after compacting of powder should not exceed the value obtained before compacting by more than 60%, and the soluble powder subjected to tropical storage at 54°C for 14 days should be chemically and physically stable.

II-1-1- The solubility test

Results in Table (3) showed that all commercial formulations were completely soluble in soft and hard water immediately without formation of any sedimentation, while after half hour Hauyang and Kuik were still completely soluble in soft and hard water and give clear solution except Lannate which give slightly trace of precipitation in hard water. After 18 hours, Hauyang and Kuik give slightly trace of precipitation, while Lannate give trace of precipitation. These results comply with FAO/WHO (2002) recommendations [28].

. **II-1-2-Presistent Foam**

Data in Table (3) indicated that Lannate and Kuik had no Foam volume in soft and hard water while Hauyang had volume of foam in soft and hard water were 1 and 2 ml, respectively. This result agrees with FAO/WHO (2002) recommendations [28].

II-1-3- Free acidity or alkalinity

Results obtained in Table (3) showed that all commercial methomyl insecticides had slight alkalinity, where Lannate had the highest alkalinity value 0.048 as % NaOH, followed by Hauyang 0.044 and Kuik 0.024. This result agrees with WHO (1979) recommendations [27].

II-1-4-Bulk Density

As shown in Table (3), Hauyang showed the highest bulk densities (before and after compacting) were 0.61 and 0.72 gm/cm^3, followed by Lannate were 0.6 and 0.46 gm/cm^3, respectively while Kuik possessed the lowest value of bulk density were 0.43 and 0.5 gm/cm^3, respectively according to FAO/WHO specifications (2002) [28], the bulk density of powder after compacting (packed bulk density) should not exceed than value obtained before compacting by more than 60%, so that these insecticides confirm these specifications.

II-1-5- % Particle size

Date obtained in Table (3) showed that Kuik give the highest percent passing from sieve 74 microns were 100%, followed by Lannate were found to be 89% and Hauyang were 86%.

II-1-6- Accelerated storage

As shown in Table (3) all commercial insecticides were completely soluble in soft and hard water immediately after stored at 54°C for 14 days. After half hour of dilution in water, they were completely soluble in soft water and in hard water Hauyang and Lannate give slight trace of precipitation, while kuik give no precipitation. After 18 hours, Lannate and Hauyang give trace of precipitation in soft and hard water, while Kuik give slight trace of precipitation.

Also, all insecticides after heat storage had a slight change in their alkalinity values. This result comply with FAO/ WHO (2002) specifications [28].

II- 1-7- Density

Data presented in Table (3) showed that Hauyang had the highest value of density were 1.42 gm/cm^3, followed by Lannate were 1.17 gm/cm^3 and Kuik were 1.11 gm/cm^3. This difference in density is attributed to the use of different adjuvant materials (wetting and spreading agent) in each commercial formulation.

Generally, the results in Table (3) showed that the commercial formulated methomyl insecticides could be considered successfully in the physico-chemical properties according to WHO (1979) and FAO/WHO (2002) recommendations [27, 28].

Table 3: The physico-chemical properties of the commercial formulation formulation insecticides, Methomyl, as 90% SP

Properties			Commercial formulation	Lannate	Hauyang	Kuik
Solubility Test	Hard Water		Immd.	√	√	√
			1/2 hr.	+	√	√
			1 hr.	+	+	+
			18 hr.	++	+	+
	Soft Water		Immd.	√	√	√
			1/2 hr.	√	√	√
			1 hr.	+	+	√
			18 hr.	+	+	+
Foam Test (ml.)	Hard Water			0.0	2	0.0
	Soft Water			0.0	1	0.0
Alkalinity As % (NaOH)				0.048	0.044	0.024
% Particle Size (< 74 µ)				89	86	100
Bulk Density (gm/cm^3)	Before compacting			0.6	0.61	0.43
	After compacting			0.69	0.72	0.50
Accelerated storage	Solubility Test	Soft Water	Immd.	√	√	√
			1/2 hr.	√	√	√
			1 hr.	+	+	+
			18 hr.	++	++	+
		Hard Water	Immd.	√	√	√
			1/2 hr.	+	+	√
			1 hr.	+	++	+
			18 hr.	++	++	+
	Alkalinity As % (NaOH)			0.058	0.034	0.044
Density (gm/cm^3)				1.17	1.42	1.11

√= complete solubility + = slightly trace of precipitation ++ = trace of ppt.

II-2- The physico-chemical properties of the pray solution of the commercial formulation insecticides, Methomyl, as 90% SP at field dilution rate

II-2-1- surface tension

Surface tension of the spray solution of commercial formulation was determined at room temperature in tap, soft and hard water by using Cole Parmer surface tension. Data obtained in Table (4) showed that Hauyang had the lowest value in surface tension (52.3, 51.8 and 44.8 dyne/cm), followed by Lannate (56.3, 54.3 and 54 dyne/cm) and Kuik (58.9, 58.9 and 56.3 dyne/ cm). This decrease in surface tension of spray solution give a prediction of increasing its wet ability and spreading on the treated plant surface, then increasing insecticidal efficiency [21, 54].

II-2-2- Viscosity

As shown in Table (4) Hauyang had the highest values of viscosity in tap, soft and hard water were 1.31, 1.30 and 1.30 centipoise, followed by Kuik (1.17, 1.16 and 1.14 centipoise) and Lannate (1.16, 1.15 and 1.15 centipoise). This increase in viscosity of spray solution would increase the deposit on the treated plant leaves, reduce the drift and increase the efficiency of insecticides [76].

II-2-3- Conductivity

Results obtained in Table (4) showed that Hauyang had the highest value of electric conductivity in tap, soft and hard water (410, 400 and 890 μmohs), followed by Kuik were (380, 375 and 850 μmohs). The increase of electric conductivity of insecticidal spray solution would lead to deionization of insecticides and increase its deposit and penetration in the treated plant surface, then increase the insecticidal efficiency [81].

II-2-4-pH value

Date obtained in Table (4) showed that Lannate had the lowest values of pH in tap, soft and hard water were: 7.24, 7.14 and 7.19, respectively followed by Kuik were (7.28, 7.22 and 7.32, respectively and Hauyang were 7.33, 7.27 and 7.38, respectively. This decrease in pH value of insecticide spray solutions indicates on increase in positive charge of spray solution leading to increasing at traction between spray solution and the treated leaves surface, which have negative charges, then will increase the insecticidal efficiency [85].

Table 4: The physico-chemical properties of the spray solution of the commercial formulation insecticides, Methomyl, at the field dilution rate

	Lannate			**Hauyang**			**Kuik**		
	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water
Surface Tension (dyne/cm)	56.3	54.3	54	52.3	51.8	49.8	58.9	58.9	56.3
Viscosity (centi poise)	1.16	1.15	1.15	1.31	1.30	1.30	1.17	1.16	1.14
Conductivity (µmohs)	340	315	800	410	400	890	380	375	850
pH value	7.24	7.23	7.29	7.33	7.27	7.38	7.28	7.22	7.32

III-1- Physico-chemical properties of the commercial formulation fungicides, copper oxychloride, as 50% WP

According to WHO (1979) and FAO/WHO (2002) recommendations[28], the successful WP should passed successfully through several tests such as suspensibility test, where the successful WP should have more than 60% of suspensibility in soft and hard water, the foam should not exceed than 60 ml after one minute at the field dilution rate, WP must have good wettability, the wettability time should not increase than 2 minutes, the free acidity or alkalinity should not be more then 0.3%, 98% of pesticide (powder) should pass through sieve 75 microns, the bulk density after compacting (packed bulk density) of powder should not exceed than the value obtained before compacting by more than 60%, and the wettable powder subjected to tropical storage at 54°C for 14 days should be chemically and physically stable to ensure that the wettable powder which pass this test will have a reasonable life under different storage conditions.

III-1-1- Suspensibility test

Data presented in Table (5) indicated that all commercial formulation fungicides passed successfully through suspensibility test in soft and hard water, since percent of suspensibility not be less than 60%,where Copral had the highest percent of suspensibility in soft and hard water (74.6 and 72.7%) followed by Curenox 71.2 and 68.4%, respectively, and Unicopper (66.5 and 64.8%). These results comply with FAO/WHO (2002) recommendations [28].

III-1-2 -Persistent foam

Result obtained in Table (5) showed that Curenox had no volume of foam in soft and hard water, while Copral had 2 ml of foam in soft and hard water and

Unicopper had the highest volume of foam in soft and hard water were 4 and 5 ml. This result agree with FAO/WHO (2002) recommendations [28].

III-1-3 -Free acidity or alkalinity

As shown in Table (5) all commercial fungicides had a slight alkalinity, where Copral had the highest alkalinity value as % NaOH 0.048 and Curenox had the lowest alkalinity value as % NaOH 0.016. These results comply with WHO (1979) recommendations [27].

III-1-4-% Particle size

Results obtained in Table (5) showed that Curenox give the highest passing from sieve 74 microns were 100%, followed by Unicopper were the percent passed be 98% and Copral were 95%. These results agree with FAO/WHO (2002) specifications [28] except Copral, where the percent passed less than 98%.

III-1-5- Wettability

As shown in Table (5) Curenox had the lowest time to wet in standard water (44 Sec.), followed by Unicoppper which had 52 Sec. to wet and finally Copral had 1.28 minutes. These results agree with FAO/WHO (2002) recommendation [28].

III-1-6- Wet Sieve test

As show in Table (5) Curenox and Unicopper had the highest percent of wet powder in water passed from sieve 74 micros and the percent was 100%, where Copral had the percent passed 99%. These results comply with FAO/WHO (2002) recommendations [28].

III-1-7- Bulk density

As shown in Table (5) Curenox showed the highest bulk densities (before an after compacting) were 0.567 and 0.83 gm / cm^3, followed by Unicopper were found to be 0.57 and 0.66 gm/cm^3, respectively. Copral possessed the lowest value of bulk density were 0.38 and 0.51 gm/cm^3, respectively. These results comply with FAO/WHO (2002) [28].

III-1-8 Accelerated storage

Results presented in Table (5) showed that all commercial fungicides had a slight decrease in the percent of suspensibility when stored at 54°C for 14 days, where Copral had the highest percent of suspensibility in soft and hard water 72.2 and 69.7%, respectively, followed by Curenox had 67.6 and 66.9, respectively. Also, all fungicides after heat storage had just a slight change in their alkalinity. This result agree with WHO (1979) and FAO/WHO (2002) specifications [27, 28].

III-1-9- Density

Data presented in Table (5) showed that Curenox had the highest value of density were 3.05 gm/cm^3 followed by Unicopper were 2.67 gm/cm^3 and copral had 2.22 gm/cm^3. This differences in density value are attributed to the use of different adjuvant materials (carriers, suspending, wetting and spreading agents…..., etc).

Generally, the results in Table (5) showed that the commercial formulation copper oxychloride fungicides could be considered successfully in the physico-chemical properties according to WHO (1979) and FAO/WHO (2002) specifications[27, 28].

Table 5: The physico-chemical properties of the commercial formulation fungicide, Copper oxychloride, as 50% WP

Physical properties \ Commercial formulation			Curenox	Copral	Unicopper
Suspencibility %		Soft Water	71.2	74.6	66.5
		Hard Water	68.4	72.7	64.8
Foam Test (ml.)		Soft Water	0.0	2	4
		Hard Water	0.0	2	5
Alkalinity As % (NaOH)			0.016	0.048	0.04
% Particle Size (< 74 µ)			100	95	98
Wettability (Sec.)			44	1:28	52
Wet Sieve %			100	99	100
Bulk Density (gm/cm^3)		Before compacting	0.657	0.38	0.57
		After compacting	0.83	0.51	0.66
Accelerated storage	**Suspencibility** %	Soft Water	67.6	72.2	65.3
		Hard Water	66.9	69.7	64.7
	Foam Test (ml.)	Soft Water	0.0	2	4
		Hard Water	0.0	3	6
	Alkalinity As % (NaOH)		0.029	0.034	0.058
Density (gm/cm^3)			3.05	2.22	2.67

III-2-The physico-chemical properties of the spray show of the commercial formulation fungicides, copper oxychloride, as WP 50% at field dilution rate

III-2-1- surface tension

Data presented in Table (6) showed that Unicopper had the lowest surface tension values in tap, soft and hard water 46.2 and 43.2 dyne/ cm, respectively, followed by Copral which had had 56.4, 54 and 56.3 dyne/ cm, respectively. Curenox had the highest values of surface tension 58.9, 58.9 and 61.7 dyne /cm, respectively. This decrease in surface tension of spray solution give a prediction of increasing its wettability and spreading on the treated plant surface, then increasing fungicidal efficiency[21, 54].

III-2-2- Viscosity

As shown in Table (6) Unicopper had the highest values of viscosity in tap, soft and hard water 2.98, 2.98 and 3.02 centipoise, respectively, followed by Copral which had 2.67, 2.71 and 2.69 centipoise, respectively. Curenox had the lowest value of viscosity 2.67, 2.71 and 2.69 centipoise, respectively. This increase in viscosity of spray solution would increase the deposition on the treated plant leaves, reduce the drift and increase the efficiency of fungicides[76].

III-2-3- Electrical conductivity

Results obtained in Table (6) showed that Unicopper had the highest values of electrical conductivity 575, 560 and 1015 μmohs, respectively, followed by Curenox which had 390, 390 and 905 μmohs. Copral had the lowest values of conductivity 345, 340 and 850 μmohs, respectively. The increase of electric conductivity of fungicide spray solution would lead to deionization of fungicide and lead to increase deposit and penetration on the treated plant surface, and then increase fungicidal efficiency [81].

III-2-4- pH value

Data presented in Table (6) showed that Curenox had the lowest pH values in tap, soft and hard water 7.19, 7.21 and 7.18, respectively, followed by Unicopper which had 7.25, 7.22 and 7.28, respectively. Copral had the highest values, pH 7.34, 7.24 and 7.33, respectively. This decrease of pH value of fungicide spray solutions indicates an increase in positive charge in spray solution leading to attraction between spray solution and the treated plant leaves, which negative charges, then will increase the fungicidal efficiency [85].

Table 6: The physico-chemical properties of the spray solution of the commercial formulation fungicides, Copper oxychloride, at the field dilution rate

	Curenox			**Copral**			**Unicopper**		
	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water
Surface Tension (dyne/cm)	58.9	58.9	61.7	56.4	54	56.3	46.2	46.2	43.2
Viscosity (centi poise)	2.67	2.71	2.69	2.95	2.97	2.92	2.98	2.98	3.02
Conductivity (μmohs)	390	390	905	345	340	850	575	560	1015
pH value	7.19	7.21	7.18	7.34	7.29	7.33	7.25	7.22	7.28

IV-1- The physico- chemical properties of the commercial formulation herbicides, Glyphosate isopropyl ammonium, as 48% SL

According to WHO (1979) and FAO/WHO (2002) recommendations[27, 28], the successful SL should passed successfully through several tests such as the miscibility test, where no any precipitation or oil separation should be occurred when SL dilute in soft and hard water at field dilution rate, the foam at field dilution rate should no exceed than 60 ml after one minute, flash point should not be lower than 22.8, The free acidity or alkalinity should agree with registration file, the soluble liquid subjected to tropical storage at 54°C for 14 days should be chemically and physically stable to ensure that the soluble powder which pass this test will have a reasonable life under different storage conditions, it should not show any separation or sedimentation when it cooled at 0.0°C for seven days.

IV-1-1- Miscibility test

Results obtained in Table (7) showed that all commercial formulation herbicides passed successfully through miscibility tests, since no precipitation or sedimentation occurred when it added at field dilution rate in both soft and hard water, and it give clear solution. These results agree with FAO/WHO (2002) recommendations [28].

IV-1-2- Foam test

As shown in Table (7) the commercial herbicides passed foam test, where no volume of foam occurred in soft and hard water. This result comply with FAO/WHO (2002) recommendations [28].

IV-1-3- Free acidity or alkalinity

Results in Table (7) indicated that all commercial herbicides had high acidity values, where Herbazed had the highest acidity value as % H_2SO_4 and Round up had the lowest acidity value as % H_2SO_4.

IV-1-4- Flash Point

As shown in Table (7), it was found that all commercial herbicides had flash point over 70°C, where it could be considered safe to use and agree with WHO (1979) recommendations [27].

IV-1-5-Cold test

As shown in Table (7) all commercial herbicides passed successfully cold test without any separation or sedimentation comply with FAO/WHO (2002) recommendations [28].

IV-1-6- Accelerated storage

Results in Table (7) showed that all commercial herbicides passed successfully miscibility test in soft and hard water without any precipitation or sedimentation and give a clear solution when stored at 54°C for 14 hours. Also, all stored commercial herbicides had a slight change in the acidity value from those before storage. These results comply with FAO/WHO (2002) recommendations [28].

According to the results in Table (7), it could be considered that these commercial formulation herbicides (Herbazed, Herphosate and Round up) are successful in the physicochemical properties agree with the recommendations of FAO / WHO (2002) [28]. While there were differences in the physical phenomenon between these herbicides as:

IV-1-7- Surface tension

As shown in Table (7), it was found that Round up had the lowest value of surface tension (40.9 dyne /cm), followed by Herphosate which had 42.5 dyne /cm, while Herbazed had the highest surface tension value (43 dyne /cm).

IV-I-8- Viscosity

Results obtained in Table (7) showed that Herphosate had the highest value of viscosity (88.8 centipoise), followed by Round up which had 72.7 centipoise, and Herbazed had the lowest value of surface tension (69.9 centipoise).

IV-1-9- Refractive index

Data presented in Table (7) showed that Herbazed had the highest value of refractive index (1.4410), followed by Herphosate which had 1.4377 and Round up had the lowest value of refractive index (1.4363).

IV-1-10- Density and specific gravity

Results obtained in Table (7) showed that Herphosate had the highest value of density and specific gravity were to be 1.177 and 1.18 gm/cm^3, respectively, while Round up had the lowest values of density and specific gravity were found to be 1.154 and 1.14 gm/cm^3, respectively. This difference in physical phenomenon is attributed to the use of different adjuvant agents (wetting and spreading agent ….etc).

Table 7: The physico-chemical properties of the commercial formulation herbicides, glyphosate isopropyl ammonium, as 48% SL

Physical Properties \ Commercial Formulation			Herbazed	Herphosate	Round Up
Miscibility test (ml. precipitation)	Hard Water		√	√	√
	Soft Water		√	√	√
Foam Test (ml.)	Hard Water		0.0	0.0	0.0
	Soft Water		0.0	0.0	0.0
Free Acidity As % H_2SO_4			1.4	1.06	1.0
Flash Point (°C)			Over 70	Over 70	Over 70
Cold Storage			passed	passed	passed
Accelerated storage	**Miscibility test** (ml. precipitation)	Hard Water	√	√	√
		Soft Water	√	√	√
	Free Acidity As % H_2SO_4		1.4	1.06	0.9
Physical Phenomenon	**Surface Tension** (dyne/cm)		43	42.5	40.9
	Viscosity (centi poise)		69.9	88.8	72.7
	Refractive Index		1.4410	1.4377	1.4363
	Density (gm/cm^3)		1.161	1.177	1.164
	Specific Gravity (gm/cm^3)		1.16	1.18	1.14

IV-2- The Phsico-chemical properties of the spray solution of the commercially formulated herbicides, Glyphosate, as 48% SL

IV-2-1- Surface tension

Surface tension of the spray solution of the commercial formulation was determined at 0.25% in tap, soft and hard water at room temperature. Results in Table (8) showed that Round up had the lowest values of surface tension 40.5, 41.2 and 40.5 dyne/cm, respectively, followed by Herphosate had 41.8 , 41.28 and 41.8 dyne/cm, respectively, where Herbazed had the highest values of surface tension 41.8, 43.2 and 43.2 dyne /cm, respectively. This decrease in surface tension of spray solution give a predication of increasing its wettability and spreading on the treated plant surface, then increasing herbicidal efficiency[21, 54].

IV-2-2- Viscosity

Data presented in Table (8) showed that Herphosate had the highest values of viscosity in tap, soft and hard water 1.92, 1.93 and 1.89 centipoise, respectively, while Herbazed had the lowest value of viscosity 1.74, 1.72 and 1.74 centipoise, respectively. This increase in viscosity of spray solution would increase the deposit on the treated plant leaves, reduce the drift and increase the efficiency of herbicides [76].

IV-2-3- Electrical conductivity

As shown in Table (8) Herbazed had the highest values of electrical conductivity in tap, soft and hard water 3500, 3350 and 3800 µmohs, respectively, followed by Round up which had 2900, 2900 and 3350 µmohs, respectively. While Herphosate had the lowest values of conductivity 2800, 2750 and 3100 μmohs, respectively. The increase of electric conductivity of herbicidal spray solution would lead to deionization of herbicides and increase its deposit and penetration on the treated plant surface, then increase the herbicidal efficiency [81].

IV-2-4- pH value

Data obtained in Table (8) indicated that Round up had the lowest values of pH in tap, soft and hard water 4.63, 4.57 and 4.72, respectively, followed by Herphosate 4.92, 4.90 and 4.87, respectively, while Herbazed had the highest values of pH 5.15, 5.11 and 5.21, respectively. This decrease of pH value of herbicide spray solutions indicates on increase in positive charge in spray solution leading to increasing attraction between spray solution and the treated plant leaves, which have negative charges, then will increase the herbicidal efficiency [85].

Table 8: The physico-chemical properties of the spray solution of the commercial formulation herbicides, glyphosate

	Herbazed			**Herphosate**			**Round Up**		
	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water
Surface Tension (dyne/cm)	41.8	43.2	43.2	41.8	41.8	41.8	40.5	41.2	40.5
Viscosity (centi poise)	1.74	1.72	1.74	1.92	1.93	1.89	1.78	1.78	1.76
Conductivity (μmohs)	3500	3350	3800	2800	2750	3100	2900	2900	3350
pH value	5.15	5.11	5.21	4.93	4.90	4.97	4.63	4.57	4.72

II- Locally preparation of active ingredient the tested commercial formulation as suitable formulation:

II- The physico-chemical properties of the constituents of different formulation types

II-1- The physico-chemical properties of the tested active ingredient

1- Solubility test

The most important requirement in formulating a pesticide is the solubility of active ingredient in solvent. Data in Table (9) showed clearly that chlorpyrifos was insoluble in water but it was soluble in different solvents as acetone, xylene, DMF and n-butanol, where the values of solubility of these solvents are 55.5, 51.3, 59.4 and 63.9%, respectively. On the other hand, methomyl was soluble in water and in all solvents used as acetone, xylene, DMF and n-butanol, the values of solubility is 15.1, 83.3, 55.5, 81.6 and 85.2%, respectively. While, Copper oxychloride was found to be insoluble in water and in all solvents. Glyphosate isopropyl ammonuium salt was found to be soluble in water and has value of solubility is 67.3%, but it was in soluble in the different solvents.

This result gives a prediction that the materials that soluble in water could be prepared as soluble powder or soluble liquid formulations such as methomyl and glyphosate isopropyl ammonium. These soluble in xylene and did not soluble in water could be prepared as emusifiable concentrate such as chlorpyrifos, and those did not soluble in both water or any solvents could be prepared as wettable powder formulation such as copper oxychloride.

2- Free Acidity or Alkalinity

Results obtained in Table (9) indicated the glyphosate had the highest value of acidity, followed by Copper oxychloirde and chlorpyrifos, while methomyl was found to be neutral.

3- Density

Results obtained in Table (9) showed that: copper oxychloride has the higher value of density (2.3 gm/cm^3) while glyphosate, methomyl and chlorpyrifos possessed low values of density 1.25, 1.11 and 1 gm /cm^3, respectively.

4- Melting point

Results in Table (9) indicated that chlorpyrifos was melted at low melting point (42°C) while methomyl was melted at moderate melting point (79.5°C) and glyphosate isopropylammonium was melted at higher melting point (216°C) , but copper oxychloride was not melted and their melting point exceed 300°C.

This results indicated that these materials require slightly acidic or slightly alkaline adjuvants, when they prepared as formulation to avoid increasing the acidity or alkalinity that cause phytotoxicity to treated plants.

Table 9: The physico-chemical properties of the tested active ingredient (Technical grade) of the tested pesticides.

	Solubility % (wt. /v.)					**Acidity** as % H_2SO_4	**Alkalinity** as % NaOH	**Density** (gm/cm^3)	**Melting Point** (C◦)
	water	acetone	xylene	DMF	n-butanol				
Chlorpyrifos	Insol	55.5	51.3	59.4	63.9	0.019	Nil	1	42
Methomyl	15.1	83.3	55.5	81.6	85.2	Nil	Nil	1.11	79.5
Copper oxychloride	Insol	Insol.	Insol.	Insol	Insol.	0.91	Nil	2.3	Over 300
Glyphosate Isopropyl amonium	67.3	Insol.	Insol.	Insol	Insol.	1.88	Nil	1.25	216

II-2- The physico- chemical properties of the some tested solvent

1- Free acidity or alkalinity

AS shown in Table (10) all tested solvents were slightly alkaline. Xylene had the highest alkalinity value (0.03) followed by n-butanol, but Dimethyl formamide had the lowest acidity value 0.014.

2- Surface tension

Results obtained in Table (10) showed that xylene had the lowest value of surface tension followed by n-butanol and Dimethyl formamid, where their surface tension values were: 27.36, 28.17 and 32.5 dyne/ cm respectively

3- Flash point

As shown in Table (10) Dimethyl formamid had the highest flash point value (57°C) followed by xylene (32°C), while n-butanol had the lowest flash point value 27°C.

These properties show clearly that the tested solvents had moderate flash point and slightly alkaline which agree with WHO (1979) and FAO/WHO (2002) recommendations[27, 28], where xylene was considered as a suitable solvent for local formulations of emulsifiable concentrates.

Table 10: The physico-chemical properties of the some tested solvent.

	Free Alkalinity as % NaOH	**Surface Tension** (dyne/cm)	**Flash Point** (°C)
Xylene	0.03	27.36	32
DMF	0.014	32.5	57
n-butanol	0.016	28.17	27

II-3-The physico- chemical properties of the some tested carriers

The selection of suitable carrier to make a dry formulation is an important factor affecting the chemical stability of incorporated toxicants. To choose a proper carrier, the pesticide formulators preferably know the carrier properties rather than proceeding trial and error. On the other hand, the tests of alkalinity, pka… etc, are necessary to determine the probable catalytic activity of carrier.

1- Free acidity or alkalinity

As shown in Table (11) the tested carriers were slightly alkaline, where Talc had the highest value of alkalinity (0.048), followed by kaolin (0.024).

2- Wettability

Data obtained in Table (11) indicated that Talc had the ability for wetting in water more than kaolin, where the wettability value for talc is 34 Sec. and for kaolin is 1 : 22 minute.

3- Density and Bulk density

Results in Table (11) showed that talc had the highest density value (2.67 gm/cm^3) than Kaolin (2.5 gm/cm^3). Talc showed the highest bulk densities values (before and after compacting) (0.76 and 0.93), while kaolin possessed the low values (0.625 and 0.81). According to FAO/WH specifications (2002) [28], the bulk density of powder after compacting (packed bulk density) should not exceed than value obtained before compacting by more than 60%. Both tested carriers confirm these specifications.

4- Surface activity (pka)

Surface activity of mineral carriers used in dry formulations is an important factor affecting their chemical stability. Results shown in Table (11) indicated that Talc and Kaolin possessed (pka) higher than 1.5 and less than 3.5. Accordingly, these carriers have slight acidic surface sites that are safe to be mixed with the tested materials.

Table 11: The physico-chemical properties of the some tested carrier

	Free Alkalinity as % NaOH	**Wettability** Sec.	**Density** (gm/cm^3)	**Bulk Density** (gm/cm^3)		**pka**
				Before compacting	After compacting	
Talc	0.048	34	2.67	0.76	0.93	>1.5<3.5
Kaolin	0.024	1:22	2.5	0.625	0.81	>1.5<3.5

II-4- The Physico-chemical properties of the some locally prepared and commercial surface active agents

1- Solubility test: As shown in Tables (12 and 13), the anionic surfactants: sodium dodecyl sulphate, potassium oleate and potassium laurate were soluble in water but they were insoluble in both acetone and xylene. Some of nonionic surfactants: Tween 80, Tween 20, Tween 40, Triton x-100 and polyethylene glycol 600 monolaurate were soluble in water and soluble in acetone and xylene, while the other give emulsion in water but they one soluble in acetone and xylene. Surfactants which soluble in water such as (potassium oleate, PEG 600 ML, SDS, Tween 80 and Triton x-100) should be used as wetting and spreading agent for preparation of soluble powder and soluble liquid, while those give emulsion in water and soluble in xylene should be used as emulsifiers for preparation of emulsifiable concentrates.

2- HLB value: Results presented in Table (12 and 13) showed that PEG 600 Ml, potassium oleate, potassium Laurate, Tween 80, SDS and Triton x-100 having a high HLB value >13 which could be considered it as detergent because they are complete soluble in water while PEG 600 MO, PEG 400 MO and Berrol 944 have HLB value (10-12) which they make translucent to clean dispersion. PEG 600 monosterate and PEG 600 monopalmitate have HLB value (6-8) which they make milky dispersion in water after vigorous agitation.

3- Free acidity and alkalinity: Results presented in Table (12 and 13) indicated that all nonionic surfactants have weakly alkaline nature except tween 80, tween 40 and tween 20 which have slightly acidic. While the anionic surfactants as potassium oleate and potassium laurate have high basic nature except sodium dodecyl sulphate which has slightly alkaline. All tested surfactants have alkalinity and acidity suitable for using in formulation without expecting any phytotoxicity effect.

4- Critical micelle concentration (CMC): the value of CMC is the concentration of surfactant at which no more decrease in surface tension could be obtained by increasing surfactant concentration, the reduction of surface tension have been measured for determining the contact angle between the droplet and leaf surface enhance wetting, spreading and deposit of pesticide on the treated plant then improving control of target species. Results in Table (12 and 13) showed that PEG 600 monopalmiate had the highest CMC value, followed by PEG 600 monooleate and PEG 600 monolaurate, where their CMC values: 0.9, 0.8 and 0.8%, respectively. While Tween 20 and SDS had the lowest CMC values: 0.2 and 0.3%, respectively. CMC was determined to make sure that the applied concentration is for less than CMC to avoid any micelle formation. Demulsification of the EC was observed to occur at a concentration little greater than the CMC indicating that this value is important in the choice of emulsifiers to be used in very concentrated emulsions [92].

5- Surface tension at 0.5%: This test was carried out to select the active surfactants which give the more reduction in surface tension at the same concentration for economic considerations. Results in Table (12 and 13) indicated clearly that: potassium oleate was the most effective surfactant in reducing surface tension of water, followed by PEG 400 monolaurate, potassium Laurate, Triton x-100 and PEG 600 monolaurate, where the surface tension values were: 26.3, 27.63, 29.1, 29.1 and 29.1 dyne/ cm, respectively. While PEG 600 monosterate and Tween 80 were the highest surface tension values 44.1 and 43.2 dyne /cm, respectively.

Table 12: The physico-chemical properties of the locally prepared surface active agents:

	Solubility % (wt. /v.)					HLB	Acidity as % H_2SO_4	Alkalinity as % NaOH	CMC %	Surface Tension (dyne/cm)
	water	acetone	xylene	DMF	n-butanol					
PEG 600 MO	Insol.	27.7	41.6	67.8	73.4	10-12	Nil	0.33	0.8	41.4
PEG 400 MO	Insol.	50.0	100	64.5	68.1	10-12	Nil	0.12	0.7	39
PEG 600 ML	15.62	29.4	50.0	71.7	72.4	>13	Nil	0.29	0.8	29.1
PEG 400 ML	Insol.	55.5	62.5	70.2	72.0	10-12	Nil	0.11	0.6	27.63
PEG 600 MS	Insol.	10.0	40.0	58.6	64.3	6 - 8	Nil	0.12	0.7	44.1
PEG 600 MP	Insol.	7.1	10.0	20.2	23.6	6 - 8	Nil	0.112	0.9	42.75
Potassium Oleate	2.5	Insol.	Insol.	Insol.	Insol.	>13	Nil	2.36	0.7	26.3
Potassium Laurate	2.5	Insol.	Insol.	Insol.	Insol.	>13	Nil	3.2	0.7	29.1

Table 13: The physico-chemical properties of the some commercial surface active agents.

	Solubility % (wt. /v.)					**HLB**	**Acidity** as % H_2SO_4	**Alkalinity** as % NaOH	**CMC** %	**Surface Tension** (dyne/cm)
	water	acetone	xylene	DMF	n-butanol					
Tween 80	25	60.7	55.7	62.3	68.5	>13	0.061	Nil	0.5	43.2
Tween 40	36	56.5	43.3	61.8	63.4	>13	0.13	Nil	0.4	37.02
Tween 20	40	65.4	60.7	65.7	68.3	>13	0.49	Nil	0.2	40.5
Triton x-100	28	68.3	59.2	71.9	73.4	>13	Nil	0.019	0.4	29.1
Berrol 449	Insol.	55.5	41.6	62.3	67.2	10-12	Nil	0.048	0.7	30.36
Sodium dodecyl sulphate (SDS)	39	Insol.	Insol.	Insol.	Insol.	>13	Nil	0.032	0.3	30.3

III- Local formulation of technical pesticides and the physico-chemical properties of the locally formulated pesticides

III-1-Local formulations and the physico- chemical properties of locally formulated chloropyrifos as 48% EC

III-1-1- Local formulation of chlorpyrifos as 48% EC

The Judgment on the successful emulsifiable concentrate formulation depends on passing the emulsion stability test in soft and hard water where no oil separation occur and precipitation or cream separation should not exceed than 2 ml according to FAO/WHO (2002) specifications[28]. As shown in Table (14, 15 and 16), many trials was conducted to formulate chlorpyrifos as 48% EC, where xylene alone was used as solvent with 11 emulsifiers to make successful EC, but it was found that the locally formulated EC not passed the emulsion stability test in soft and hard water, where all of them give precipitation varied from 1.5 to 5.5 ml. So that, these locally formulated EC was improved by using co-solvents as dimethyl formamide (DMF) and n-butanol, it was found that the most successful locally formulated EC those with co-solvent n-butanol and emulsifiers PEG 600 monooleate, PEG 400 monooleate, Tween 80, Triton x-100 and Berrol 944, which passed the emulsion stability test in soft and hard water at the rate of 5% with no oil, creamy separation or precipitation and it take formulation codes CP23, CP24, CP29, CP32 and CP33, respectively.

(Table 14): Locally formulations of Chlorpyrifos insecticide as emulsifiable concentrate 48% EC = (50% technical Pesticide).

Formulation code	**Active ingredient**	**Solvent**	**Surfactants**	**Emulsion Stability** (ml. precipitation)	
				Soft Water	Hard Water
CP1	Chlorpyrifos (50%)	Xylene (37%)	PEG 600 MO (13%)	1.6	1.8
CP2		Xylene (37%)	PEG 400 MO (13%)	2	2
CP3		Xylene (37%)	PEG 600 ML (13%)	3	4
CP4		Xylene (37%)	PEG 400 ML (13%)	3.5	4
CP5		Xylene (37%)	PEG 600 MS (13%)	5	5.3
CP6		Xylene (37%)	PEG 600 MP (13%)	5	5.5
CP7		Xylene (37%)	Tween 80 (13%)	1.8	2
CP8		Xylene (37%)	Tween 40 (13%)	3.1	4
CP9		Xylene (37%)	Tween 20 (13%)	4.2	4.8
CP10		Xylene (37%)	Triton X-100 (13%)	1.2	1.5
CP11		Xylene (37%)	Berrol 499 (13%)	1.3	1.5

(Table 15): Locally formulations of Chlorpyrifos insecticide as emulsifiable concentrate 48% EC = (50% technical

Formulation code	Active ingredient	Solvent	Co-solvent	Surfactants	Emulsion Stability (ml. precipitation)	
					Soft Water	Hard Water
CP12	Chlorpyrifos (50%)	Xylene (32%)	DMF (5%)	PEG 600 MO (13%)	0.8	1
CP13		Xylene (32%)	DMF (5%)	PEG 400 MO (13%)	1	1.1
CP14		Xylene (32%)	DMF (5%)	PEG 600 ML (13%)	3	3.5
CP15		Xylene (32%)	DMF (5%)	PEG 400 ML (13%)	2.7	3.1
CP16		Xylene (32%)	DMF (5%)	PEG 600 MS (13%)	4	4.2
CP17		Xylene (32%)	DMF (5%)	PEG 600 MP (13%)	4.5	5.2
CP18		Xylene (32%)	DMF (5%)	Tween 80 (13%)	1.5	1.8
CP19		Xylene (32%)	DMF (5%)	Tween 40 (13%)	2.6	3.1
CP20		Xylene (32%)	DMF (5%)	Tween 20 (13%)	3	3.3
CP21		Xylene (32%)	DMF (5%)	Triton X-100 (13%)	0.0	0.6
CP22		Xylene (32%)	DMF (5%)	Berrol 499 (13%)	0.8	1.5

(Table 16): Locally formulations of Chlorpyrifos insecticide as emulsifiable concentrate 48% EC = (50% technical

Formulation code	Active ingredient	Solvent	Co-solvent	Surfactants	Emulsion Stability (ml. precipitation)	
					Soft Water	Hard Water
CP23	Chlorpyrifos (50%)	Xylene (32%)	n-butanol (5%)	PEG 600 MO (13%)	0.0	0.0
CP24		Xylene (32%)	n-butanol (5%)	PEG 400 MO (13%)	0.0	0.0
CP25		Xylene (32%)	n-butanol (5%)	PEG 600 ML (13%)	1.1	1.6
CP26		Xylene (32%)	n-butanol (5%)	PEG 400 ML (13%)	1.3	1.6
CP27		Xylene (32%)	n-butanol (5%)	PEG 600 MS (13%)	2.1	2.5
CP28		Xylene (32%)	n-butanol (5%)	PEG 600 MP (13%)	3	3
CP29		Xylene (32%)	n-butanol (5%)	Tween 80 (13%)	0.0	0.3
CP30		Xylene (32%)	n-butanol (5%)	Tween 40 (13%)	2	3
CP31		Xylene (32%)	n-butanol (5%)	Tween 20 (13%)	1.5	1.8
CP32		Xylene (32%)	n-butanol (5%)	Triton X-100 (13%)	0.0	0.0
CP33		Xylene (32%)	n-butanol (5%)	Berrol 499 (13%)	0.0	0.0

III-1-2- The physico-chemical properties of the locally formulated insecticides, chlorpyrifos, as 48% EC

1- Persistent Foam

Results in Table (17) showed that all locally formulated chlorpyrifos had volume of foam, where CP29 had the lowest volume of foam in soft and hard water 2 and 2 ml, respectively, followed by CP23 had 3 ml and CP32 had the highest volume of foam in soft and hard water 7 and 8.5 ml, respectively. This result agrees with FAO/WHO (2002) recommendations for successful EC [28].

2- Free acidity or alkalinity

Data presented in Table (17) showed that all locally formulated chlorpyrifos had a slight acidity, where CP29 and CP33 had the lowest values of acidity as % H_2SO_4 0.019, while CP23 had the highest acidity value as % H_2SO_4 0.11. This result complies with WHO (1979) recommendations [27].

3- Flash point

As shown in Table (17) it was found that CP32 had the highest value of flash point 35°C, followed by CP23, CP29 and CP33 which had the same value of flash point 34°C, while CP24 had the lowest value of flash point 33°C. These results agree with WHO (1979) recommendations [27].

4- Cold stability test

Results obtained in Table (17) showed that all locally formulated chlorpyrifos passed successfully cold test without any separation or sedimentation, except CP29 failed in this test since it showed stable precipitation and this result not agree with FAO/WHO (2002) recommendations [28].

5- Accelerated storage

Results in Table (17) showed that CP23 and CP33 had no precipitation in the emulsion stability test in soft water, while they had 0.8 and 0.4 ml precipitation in hard water, when stored at 54°C for 14 days. CP32 had precipitation 0.3 ml in soft water and 0.9 ml in hard water, while CP24 had 0.5 ml precipitation in soft and 1.2 ml in hard water. CP29 failed in the emulsion stability test after accelerated storage because it had 1.7 ml precipitation in soft water and 2.5 ml precipitation in hard water. Also all stored locally formulated chlorpyrifos had a slight increase in the acidity values. This result complies with FAO/WHO (2002) recommendations [28], except the results of CP29 which had 2.5 ml precipitation in hard water in the emulsion stability test.

III-1-3-Physical phenomenon of the locally formulated insecticides, chlorpyrifos, as 48% EC

1- Surface tension

As shown in Table (17) it was found that CP32 and CP33 had the lowest values of surface tension 33 and 33.7 dyne/cm, respectively,

2- Viscosity

As shown in Table (17) it was found that followed by CP23 which had 10.95 centipoise, while CP32 and CP33 had the lowest viscosity 9.83 and 8.92 centipoise, respectively.

3- Refractive index

As shown in Table (17), CP32 had the highest value of refractive index 1.494, followed by CP33 which had 1.493 and CP29 had 1.490, while CP23 and CP24had he lowest values of refractive index 1.489.

4- Density and specific gravity

Results obtained in Table (17) showed that CP29 had the highest values in density and specific gravity 1.07 and1.08 gm/cm^3, respectively, followed by CP32 which had 1.066 and 1.07 gm/cm^3, while CP23 had the lowest values of density and specific gravity 1.056 and 1.06 gm/cm^3, respectively. The differences between formulations in physical phenomenon are attributed to the use of different adjuvant materials (solvent, emulsifiers…, etc) from one formulation to the other.

Table 17: The physico-chemical properties of the locally formulated insecticides, Chlorpyrifos, as 48% EC.

Physical properties \ Local formulation			CP23	CP24	CP29	CP32	CP33
Foam Test (ml.)		Soft Water	3	3	2	7	4.5
		Hard Water	3	4.5	2	8.5	5
Free Acidity As % H_2SO_4			0.041	0.038	0.049	0.089	0.069
Flash Point (°C)			34	33	34	35	34
Cold Storage			passed	passed	Stable precipitation	passed	passed
Accelerated Storage	**Emulsion Stability** (ml. precipitation)	Soft Water	√	0.5	1.7	0.3	√
		Hard Water	0.8	1.2	2.5	0.9	0.4
	Free Acidity As % H_2SO_4		0.036	0.038	0.058	0.084	0.065
Physical Phenomenon	**Surface Tension** (dyne/cm)		35.6	36.2	37.2	33	33.7
	Viscosity (centi poise)		10.95	8.41	11.85	9.83	8.92
	Refractive Index		1.489	1.489	1.490	1.494	1.493
	Density (gm/cm^3)		1.056	1.06	1.07	1.066	1.06

	Specific Gravity (gm/cm^3)	1.06	1.07	1.08	1.07	1.065

III-1-4- The physico- chemical properties of the spray solution of the locally formulated insecticides, chlorpyrifos, as 48% EC at of field dilution rate

1- Surface tension

Data presented in Table (18) indicated that CP32 had the lowest values of surface tension at field dilution rate in tap, soft and hard water 33.5, 33 and 33.2 dyne/cm, respectively, followed by CP33 which had 33.9, 33.4 and 33.7 dyne/cm, respectively. While, CP24 had the highest values of surface tension in tap, soft and hard water. This decrease in surface tension of spray solution give a predication of increasing its wettability and spreading on the treated plan surface increasing insecticidal efficiency [21, 54].

2-Viscosity

Results in Table (18) showed that CP23 the highest value of viscosity in tap, soft and hard water: 2.03, 20.7 and 2.06 centipoise, respectively, followed by CP32 had 2.04, 2.04 and 2.04 centipoise, respectively, while CP33 had the lowest values of viscosity 1.94, 1.97 and 1.96 centipoise, respectively. This increase in viscosity of spray solution would increase its deposit on the treated plant leaves, reduce the drift and increase the efficiency of insecticides [76].

3- Electrical conductivity

As shown in Table (18) it was found that CP23 had the highest electrical conductivity in tap, soft and hard 328, 315 and 880 µmohs, respectively, followed by CP32 had 317, 310 and 820 µmohs, respectively, while CP33 had the lowest conductivity values 280, 275 and 710 µmohs, respectively. This increase of electrical conductivity of insecticidal spray solution would lead to deionization of insecticides and increase its deposit and penetration in the treated plant surface, than increase the insecticidal efficiency [81].

4- pH value

Results obtained in Table (18) showed that CP32 had the lowest pH values in tap, soft and hard water 6.44, 6.42 and 6.43, respectively, and CP33 had 6.49, 6.51 and 6.48, respectively, while CP23 had the highest values of pH 6.88, 6.86 and 6.88, respectively. This decrease in pH values of insecticide spray solutions indicates an increase in positive charge of spray solution leading to increasing attraction between spray solution and the treated plant leaves surface, which have negative charges, then will increase the insecticidal efficiency [85].

Generally, it could be said that only formulations CP23, 32, and 33 passed successfully through the world tests and are as the same properties as commercial formulations while formulation CP29 failed in both cold and accelerated storages. The results in Table (17) and (18) indicate that CP32 had the best physico-chemical properties of the locally formulated and in its spray solution, followed by CP33 and CP23. Also, CP32 nearly had the same physico-chemical properties of the commercial formulation insecticide insecticidal efficiency of both CP32 and Helban.

(Table 18): The physico-chemical properties of the spray solution of the locally formulated insecticides, chlorpyrifos, at the field dilution rate.

	Surface Tension (dyne/cm)			**Viscosity** (centi poise)			**Conductivity** (µmohs)			**pH value**		
	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water
CP23	35.1	35.6	35.5	2.03	2.07	2.06	328	315	880	6.88	6.86	6.88
CP24	36.5	36.8	36.8	1.98	1.98	2.01	307	297	810	6.76	6.78	6.75
CP29	38.5	38.5	38.5	2.05	2.06	2.1	335	330	905	6.67	6.67	6.67
CP32	33.5	33	33.2	2.04	2.04	2.04	317	310	820	6.44	6.42	6.43
CP33	32.9	33.4	33.1	1.94	1.97	1.96	280	275	710	6.49	6.51	6.48

III-2-Local formulations and the physico-chemical properties of the locally formulated, methomyl, as 90% SP

III-2-1- Local formulations of Methomyl as 90% SP

The successful soluble powder formulation should pass the solubility test without any precipitation and sedimentation, and it should cause observed decrease in the surface tension of water at field dilution rate according to FAO/WHO (2002) specifications [28]. As shown in Table (19), many trials was conducted to formulate methomyl as 90% SP, where many surfactants as (SDS, PEG 600 monolaurate and potassium oleate) which had complete solubility in water were used alone and mixed together in ratio (1:1 wt./wt.) to make five successful SP's which take formulations codes, (Methomyl + SDS) ME1, (Methomyl + PEG 600 ml) ME2, (Methomyl + potassium oleate) ME3, (Methomyl + SDS + PEG 600 Ml) ME4 and (Methomyl + Potassium oleate + PEG 600 ML) ME5. Then the surface tension of each successful SP's was determined at field dilution rate compared with surface tension of methomyl alone. It was found that surface tension of methomyl alone was 68.1 dyne /cm, while in ME1 the surface tension decreased to 38.7 dyne/ cm, followed by ME4 which had 40.5 dyne/cm and ME3 cause the low decrease in surface tension 49 dyne/cm. So that, the physico-chemical properties was completed on those successful soluble powders.

Table 19: Locally formulations of insecticide, Methomyl, as Soluble powder 90% SP = (91.8% technical pesticide).

Formulation code	% Technical pesticide	% Wetting agent			Surface Tension (dyne/cm)
		SDS	PEG 600 ML	Potassium Oleate	
ME	Methomyl (100%)	---	---	---	68.1
ME1	Methomyl (91.8%)	8.2%	---	---	38.7
ME2	Methomyl (91.8%)	---	8.2%	---	42.1
ME3	Methomyl (91.8%)	---	---	8.2%	49
ME4	Methomyl (91.8%)	4.1%	4.1%	---	40.5
ME5	Methomyl (91.8%)	---	4.1%	4.1%	44.1

III-2-2- The physico-chemical properties of the locally formulated insecticides, Methomyl, as 90% SP

1- The solubility test

As shown in Table (20) all locally formulated SP's were completely soluble in soft and hard water immediately and after half hour without formation of any precipitation. After 18 hours, ME4 had no precipitation in soft water and the other locally formulated SP's had slightly trace of precipitation, while in hard water all locally formulated SP's had slightly trace of precipitation except ME3 which had trace of precipitation. These results agree with FAO/ WHO (2002) recommendations [28].

2- Persistent Foam

Results in Table (20) showed that ME1 had the highest volume of foam in soft and hard water 10, 11 ml, respectively, followed by ME3 which had 9 ml and 12 ml, respectively, while ME2 had the lowest value of foam 2 ml in both soft and hard water. This result agrees with FAO/WHO (2002) recommendations [28].

3- Free acidity or alkalinity

Data presented in Table (20) showed that all locally formulated had slight alkalinity value except ME3 and ME5 which had a great value of alkalinity as % NaOH 0.608 and 0.431, respectively, and this result not agree with WHO (1979) recommendations [27], where the value of alkalinity should not exceed 0.3% as NaOH to avoid any phytotoxicity to the plant.

4- % Particle size

As shown in Table (20) all locally formulated SP's passed successfully though sieve 74 microns to have 100% particle size. This result comply with FAO/ WHO (2002) specifications [28].

5- Bulk density

Results in Table (20) should that ME2 had the highest values of bulk density (before and after compacting) were 0.75 and 0.84 gm/cm^3, respectively, followed by ME5 which had 0.714 and 0.82 gm/cm^3, respectively, while ME1 had the lowest values of bulk density (before and after compacting) were 0.61 and 0.7 gm/cm^3, respectively. These results agree with FAO/ WHO (2002) recommendations [28].

6- Accelerated storage

As shown in Table (20) it was found that all locally formulated SP's were completely soluble in soft and hard water immediately and after half hour when stored at 54°C for 14 days. After 18 hours, all locally formulated SP's had a slight trace of precipitation in soft water except ME1 and ME4 which had no precipitation, while in had water all of them had a slight of precipitation. Also, locally formulated SP's after heat storage had a slight change in their alkalinity values, except ME1 which had no change. This result comply with WHO (1979) and WHO (2002) recommendations [27, 28].

7- Density

Data presented in Table (20) showed that ME2 and ME5 had the highest values of density 1.25 gm/cm^3, followed by ME4 which had 1.176 gm/cm^3, while ME3 had the lowest values of density 1.11 gm/cm^3. This difference in density is attributed to the use of different adjuvant materials (wetting and spreading agent) in each commercial formulation.

Properties \ Local formulation				ME1	ME2	ME3	ME4	ME5
Solubility Test		Soft Water	Immd.	√	√	√	√	√
			1/2 hr.	√	√	√	√	√
			1 hr.	√	√	+	√	√
			18 hr.	+	+	+	√	+
		Hard Water	Immd.	√	√	√	√	√
			1/2 hr.	√	√	√	√	√
			1 hr.	√	+	+	√	+
			18 hr.	+	+	++	+	+
Foam Test (ml.)		Soft Water		10	2	9	7	4
		Hard Water		11	2	12	7	6
Alkalinity As % (NaOH)				0.032	0.048	0.608	0.04	0.431
% Particle Size (< 74 µ)				100	100	100	100	100
Bulk Density (gm/cm^3)		Before compacting		0.61	0.75	0.67	0.67	0.714
		After compacting		0.70	0.89	0.73	0.74	0.82
Accelerated storage	**Solubility Test**	Soft Water	Immd.	√	√	√	√	√
			1/2 hr.	√	√	√	√	√
			1 hr.	√	√	+	√	√
			18 hr.	√	+	+	√	+
		Hard Water	Immd.	√	√	√	√	√
			1/2 hr.	√	√	√	√	√
			1 hr.	√	+	+	√	√
			18 hr.	+	+	+	+	+
	Alkalinity As % (NaOH)			0.032	0.064	0.66	0.048	0.448
Density (gm/cm^3)				1.17	1.25	1.11	1.176	1.25

Table 20: The physico-chemical properties of the locally formulated insecticides, Methomyl, as 90% SP.

√ = completely soluble **+ = slightly trace of precipitation**

++ = trace of precipitation

III-2-3- The physico–chemical properties of the spray solution of the locally formulated insecticides, Methomyl, as 90% SP at the field dilution rate

1- Surface tension

Results obtained in Table (21) showed that ME1 had the lowest values of surface tension in tap, soft and hard water were 38.7, 39.1 and 38.7 dyne/ cm, respectively, followed by ME4 which had 40.5, 41.8 and 40.5 dyne/cm, while ME3 had the highest values of surface tension were 49.78 and 48.7 dyne/ cm, respectively. This decrease in surface tension of spray solution give a prediction of increasing its wettability and spreading on the treated plant surface, then increasing insecticidal efficiency[21, 54].

2- Viscosity

Data presented in Table (21) showed that ME2 and ME4 had the highest values of viscosity in tap, soft and hard water which were 1.24, 1.26 and 1.26 centipoise, respectively, followed by ME5 which had 1.23, 1.24 and 1.23 centipoise, respectively. ME1 had the lowest viscosity values were 1.08, 1.11 and 1.10 centipoise, respectively. This increase in viscosity of spray solution would increase the deposition the treated plant leaves, reduce the drift and increase the efficiency of insecticides[76].

3- Electrical conductivity

As show in Table (21) it was found that ME3 had the highest values of electrical conductivity in tap, soft and hard water which were 435, 410 and 950 µmohs, respectively, followed by ME4 which had 425, 41 and 915 µmohs, respectively, and ME1 had 420, 400 and 910 µmohs, respectively, while ME2 had the lowest conductivity 390, 375 and 850 µmohs, respectively. The increase of electrical conductivity of insecticidal spray solution would lead to deionization of insecticides and increase its deposit and penetration in the treated plant surface, then increase the insecticidal efficiency [81].

4- pH value

Data obtained in Table (21) showed that ME1 had the lowest pH values in tap, soft and hard water which were 7.15, 7.13 and 7.15, respectively, followed by ME4 which had 7.20, 7.18 and 7.24, respectively and ME2 which had 7.25, 7.20 and 7.30, respectively, while ME3 had the highest pH values were 8.21, 8.20 and 8.24, respectively. This decrease in pH value of spray solution indicates an increase in positive charge of spray solution leading to increasing attraction between spray solution and the treated leave surface, which have negative charges, then will increase the insecticidal efficiency [85].

Generally, results obtained in Table (20) and (21) showed that ME1 had the best physico-chemical properties for the formulation and spray solution rather than the other successful locally formulated SP's, also it had the best physico- chemical properties when it compared with the properties of the commercial formulation SP's. This gives a prediction of increasing the insecticidal efficiency of ME1 as a result of improving its physico-chemical properties from that of commercial SP's.

Table 21: Thephysico-chemical properties of the spray solution of the locally formulated insecticides, Methomyl, at the field dilution rate.

	Surface Tension (dyne/cm)			**Viscosity** (centi poise)			**Conductivity** (μmohs)			**pH value**		
	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water
ME1	38.7	39.1	38.7	1.08	1.11	1.10	420	400	910	7.15	7.13	7.15
ME2	42.1	42.1	41.3	1.26	1.26	1.24	390	375	850	7.25	7.20	7.30
ME3	49	48.7	48.7	1.17	1.16	1.17	435	410	950	8.21	8.20	8.24
ME4	40.5	41.8	40.5	1.24	1.26	1.26	405	395	890	7.20	7.18	7.24
ME5	44.1	44.1	43.2	1.23	1.24	1.23	425	410	915	8.07	8.09	8.09

III-3- Local formulations and the physico- chemical properties of the locally formulated, copper oxychloride, as 50% WP

III-3-1- Local formulations of Copper oxychloride as 50% WP

The judgment on the successful wettable powder formulation depends on passing successfully the suspensibility test, where the percent of suspensibility in this test must be not less 60% in soft and hard water according to FAO/ WHO (2002) specifications [28]. As shown in Tables (22) and (23), many trials was conducted to formulate copper oxychloride as 50% WP by using two different carriers as talc and kaolin with two kinds of surfactant as non-ionic surfactants (PEG 600 ML, PEG 400 ML and PEG 600 MO) and anionic surfactants (SDS, potassium oleate and potassium laurate) alone and mixed of anionic with non-ionic surfactant in ratio of (1:1 wt./ wt.), then the suspensibility test was carried out in soft and hard water to determine the successful WP's. It was found that the formulation of copper oxychloride with talc and anionic or non-ionic surfactants not passed the suspensibility test and had % of suspensibility less than 60% in both soft and hard water. While the formulation of copper oxychloride with Kaolin and anionic or non-ionic surfactants alone or mixed together passed the suspensibility test and had % of suspensibility more than 60% in both soft and hard water, except that with PEG 600 MO which had % of suspensibility in soft and hard water 58.66 and 56.87%, respectively, also that with potassium laurate which had 47.16 and 46.21%, and that with potassium oleate which had 33.95 and 33.67, respectively. The most successful six wettable powder which had the highest values of suspensibility in soft and hard water are which had formulation codes CO9, CO11, CO12, CO14, CO15, and CO18, where the physico-chemical properties could be completed on these successful six WP's.

Table 22: Locally formulation of copper oxychloride fungicide as wettable powder 50% WP = (51.4% technical).

Formulation Code	**Active ingredient**	**Carrier**	**Surfactants**		**Suspensibility %**		**Foam test** (ml.)	
			Non-ionic	Anionic	Soft Water	Hard water	Soft Water	Hard water
CO1	Copper oxychloride (51.4%)	Talc (41.6%)	PEG 600 ML (7%)	----	44.48	39.36	--	--
CO2		Talc (41.6%)	PEG 400 ML (7%)	---	42.21	38.51	--	--
CO3		Talc (41.6%)	PEG 600 MO (7%)	---	21.02	19.50	--	--
CO4		Talc (41.6%)	---	SDS (3.5%)	52.36	43.91	7	8.5
CO5		Kaolin (41.6%)	PEG 600 ML (7%)		65.77	62.21	--	--
CO6		Kaolin (41.6%)	PEG 400 ML (7%)	---	67.54	66.66	--	--
CO7		Kaolin (41.6%)	PEG 600 MO (7%)	---	58.66	56.87	--	--
CO8		Kaolin (41.6%)	---	Pot. Laurate (7%)	47.16	46.21	6.5	7
CO9		Kaolin (41.6%)	---	SDS (7%)	76.43	73.7	9	10.5
CO10		Kaolin (41.6%)	---	Pot. Oleate (7%)	33.95	33.67	4	4

Table (23): Locally formulations of Copper oxychloride fungicide as wettable powder 50% WP =(51.4% technical).

Formulation Code	Active ingredient	Carrier	Surfactants		Suspensibility %		Foam test (
			Non-ionic	Anionic	Soft Water	Hard water	Soft Water
CO11	Copper oxychloride (51.4 %)	Kaolin (41.6%)	PEG 600 ML (3.5%)	Pot. Laurate (3.5%)	83.01	82.65	3.5
CO12		Kaolin (41.6%)	PEG 600 ML (3.5%)	SDS (3.5%)	86.92	84.43	12
CO13		Kaolin (41.6%)	PEG 600 ML (3.5%)	Pot. Oleate (3.5%)	65.23	63.99	3.5
CO14		Kaolin (41.6%)	PEG 400 ML (3.5%)	Pot. Laurate (3.5%)	84.08	81.7	2
CO15		Kaolin (41.6%)	PEG 400 ML (3.5%)	SDS (3.5%)	83.26	79.1	8
CO16		Kaolin (41.6%)	PEG 400 ML (3.5%)	Pot. Oleate (3.5%)	67.01	65.77	1
CO17		Kaolin (41.6%)	PEG 600 MO (3.5%)	Pot. Laurate (3.5%)	69.74	69.32	4.5
CO18		Kaolin (41.6%)	PEG 600 MO (3.5%)	SDS (3.5%)	77.32	75.54	9
CO19		Kaolin (41.6%)	PEG 600 MO (3.5%)	Pot. Oleate (3.5%)	60.23	55.99	4

III-3-2- The physico-chemical properties of the locally formulated copper oxychloride as 5% WP

1- Persistent foam

Data presented in Table (24) showed that CO12 had the highest values of foam in soft and hard water 12 and ml, respectively, followed by CO9 which had 9 and 10.5ml, respectively, and CO18 which had 9 and 10 ml, respectively, while CO14 had the lowest values of foam in soft and hard water 2 and 3 ml, respectively. This result agrees with FAO/WHO (2002) recommendations [28].

2- Free acidity or alkalinity

As shown in Table (24) it was found that CO11 had the highest value of alkalinity as % NaOH (0.088), followed by CO14 which had 0.072, while CO18 had the lowest value of alkalinity as % NaOH 0.32. This result agrees with WHO (1979) [27].

3- % Particle size

Results obtained in Table (24) showed that all successfully locally formulated WP's were completely passed from sieve 74 microns to have 100% particle size. These results comply with FAO/WHO (2002) specifications[28].

4- Wettability test

As shown in Table (24) it was found that CO15 had the lowest time to wet in standard water 45 second, followed by CO12 which had 52 second and CO18 which had 54 second, while CO11 had the highest time to wet. These results agree with FAO/WHO (2002) specification[28].

5- Wet sieve test

Results in Table (24) showed that all successfully locally formulated WP's had 100 percent of wet powder in water which passed completely from sieve 74 microns.

6- Bulk density

As shown in Table (24) it was found that CO12 had the highest values of bulk density (before and after compacting) were 0.65 and 0.76 gm/cm^3, respectively, followed by CO9 which had 0.6 and 0.69 gm/cm^3, respectively, and CO15 which had 0.57 and 0.63 gm/cm^3, respectively, while CO14 had the lowest values of bulk density (before and after compacting) were 0.38 and 0.52 gm/cm^3, respectively. These results agree with FAO/WHO (2002) recommendations [28].

7- Accelerated storage

Results presented in Table (24) showed that all successfully locally formulated WP's passed successfully through the suspensibility test in soft and hard water when stored at 54°C for 14 days, also all successful WP's had a slight change in their alkalinity values. These results comply with FAO/WHO (2002) [28].

8- Density

As shown in Table (24) it was found that CO12 had the highest value of density 2.94 gm/cm^3, followed by CO9 which had 2.67 gm/cm^3, while CO14 had the lowest value of density 1.93 gm/cm^3. This difference in density is attributed to the use of different adjuvant materials (carriers, suspending, wetting and spreading agent) in each commercial formulation.

Table 24: The physico-chemical properties of the locally formulated fungicide, Copper oxychloride, as 50% WP.

Physical properties \ Local formulation			CO9	CO11	CO12	CO14	CO15	CO18
Alkalinity As % (NaOH)			0.04	0.088	0.056	0.072	0.048	0.032
% Particle Size (< 74 μ)			100	100	100	100	100	100
Wettability (Sec.)			1:08	2:11	52	1:56	45	54
Wet Sieve %			100	100	100	100	100	100
Bulk Density (gm/cm^3)		Before compacting	0.6	0.57	0.65	0.38	0.57	0.43
		After compacting	0.69	0.61	0.76	0.52	0.63	0.51
Accelerated storage	**Suspencibility %**	Soft Water	72.64	83.08	86.43	80.16	79.45	76.79
		Hard Water	69.32	81.73	83.67	76.38	78.56	73.23
	Foam Test (ml.)	Soft Water	8.5	4	11.5	2.5	6	8.5
		Hard Water	10.5	4.5	13.5	3	8	10
	Alkalinity As % (NaOH)		0.52	0.084	0.056	0.08	0.052	0.036
Density (gm/cm^3)			2.67	2.13	2.94	1.93	2.22	2

III-3-3- The physico-chemical properties of the spray solution of the locally formulated copper oxychloride as 50% WP at field dilution rate:

1- Surface tension

Data presented in Table (25) showed that CO18 had the lowest values of surface tension in tap, soft and hard water were 31.8, 32.5 and 32.1 dyne/ cm, respectively, followed by CO12 which had 32.4, 32 and 31.6 dyne/cm, respectively, while CO14 had the highest values of surface tension 46.2, 45.5 and 46.1 dyne/ cm, respectively. This decrease in surface tension of spray solution give a prediction of increasing its wettability and spreading on the treated plant surface, then increasing fungicidal efficiency[21, 54].

2- Viscosity

As shown in Table (25), it was found that CO11 had the highest values of viscosity in tap, soft and hard water were 3.08, 3.11 and 3.12 centipoise, respectively, followed by CO18 which had 2.98, 2.97 and 3.04 centipoise, respectively, while CO9 had the lowest values of viscosity in tap, soft and hard water were 2.73, 2.75 and 2.75 centipoise, respectively. This increase in viscosity of spray solution would increase the deposition on the treated plant leaves, reduce the drift and increase the efficiency of fungicides [76].

3- Electrical conductivity

Results obtained in Table (25) showed that CO9 had the highest values of conductivity in tap, soft and hard water were 435, 430 and 930 µmohs, respectively, followed by CO14 which had 370, 365 and 860 µmohs, respectively, and CO12 which had 368, 365 and 850 µmohs, respectively, while CO14 had the lowest values of conductivity in tap, soft and hard water were 325, 320 and 810 µmohs, respectively, This increase in electric conductivity of spray solution would lead to deionization of fungicide and lead to increase deposit and penetration on the treated plant surface, then increase fungicidal efficiency [81].

4- pH value

As shown in Table (25), it was found that CO18 had the lowest values of pH in tap, soft and hard water were 7.18, 7.17 and 7.18, respectively, followed by CO9 which had 7.22, 7.20 and 7.23, respectively, while CO14 had the highest values of pH in tap, soft and hard water were 7.40, 7.40 and 7.41, respectively. This decrease of pH value of fungicide spray solution indicates an increase in positive charge of spray solution leading attraction between spray solution and the treated plant leaves, which have negative charges, then will increase the fungicidal efficiency [85].

Generally, as shown in Tables, (24) and (25), it was clear that CO18 had the best physico- chemical properties of formulation and for spray solution rather than the other successfully formulated WP's. Also, it had the best physico-chemical properties rather than the commercial formulated fungicides. This gives a prediction of increasing the fungicidal efficiency of CO18 rather than the other successful WP's and from the commercial fungicides.

	Surface Tension (dyne/cm)			**Viscosity** (centi poise)			**Conductivity** (μmohs)			**pH value**		
	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water
CO9	40.5	40.5	41.8	2.73	2.75	2.75	435	430	930	7.22	7.20	7.23
CO11	43.5	41.8	43.5	3.08	3.11	3.12	365	365	840	7.40	7.39	7.46
CO12	32.4	32	31.6	2.93	2.96	2.99	368	365	850	7.36	7.35	7.36
CO14	46.2	45.5	46.1	2.95	2.96	2.9	325	320	810	7.40	7.40	7.41
CO15	33.2	34.1	33.5	2.78	2.75	2.77	370	365	860	7.32	7.29	7.33
CO18	31.8	32.5	32.1	2.98	2.97	3.04	328	325	835	7.18	7.17	7.18

(Table 25): The physico-chemical properties of the spray solution of the locally formulated fungicides, Copper Oxychloride, at the field dilution rate.

III-4- Local formulations and the physico- chemical properties of the locally formulated, glyphosate isopropyl ammonium, as 48% SL

III-4-1- Local formulations of Glyphosate as 48% SL

The successful soluble liquid formulation should pass the miscibility test at the field dilution rat without showing any precipitation or oil separation, and it should cause observed decrease in the surface tension of water at field dilution rate according to FAO/WHO (2002) specifications[28]. As shown in Table (26), many trials was conducted to formulate glyphosate as 48% SL, many non-ionic surfactants as (PEG 600 ML, Tween 80, 40, Tween 20 and Triton x-100) and anionic surfactants as (potassium oleate, potassium laurate and SDS) were added to solution of glyphosate in water it was found that the formulation with surfactants: Tween 80, Tween 40, Potassium oleate and potassium laurate had oil separation layer when mixed with water, and the formulation with surfactant as SDS gave change gelatinous solution when mixed with water, while the most successful formulation SL's were that with surfactants PEG 600 ML, Tween 20 and Triton x-100 which gave complete solubility and clear solution when mixed with water, to take formulation Codes GL1, GL4 and GL5, respectively. Then the surface tension of each successful SL's were determined at field dilution rate and compared with the surface tension of glyphosate alone. It was found that the surface tension of glyphosate alone was 61.7 dyne/ cm, while GL1 cause the high decrease in surface tension 32.8 dyne/cm, followed by GL5 which 36.2

dyne/cm, while GL4 had 38.6 dyne/cm. So that, the physico-chemical properties was continued on these successful locally formulated soluble liquids.

Table 26: Locally formulations of glyphosate isopropyl ammonium herbicide as Soluble liquid 48% SL =(49.4% technical).

Formulation Code	Active ingredient	Surfactants		Solubility	Surface Tension (dyne/cm)
		Anionic	Non-ionic		
GL	Glyphosate (49.4%)	---	---		61.7
GL1	Glyphosate isopropyl ammonium (49.4%)	---	PEG 600 ML (5%)	Soluble	32.8
GL2		---	Tween 80 (5%)	Oil separation	-----
GL3		---	Tween 40 (5%)	Oil separation	-----
GL4		---	Tween 20 (5%)	Soluble	38.6
GL5		---	Triton x-100 (5%)	Soluble	36.2
GL6		Potassium Oleate (5%)	---	Oil separation	-----
GL7		Potassium Laurate (5%)	---	Oil separation	-----
GL8		SDS (5%)	---	Change to gelatinous solution	-----

III-4-2- The physico–chemical properties of the locally formulated glyphosate isopropyl ammonium as 48% SL

1- Miscibility test

Results obtained in Table (27) showed that all successful locally formulated herbicides passed successfully through miscibility test, since no precipitation or sedimentation occurred when it added in both soft and hard water at field dilution rate. These results comply with FAO/WHO (2002) recommendations[28].

2- Persistent foam

As shown in Table (27), it was found that GL1 had the lowest values of foam in soft and hard water 2 ml, followed by GL4 which had 4 and 5 ml, respectively, while GL5 had the highest values of foam in soft and hard water 14 and 18 ml, respectively. These results agree with FAO/WHO (2002) [28].

3- Free acidity or alkalinity

Data presented in Table (27) showed that all successful locally formulated SL's had high acidic values, where GL1 had the highest value of acidity % as H_2SO_4, 0.558. While GL5 had the lowest value of acidity 1.012 % as H_2SO_4.

4- Flash point

As shown in Table (27) it was found that all successful herbicides had flash point over 70°C, where it could be considered safe to use and this result agree with FAO/WHO (2002) recommendations [28].

5- Cold stability test

Results in Table (27) showed that all successful locally formulated herbicides passed successfully cold test without any separation or sedimentation and this result comply with FAO/WHO (2002) recommendations [28].

6- Accelerated storage

Results in Table (27) showed that GL5 passed successfully miscibility test without any precipitation or sedimentation in soft and hard water and a give clear solution when stored at 54°C for 14 days, while GL1 and GL4 not passed miscibility test when stored at 54°C for 14 days because it give oil separation, also it was found they gave a great change in the acidity values of GL1 and GL4, so that this result not agree with FAO/ WHO (2002) recommendations [28] to consider GL1 and GL4 were not successful SL formulation.

7- Surface tension

As shown in Table (27), it was found that GL1 had the lowest surface tension 34.9 dye/cm, followed by GL5 which had 37 dyne/cm, while GL4 had the highest surface tension 38.1 dyne/ cm.

8- Viscosity

Results in Table (27) showed that GL4 had the highest value of viscosity 73.6 centipoise, followed by GL5 which had 65.3 centipoise, while GL1 had the lowest viscosity value 57.2 centipoise.

9- Refractive index

As shown in Table (27), it was found that GL4 had the highest refractive index value 1.4273, followed by GL1 which had 1.4113 and GL5 which had 1.3968.

10- Density and specific gravity

Results obtained in Table (27) showed that GL1 had the highest values of density and specific gravity were 1.172 and 1.18 gm/cm^3, respectively, followed by GL5 which 1.169 and 1.17 gm/cm^3, respectively, while GL4 had the lowest values of density and specific gravity 1.162 and 1.15 gm/cm^3, respectively. These differences in physical phenomenon are attributed to the use of different adjuvant agents (wetting and spreading agent ….etc).

Table 27: The physico-chemical properties of the locally formulated herbicides, glyphosate isopropyl ammonium, as 48% SL.

√ = Complete solubility

Physical Properties / Formulation Code			GL1	GL4	GL5
Miscibility test (ml. precipitation)	Hard Water		√	√	√
	Soft Water		√	√	√
Foam Test (ml.)	Hard Water		0.0	0.0	0.0
	Soft Water		0.0	0.0	0.0
Free Acidity As % H_2SO_4			1.558	1.274	1.012
Flash Point (°C)			Over 70	Over 70	Over 70
Cold Storage			passed	passed	passed
Accelerated Storage	**Miscibility test** (ml. precipitation)	Hard Water	√	√	√
		Soft Water	√	√	√
	Free Acidity As % H_2SO_4		1.646	1.411	1.143
Physical Phenomenon	**Surface Tension** (dyne/cm)		34.9	38.1	37
	Viscosity (centi poise)		57.2	73.6	65.3
	Refractive Index		1.4113	1.4273	1.3968
	Density (gm/cm^3)		1.172	1.162	1.169
	Specific Gravity (gm/cm^3)		1.18	1.15	1.17

III-4-3- The physico-chemical properties of the spray solution of the locally formulated herbicides, Glyphosate, as 48% SL at field dilution rate

1- Surface tension

Results presented in Table (28) showed that GL1 had the lowest values of surface tension in tap, soft and hard water were 32.8, 33.4 and 33.1 dyne/cm, respectively, followed by GL5 which had 36.2, 36.4 and 36 dyne /cm, respectively, while GL4 had the highest values of surface tension 38.6, 38.1 and 37.8 and 37.8 dyne/ cm, respectively. This decrease is surface tension of spray solution give a prediction of increasing its wettability and spreading on the treated plant surface, then increasing herbicidal efficiency [21, 54].

2- Viscosity

Data obtained in Table (28) showed that GL4 had the highest values of viscosity in tap, soft and hard water were 1.82, 1.83 and 1.83 centipoise, respectively, while GL5 had the lowest viscosity values 1.72, 1.73 and 1.75 centipoise, respectively. This increase in viscosity of spray solution would increase the deposit on the treated plant leaves, reduce the drift and increase the efficiency of herbicides [76].

3- Electrical conductivity

As shown in Table (28), it was found that GL1 had the highest values of conductivity in tap, soft and hard water were 3550, 3420 and 4050 µmohs respectively, followed by GL4 which had 3050, 290 and 3420 µmohs, while GL5 had the lowest values of conductivity in tap, soft and hard water 2860, 2800 and 3160 µmohs, respectively. The increase of electrical conductivity of herbicidal spray solution would lead to deionization of herbicides and increase its deposit and penetration on the treated plant surface, then increase the herbicidal efficiency [81].

4- pH values

Results obtained in Table (28) showed that GL5 had the lowest values of pH in tap, soft and hard water were 4.72, 4.69 and 4.81, respectively, followed by GL1 which had 5.83, 5.87 and 5.82, respectively, while GL4 had the highest values of pH in tap, soft and hard water 5.96, 6.03 and 5.89, respectively. This decrease of pH value of spray solution indicates on increase in positive charge of spray solution leading to increase attraction between spray solution and the treated plant leaves, which have negative charges, then will increase the herbicidal efficiency [85].

Generally, as shown in Tables (27) and (28), it was clear that Gl5 had the best physico- chemical properties for formulation and for spray solution, because GL4 and GL1 had failed in the physico-chemical properties after heat accelerated storage. Also, Gl5 had nearly the similar physico-chemical properties for formulation and spray solution of Round up which had the best physico-chemical properties from between the commercial formulation herbicides. This gives a prediction of increasing the herbicidal efficiency of GL5 and Round up rather the other commercial formulation herbicides.

Table 28: The physico-chemical properties of the spray solution of the locally formulated glyphosate herbicides at the field dilution rate.

Formulation codes / Properties	GL1			GL4			GL5		
	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water	Nile Water	Soft Water	Hard Water
Surface Tension (dyne/cm)	32.8	33.4	33.1	38.6	38.1	37.8	36.2	36.4	36
Viscosity (centi poise)	1.73	1.78	1.74	1.82	1.83	1.83	1.72	1.73	1.75
Conductivity (μmohs**)**	3550	3420	4050	3050	2980	3420	2860	2800	3160
pH value	5.83	5.87	5.82	5.96	6.03	5.89	4.72	4.69	4.81

IV-1- Insecticidal efficiency of the locally and commercially formulated insecticides, chlorpyrifos, against 4th instar larvae of cotton leaf worm *(S. littoralis)*

The experiment was conducted to determine the initial mortality rate immediately after spraying and the morality at indicated days (3, 6, 9 and 12 days) after application, then determining the average residual toxic effect for both the commercial formulations and the most three successful locally formulated insecticides, chlorpyrifos, (CP23, CP32 and CP33), which had the best physico-chemical properties for both formulation and spray solution. Results presented in Table (29) showed that all locally formulated chlorpyrifos are successful in this test since they gave initial and residual insecticidal activity as the same or more than the regestirated commercial insecticides. Helban and CP32 gave the higher percent of the initial morality in the larvae, in which they had similar percent 100%), while CP32 gave the higher residual toxic effect

(29.15%) rather than that of Helban (26.65%), followed by CP33 which gave initial morality rate in the larvae and residual toxic effect 96.6 and 25.05%, respectively, while Pyriban A and CP23 had the same percent of the initial mortality 93.3%, but CP23 had the higher residual toxic effect (23.32%). Pestiban gave the lowest initial mortality rate and residual toxic effect 90 and 17.5%, respectively. These results agree with (Jaglan and Sircar, 1997) and (Abdau and Abdella, 2006) [103, 104]. From the above results it was cleared that Helban and CP32 which had the best physic-chemical properties between all locally and commercially formulated insecticides, chlorpyrifos, also they gave the higher initial morality rate and residual toxic effect. This gives an indication that the efficiency of any insecticides increased by improving the physico-chemical properties of both its formulation and it is spray solution.

Table 29: Effect of the locally formulated and commercial formulation insecticides, chlorpyrifos, on the initial mortality rate and

latent effect on the 4th instar larvae of *S.littoralis*:-

Treatments	Initial mortality %	% Mortality at indicated days after application				Average residual effect %
		3	6	9	12	
Helban	100	63.3	26.7	16.6	---	26.65
Pyriban A	93.3	53.5	20.0	6.7	---	20.05
Pestiban	90.0	46.7	16.6	6.7	---	17.5
CP23	93.3	56.6	26.7	10.0	---	23.32
CP32	100	70.0	30.0	16.6	---	29.15
CP33	96.66	63.3	23.4	13.5	---	25.05

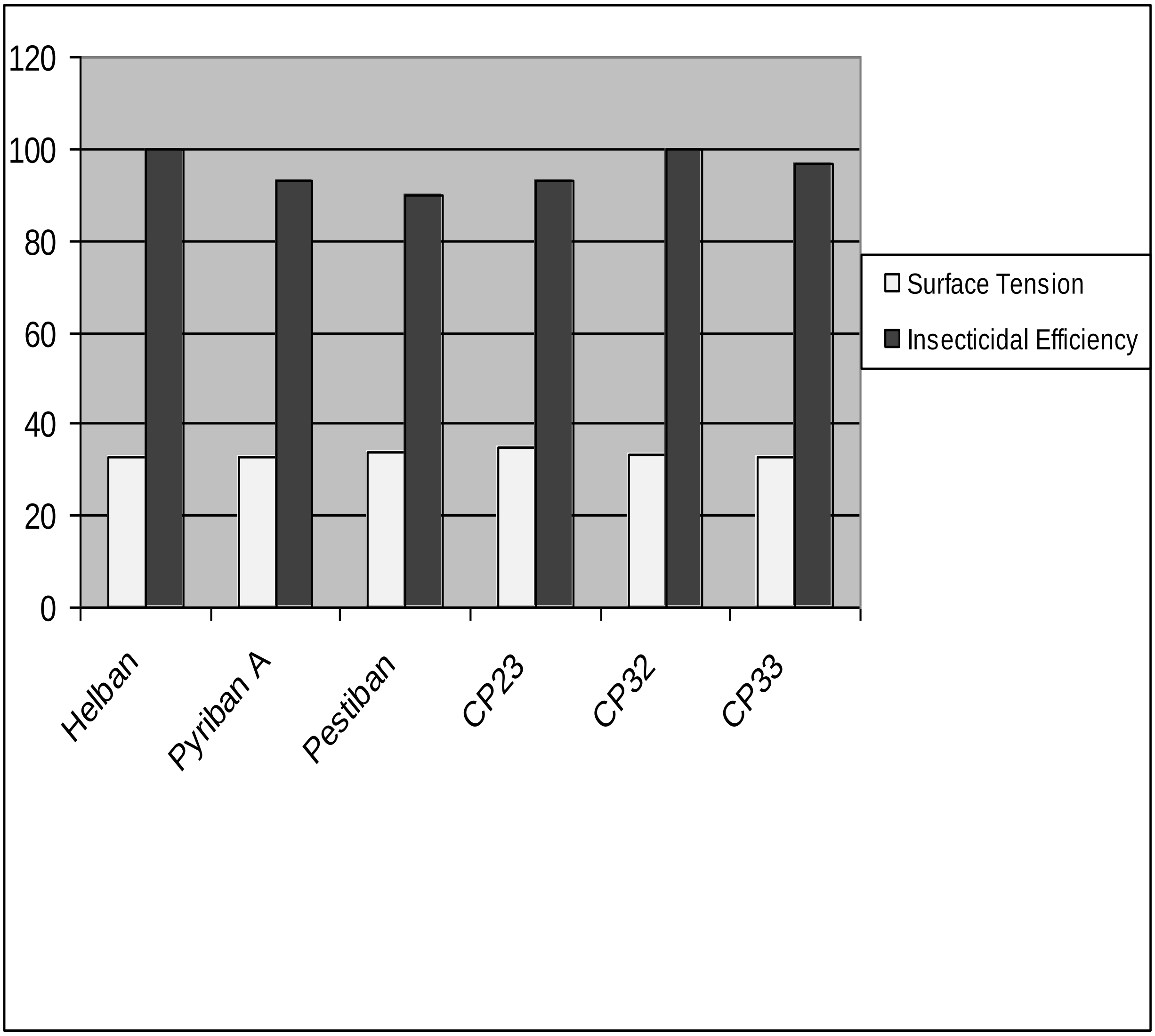

Fig. (7): Correlation between decreasing surface tension of spray solution and increasing insecticidal efficiency of the locally and commercially formulated chlorpyrifos insecticides.

IV-2- Insecticidal efficiency of the locally and commercially formulated insecticides, Methomyl, against 4th instar larvae of cotton leafworm

(S. littoralis)

The aim of this experiment was determination of the initial mortality rate and the mortality at indicated days (3, 6, 9 and 12 days) after application, then determining the average residual toxic effect for both the commercial formulation insecticides, methomyl, as 90% SP and the most three successful locally formulated insecticides, methomyl, (ME1, ME4 and ME5), which had the best physico-chemical properties for both formulation and spray solution. Data presented in Table (30) showed that all locally formulated methomyl are successful in this test since they gave initial and residual insecticidal activity more than the regestirated commercial insecticides. ME1 gave the higher percent of the initial mortality in the Larvae and the higher residual effect (96.6 and 12.4%) respectively, followed by ME4 which gave percent of initial mortality and residual effect 93.3 and 9.95%, respectively, and ME5 gave 90 and 8.32%, respectively, while it was found that the commercial formulation insecticides gave the lower percent of initial mortality and residual effect, where Hauyang gave percent of initial mortality and residual effect 86.6 and 8.32%, respectively, This result agree with (Jaglan and Sircar, 1997) and (Abdau and Abdella, 2006) [103, 104]. From the above results it was cleared that ME1 which had the best physico-chemical properties between the other locally and commercially formulated insecticides, methomyl, also gave the higher percent of initial mortality and residual toxic effect. This gave an indication that the efficiency of insecticides increased by improving the physico-chemical properties of both it is formulation and it is spray solution.

Table 30: Effect of the locally formulated and commercial formulation insecticides, Methomyl, on the initial mortality rate and latent effect on the 4th instar larvae of *S.littoralis*:-

Treatments	**Initial mortality %**	**% Mortality at indicated days after application**				**Average residual effect %**
		3	**6**	**9**	**12**	
Lannate	86.6	26.6	3.3	---	---	7.47
Hauyang	86.6	30.0	3.3	---	---	8.32
Kuik	76.6	23.3	---	---	---	5.82
ME1	96.6	36.3	13.3	---	---	12.4
ME4	93.3	33.3	6.6	---	---	9.95
ME5	90.0	30.0	3.3	---	---	8.32

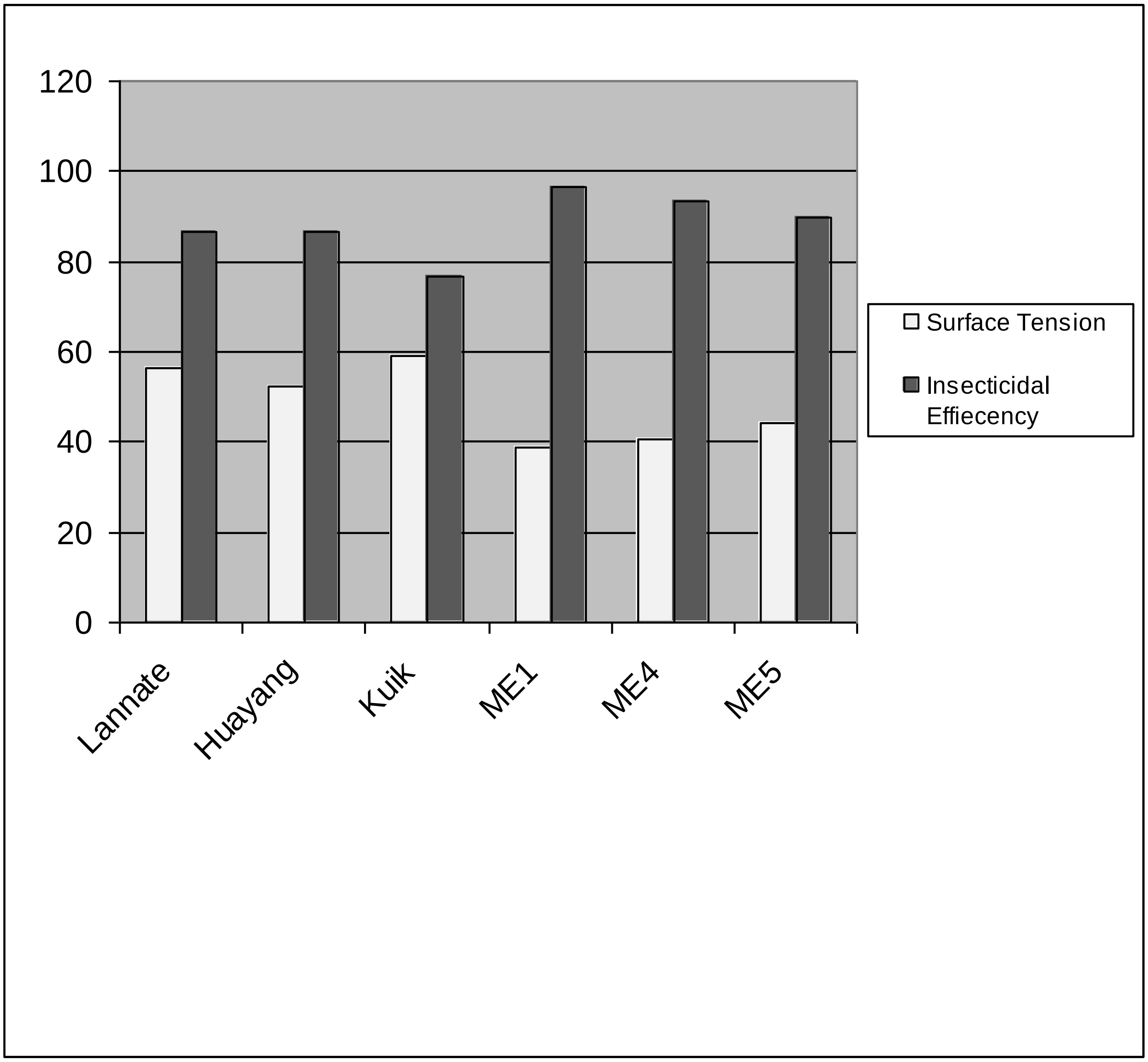

Fig. (8): Correlation between decreasing surface tension of spray solution and increasing insecticidal efficiency of the locally and commercially formulated methomyl insecticides.

IV-3- Fungicidal efficiency of the locally and commercially formulated fungicides, copper oxychloride against Downy Mildew infested onion plant

The experiment was conducted to determine the percent of growth inhibition of downy mildew fungus infested onion plant by using both of the commercial formulation fungicides, copper oxychloride, and the most three successful locally formulated copper oxychloride in the physico-chemical properties of formulation and spray solution (CO12, CO15 and CO18) which used as protective fungicides and sprayed for fifth consequence spraying. Results obtained in Table (31) showed that all locally formulated copper oxychloride are successful in this test since they gave % of growth inhibition more than the regestirated commercial fungicides. CO18 gave the higher percent of growth inhibition in the all fifth sprays, where the percent of growth inhibition in the all fifth sprays, where the percent was 35, 59.25, 77.41, 85.36 and 92.15%, respectively, followed by CO15 which gave percent of growth inhibition in all fifth sprays 20, 48.15, 64.51, 85.36 and 88.63%, respectively, and CO12 which gave percent of growth inhibition 30, 59.25, 67.74, 80.4 and 86.279, respectively. It was found that the commercial formulation fungicides gave the lower percent of growth inhibition in all fifth sprays, where Unicopper gave percent of inhibition in all fifth sprays 20, 48.14, 61.29, 78.04 and 80.39% respectively, while Copral gave the lower percent of growth inhibition in all fifth sprays from the other commercially and locally formulated copper oxychlroide were 15, 40.74, 58.6, 68.29 and 70.58%, respectively. This result agrees with (Khalil et al., 1992) and (Thind et al., 2004) [105, 106]. From the above results it was cleared that CO18 which had the best phsico-chemical properties from between all locally and commercially formulated fungicides, copper oxychlride also gave the higher percent of growth inhibition. This give an indication that the fungicidal efficiency increased by increasing the physico- chemical properties of both formulation and spray solution of fungicides.

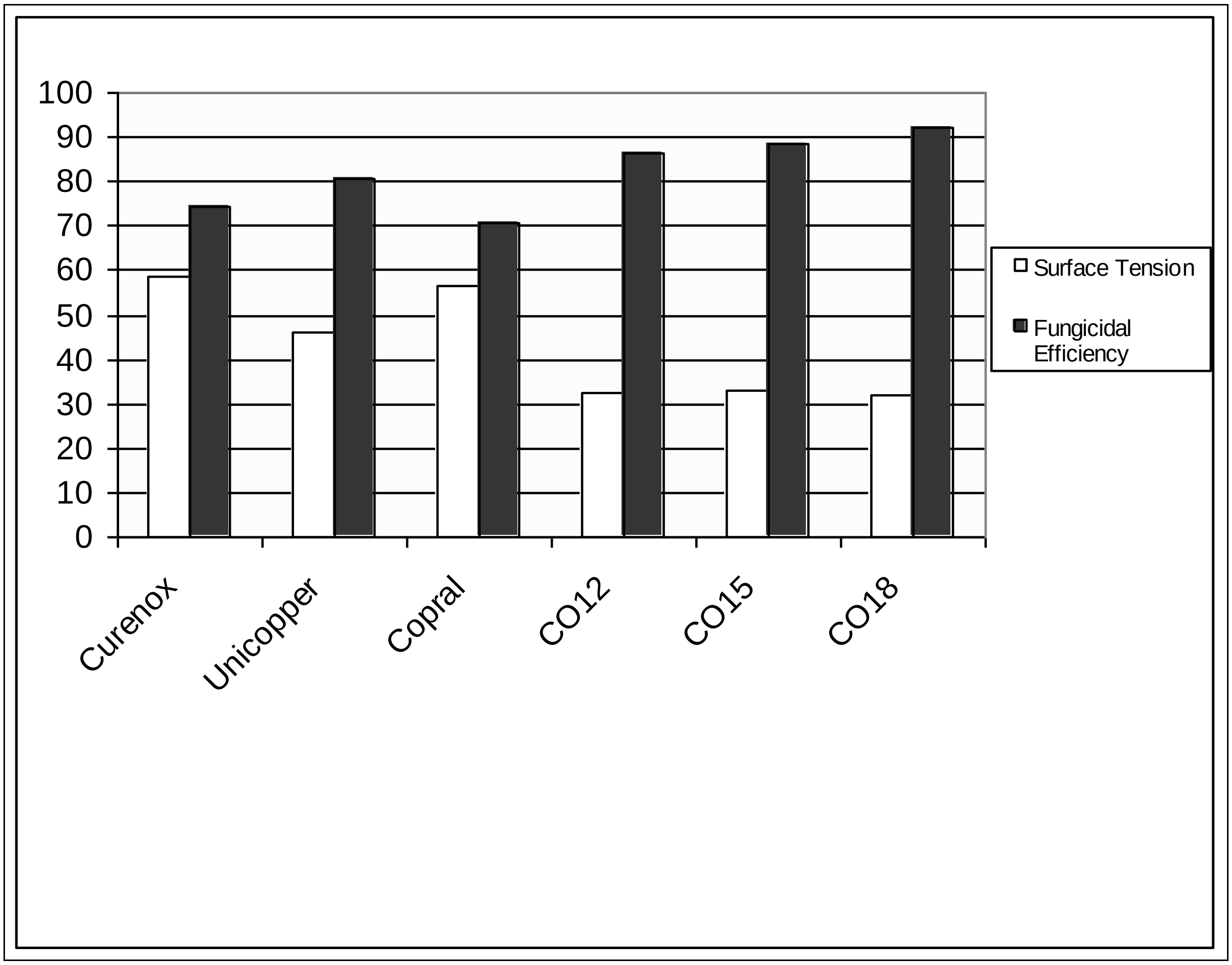

Fig. (9): Correlation between decreasing surface tension of spray solution and increasing fungicidal efficiency of the locally and commercially formulated copper oxychloride fungicides.

IV-4- Herbicidal efficiency of the locally and commercially formulated herbicdies, Glyphosate, against perennial narrow leaf weeds

The aim of this experiment was determination of the average fresh dry weight of weeds (gm/Cm^3), then determining the percent of efficiency of the both commercial formulation herbicides, glyphosate, and the locally formulated herbicides, GL5, which successes in the physico-chemical properties of both formulation and spray solution after 2, 3 and 4 weeks from treatment. As shown in Table (32), it was found that all locally formulated glyphosate are successful in this test since they gave % of efficiency as the same or more than the regestirated commercial herbicides. Round up gave the lower average fresh and dry weight of weeds after 2, 3 and 4 weeks where its % of efficiency 72.12, 80.37 and 84.68 % respectively, for fresh weeds and 62.94, 68.34 and 14.6 %, respectively, for dry weeks, followed by GL5 which had nearly the % of efficiency as Round up, for fresh weeds which were 70.02, 79.60 and 84.55 %, respectively, and it % of efficiency for dry weeks were 59.16, 68.36 and 74.43 %, respectively, while Herbazed had the higher average fresh dry weights of weeks after 2,3 and 4 weeks, so that it had the lower percent of efficiency after 2, 3 and 4 weeks for fresh weeks which were 63.89, 75.29 and 82.05% respectively, and it is percent for dry weeks 54.14, 60.73 and 71.38 %, respectively, this result agree with (Satao et al., 1995), (Sukhadia et al., 2000) and (Fritea et al., 2001) [107, 108, 109]. From the above results it was cleared that Round up and GL5 which had the test physico-chemical properties from between all locally and commercially formulated Herbicides, Glyphosate, also, they gave the higher percent of herbicidal efficiency. This give an indication that the herbicidal efficiency increased by increasing the physico–chemical properties of both formulation and spray solution of herbicides.

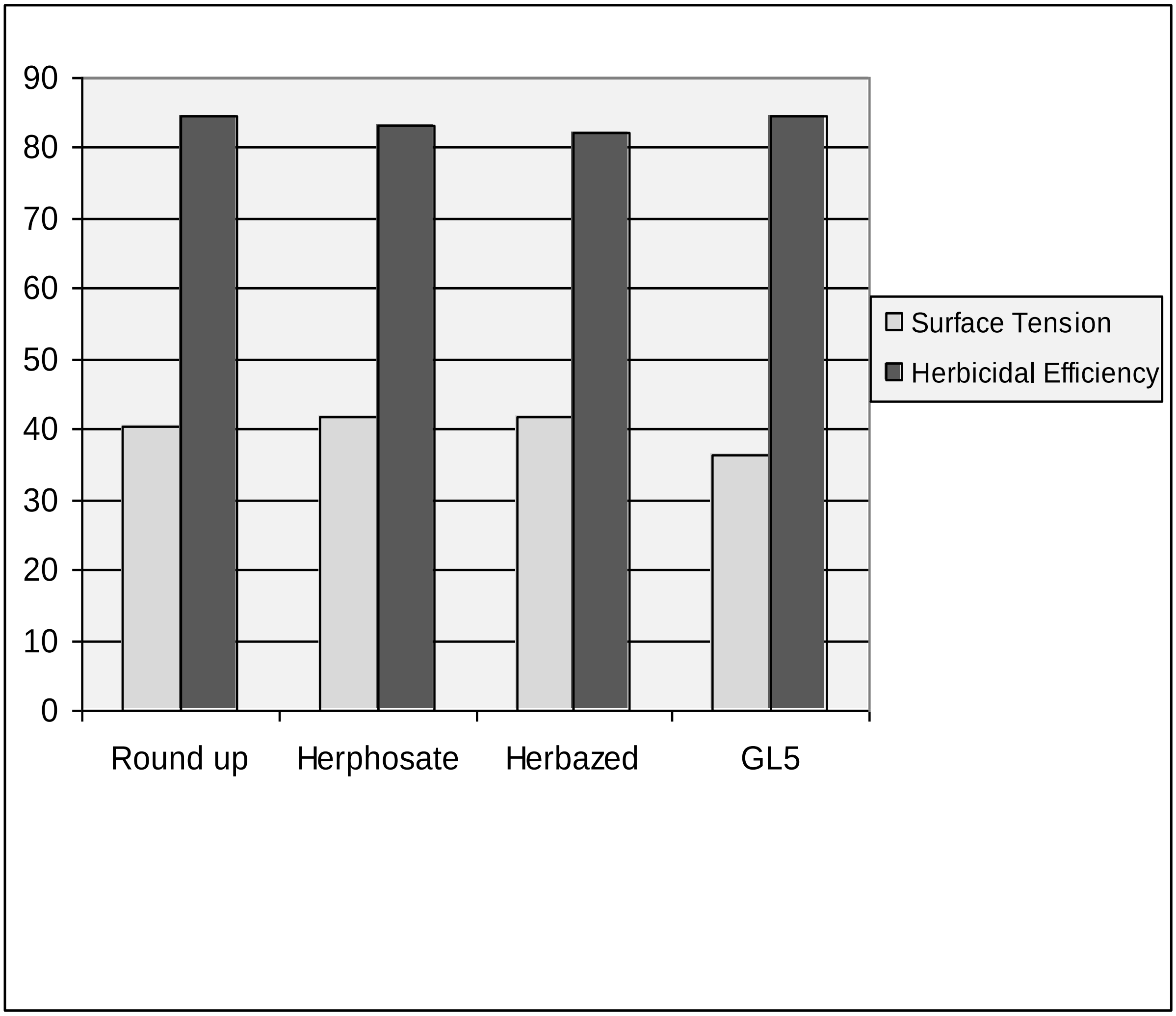

Fig. (10): Correlation between decreasing surface tension of spray solution and increasing herbicidal efficiency of the locally and commercially formulated glyphosate herbicides.

V-1- The residue of the locally and commercially formulated insecticides, chlorpyrifos, in cotton leaves

Results obtained in Table (33) showed that Helban gave the higher initial deposit in leaves which was 33.49 ppm, then decreased to 20.11 ppm 3 days after treatment and decreased to 5.50, 1.45, 0.036 and zero ppm at 6, 10, 15 and 17 days after application. The data indicate that the loss rates were amounted to 39.95, 83.5, 95.76 and 99.89 % after 3, 6, 10 and 15 days, respectively, and its residue half –life value was 2.796 days. The higher deposit of Helban followed by CP32 which had initial deposit in leaves 33.12 ppm, then decreased to 18.57, 4.90, 1.10, 0.18 and zero ppm at 3, 6, 10, 15 and 17 days after application, and its residue half –life value was found to be 2.568 days. CP33 gave initial deposit in leaves was 32.66 ppm then decreased to 19.14, 5.52, 1.50, 0.023 and zero ppm at 3, 6, 10, 15 and 17 day after application. The data indicate that the loss rates were amounted to 41.39, 83.09, 95.40 and 99.92% after 3,6,10 and 15 days from application, respectively, and its residue half –life value was 2.74 days, while Pyriban A gave the lower initial deposit in leaves was 30.81 ppm, then decreased to 15.86, 4.62, 0.80, 0.012 and zero ppm after 3, 6, 10, 15 and 17 day after treatment, respectively. The data indicate that the loss rate was amounted to 48.5, 85.0, 97.4 and 99.9% after 3,6,10 and 15 days, respectively, and its residue half –life value was 2.43 days. It was considered that the preharvest intervals period (PHI) for the locally formulated and commercially formulated chlorpyrifos was 15 days where the residue levels for all insecticide were less than maximum residue levels (MRL) which should not exceed 0.05 ppm according to Codex (2008). These results agree with the data of Al-Samariae (1988), Kaushik et al., (2002), Aguilera (2003) and Jha et al. (2006) [86, 110, 111, 112]. From the above results in Table (33)it was cleared that Helban and CP32 gave the higher initial deposit on the treated plant leaves, so that Helban and CP32 gave the higher insecticidal efficiency as shown before in Table (29), as a result of increasing the initial deposit on the treated plant leaves, where the increasing of deposit on plant leaves was related to the best physico- chemical properties of Helban and CP34 spray solution than the other locally and commercially formulated chlorpyrifos insecticides.

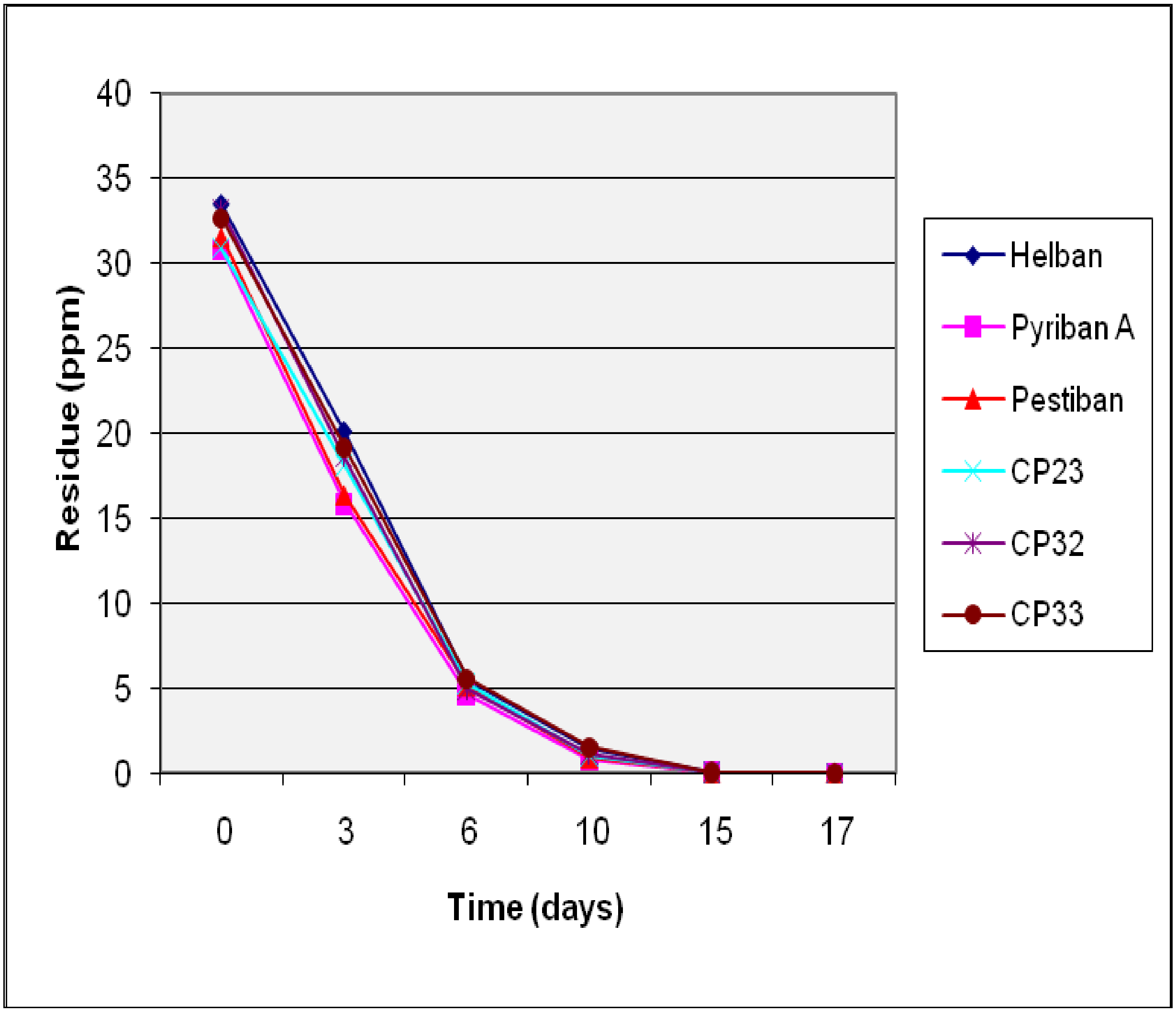

Fig. (11): The persistence of the locally and commercially formulated insecticides, chlorpyrifos, in cotton leaves.

V-2- The residue of the locally and commercially formulated insecticides, Methomyl, in and on cotton leaves

Data presented in Table (34) showed that ME1 gave the higher initial deposit in leaves was 20.24 ppm, then decreased to 12.05, 8.07, 3.40 and 0.31 ppm at 1, 3, 5 and 7 days after treated. The data indicated that the loss rates of ME1 were amounted to 40.46, 60.12, 83.20 and 99.84% after 1, 3, 5 and 7 days, respectively, and its residue half –life value was 1.647 days. It was found that the higher deposit for ME1 followed by ME4 which gave initial deposit in leaves was 17.99 ppm, then decreased to 10.98, 7.42, 3.06 and 0.026 ppm at 1, 3, 5 and 7 days after application. The data indicate that the loss rates of ME4 were amounted to 38.96, 58.75, 82.99 and 99.85% at 1, 3, 5 and 7 days, respectively, and its residue half –life value 1.671 days. ME5 gave initial deposit in leave was 16.91 ppm the decreased to 10.21, 7.17, 2.93 and 0.017 ppm at 1, 3, 5 and 7 days after treatment and its residue half –life value 1.632 days, while Kuik gave the lower initial deposit in leaves 15.36 ppm, then decreased to 8.03, 5.82, 1.83 and zero ppm at 1, 3, 5 and 7 days after application. The data indicate that the loss rates of Kuik were amounted to 47.42, 62.10, 88.08 and 100% after 1, 3, 5 and 7 days, respectively, and its residue half –life value 1.987 days. It was considered that the preharvest intervals period (PHI) for the locally formulated and commercially insecticides, Methomyl, was 7 days, where the residue levels for all insecticides at this period were less than the maximum residue levels (MRL) which should not exceed 0.1 ppm in cotton plant according to codex (2008). The present results are in agreement with findings of Gambacorta et al. (2005) and khay et al., (2006) [86, 114, 115].

From the above results, it was cleared that ME1 had the higher initial deposit on the treated plant leaves after treatment, so that ME1 gave the higher insecticidal efficiency as shown before in Table (30), as a result of increasing the deposit on the treated plant leaves, where the increasing of initial deposit on plant leaves was related to the best physico- chemical properties of ME1 spray solution than the other locally formulated and commercially methomyl insecticides.

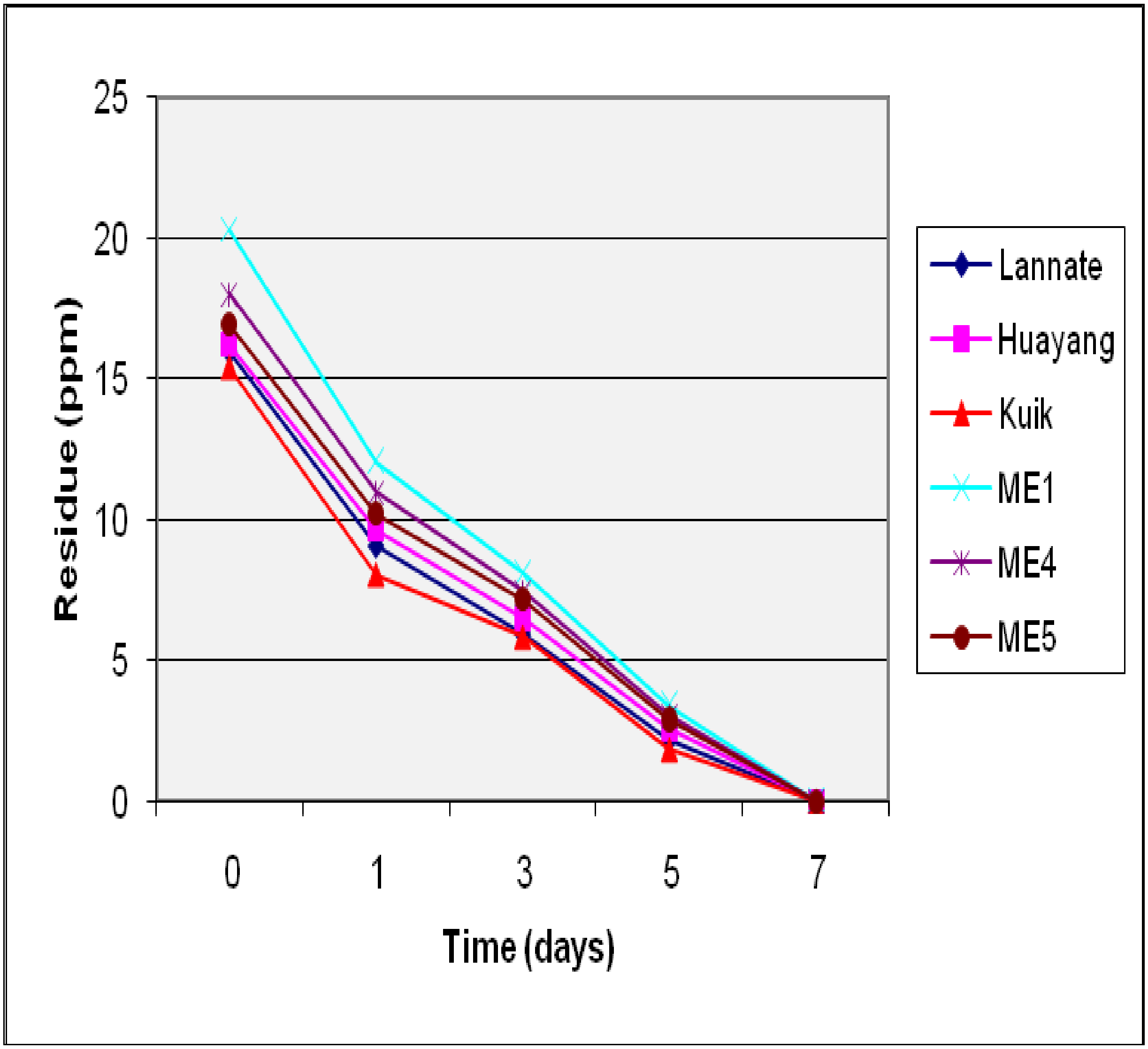

Fig. (12): The persistence of the locally and commercially formulated insecticides, methomyl, in cotton leaves.

V-3- The residue of the locally and commercially formulated fungicides, copper oxychloride, in and onion plant

Results obtained in Table (35) showed that CO18 gave the higher initial deposit on onion plant was 441.5 ppm, and then decreased to 218.6. 126.6, 60.73 and 5.16 ppm at 5, 10, 15 and 20 days after treatment. The data indicate that the loss rates of CO18 were amounted to 50.17, 71.32, 86.24 and 98.83% after 5, 10, 15 and 20 days, respectively, and its residue half-life was 5.58 days. The higher initial deposit of CO18 followed by CO15 which gave intial deposit was 426.8 ppm, then decreased to 203, 125.07, 4.5 and 2.24 ppm at 5, 10, 15 and 20 days after application. This data indicate that the loss rates of CO15 were amounted to 52.43, 70.69, 98.94 and 99.47% after 5, 10, 15 and 20 days, respectively, and its residue half- life was 4.143 days, and CO12 which gave initial deposit 388.1 ppm then decreased to 182.4, 134.9, 25.04 and 1.21 ppm at 5, 10, 15 and 20 days after treatment, and Unicopper gave initial deposit 342.9 ppm, then decreased to 192.72, 108.6 and 3.94 ppm at 5, 10, 15 and 20 days after treatment, and its residue half- life was 4.834 days. While Curenox gave the lower intial deposit was 275 ppm, and then decreased to 125.1, 103.2, 36.1 and 3.49 ppm at 5, 10, 15 and 20 days after treatment. This data indicate that the loss rates of Curenox were amounted to 54.4, 62.47, 86.87 and 98.5 % after 5, 10, 15 and 20 days, respectively, and its residue half- life was 7.04 days. It was considered that the preharvest intervals period (PHI) for Unicopper, Corpal, CO12 and CO15 was 15 days, while for Curenox and CO18 was 20 days, where the residue levels for all these fungicides must be less than the maximum residue levels (MRL), which was 30 ppm according to codex (2008) [86].

From the above results, it was cleared that CO18 had the higher initial deposit on the treated plant leaves after treatment, so that CO18 gave the higher fungicidal efficiency as shown before in Table (31), as a result of increasing the deposit on the treated plant leaves, where the increasing of initial deposit on plant leaves was related to the best physico- chemical properties of CO18 spray solution than the other locally formulated and commercially copper oxychloride fungicides.

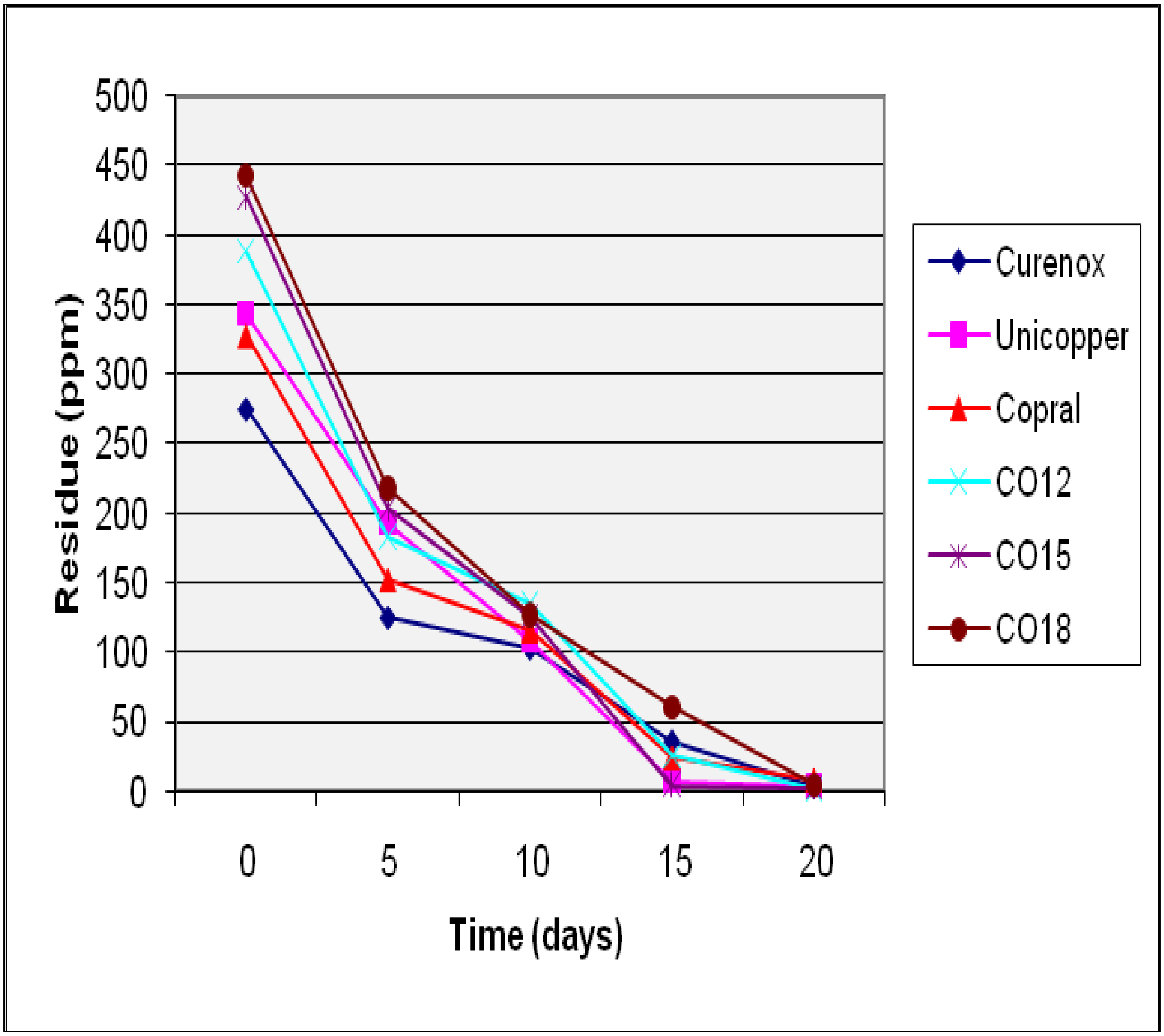

Fig. (13): The persistence of the locally and commercially formulated fungicides, copper oxychloride, in onion plant.

V-4- The residue of the locally and commercially formulated herbicides, Glyphosate isopropyl ammonium

Data presented in Table (36) showed that Round up gave the higher initial deposit in weeds was 14.35 ppm, then decreased to 5.69, 1.43 and zero ppm at 5, 10 and 15 days after treatment. The data indicate that the loss rates of round up were amounted to 60.34, 90.03 and 100% after 5, 10 and 15 days, respectively, and its residue half- life was 4.91 days. The higher initial deposit of Round up followed by GL5 which gave initial deposit was 13.14 ppm, then decreased to 4.28, 0.83 and zero ppm at 5, 10 and 15 days after application. The data indicate that the loss rates of GL5 were 67.42, 93.45 and 100% after 5, 10 and 15 days, respectively, and its residue half- life was 4.188 days. Herphosate gave initial deposit was 9.82 ppm then decreased to 3.19 , 0.65 and zero ppm at 5, 10 and 15 ppm after treatment, and its residue half- life was 4.19. While Herbazed gave the lower initial deposit was 8.61 ppm, and then decreased to 3.14, 0.69 and zero ppm at 5, 10 and 15 days after application, and its residue half- life was 4.58 days. It was considered that the perharvest intervals period for the locally and commercially formulated herbicides, Glyphosate, was 15 days, where the residue levels for all herbicides at this period were less than the maximum residue levels (MRL) which should not exceed 0.2 ppm according to codex (2008). The present results are in agreement with findings of Cessna and Cain (1992), Griffiths and Mason (2003) and Lorenzatti et al., (2004) [86, 116, 117, 118].

From the above results, it was cleared that Round up and GL5 had the higher intial deposit on the treated plant leaves, so that they gave the higher herbicidal efficiency as shown before in Table (32), as a result of increasing deposition on the plant leaves, where the increasing of initial deposit on plant leaves was related to the best physico – chemical properties of Round up and

GL5 spray solution than the other commercially formulated glyphosate herbicides.

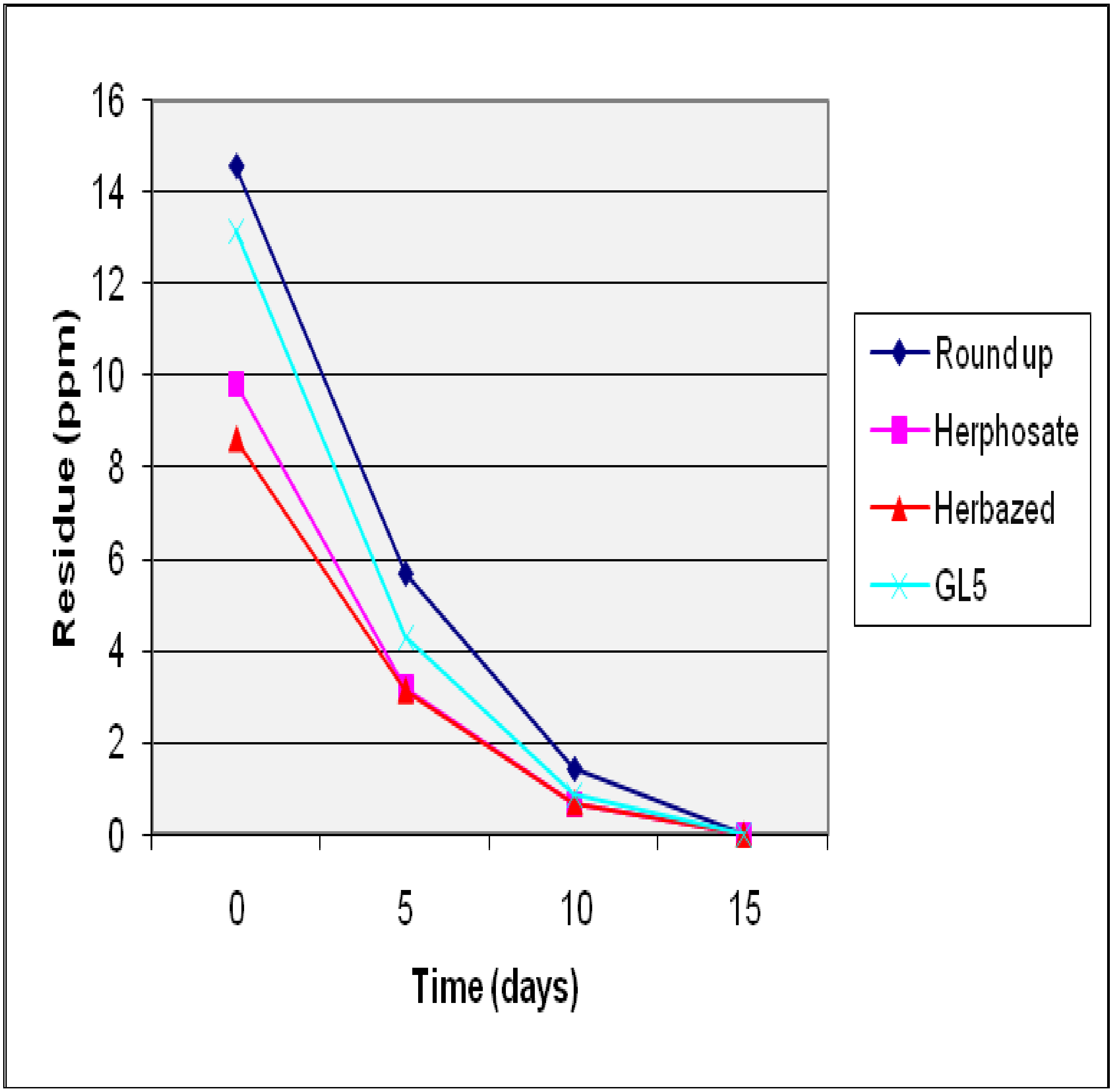

Fig. (13): The persistence of the locally and commercially formulated herbicides, glyphosate, in grass leaves.

Table (36): Determination the residue of the locally formulated and commercial formulation herbicides, Glyphosate, on the Weeds:-

Time after treatments (days)	**Round UP**		**Herphosate**		**Herbazed**		**GL5**	
	Residue* (ppm)	Loss %	Residue* (ppm)	Loss %	Residue* (ppm)	Loss %	Residue* (ppm)	Loss %
Initial (deposit)**	14.56	--	9.82	--	8.61	--	13.14	--
5	5.69	60.34	3.19	67.51	3.14	63.53	4.28	67.42
10	1.43	٩٠.٠٣	0.65	٩٣.٣٨	0.69	91.98	0.86	93.45
15	UD	١٠٠	UD	100	UD	100	UD	100
RL_{50}	4.91		4.19		4.853		4.188	

*: Each value represents an average of three replicates. UD: Undetected

**: Samples were taken one hour after application.

The general conclusions of this study are

1- The local raw materials and products which used as emulsifiers, solvents and co-solvents are suitable for preparation successful formulation of the conventional insecticides: chlorpyrifos as 48% emulsifiable concentrate, where wetting and spreading agents are suitable for preparation successful formulation of methomyl as 90% soluble powder and glyphosate as 48% soluble liquid, while carriers, suspending, wetting and spreading agents are suitable for preparation successful formulation of copper oxychloride as 50% wettable powder.

2- Although the locally prepared formulation and commercially formulation of chlorpyrifos, methomyl, copper oxychloride and glyphosate contained the same percent of active ingredient and tested by the same concentration but they gave different result in their pesticidal efficiency against different pests, deposit and residue on treated leaves.

3- There are correlation between the physico-chemical properties of field spray solution and both of deposit on treated plant and pesticidal efficiency. Deposit and pesticidal efficiency increasing by decreasing surface tension, decreasing pH corresponding with increasing electrical conductivity and increasing viscosity of spray solution.

4- Physical properties of locally prepared formulation (emulsion stability, persistent foam, free acidity or alkalinity, flash point, cold test and accelerated storage) for emulsifiable concentrate, (solubility test, persistent foam, free acidity or alkalinity, % particle size, bulk density and accelerated storage) for soluble powder and (suspensibilty test, persistent foam, free acidity or alkalinity, wet sieve test, wettability, bulk density and accelerated storage) for wettable powder and physical phenomena (surface tension, viscosity, refractive index, specific gravity and density) and physico-chemical properties of spray solution are depend on the type and percent of the formulation constituents (solvent, co-solvent and emulsifiers) for emulsifiable concentrate and (carriers, suspending, wetting and spreading agents) for wettable powder.

5- Since any change in the constituents of formulation either in type or percent cause changes in physical phenomena, physico-chemical properties of formulation, physico-chemical properties of spray solution and insecticidal efficiency, therefore it could be recommended by necessity of carrying out the physical phenomena tests which called physical fingerprint during registration of any pesticide formulation and at production for discovering any change in the formulation constituents than registerated which will affect in its pesticidal efficiency, by the other meaning, discovering any traditional deceive.