Double Action Formulations of Two Plant Growth Regulators in Combination with Abamectin and Their Stability in Different Types of Water

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Received: *24/5/2020*

Abstract: The present study aimed to prepare certain formulations that contain an acaricide (abamectin) and one of plant growth regulators (β-Naphthoxy acetic acid [NAA] or 6-benzylaminopurine [6-BAP]). The study also investigated the effect of pH and total soluble salts of certain types of diluted water on the physical and chemical properties of those formulations. The purpose of combining the two active ingredients (acaricide and a plant growth regulator) is to save time and money of the application. Water analysis revealed that different types of collected water from different sources had an alkaloid level where pH values were more than 7.0. It can also be seen that underground water the highest value of pH was (8). The results indicated that Beta 410® and Cyto G 5%® reduced the pH value of the all tested water sources to be in the acid range (5.5). Both Beta 410® and Cyto G 5%® acted as plant growth regulators and they were useful for lowering the pH of the ground water that has been used for dilution. Therefore, they can act as buffering agents where the ground water is still being used for dilution of pesticides. The study also investigated the effect of salinity of different tested types of water on the stability of the prepared emulsifiable concentrate formulations. The results of testing each component alone (Beta410®, Cyto G® and Abalone®) showed that these tested ingredients were stable in all tested water samples, exception underground water with the formulation (Abalone + Cyto G).

Keywords: Pesticides formulation, plant growth regulator, sprays pH and ground water

INTRODUCTION

Pesticide formulation is the process of transforming a pesticidal chemical into a form which can be applied, by practical methods, to permit their effective, safe and economical use (Friloux and Tann, 1993). The primary objectives of formulation technology are to optimize the biological activity of the pesticide and to give an effective product which is safe for use. Moreover, the introduction of additives and adjuvants aim to minimize the residues of pesticides on food crops after spraying. All of these aspects increase the pressure on the development of improving formulations and adjuvant technologies (Knowles, 2008; Hazra *et al.,* 2013). Pesticide formulation is classified into two general types, according to the physical forms; namely, liquid and dry formulations. Liquid formulations are among the most popular formulation types. Emulsifiable and similar liquid concentrates are considered economic formulations. It is worth to mention that all liquid formulations have the same requirements, that is solvent or fluid diluents must be physically compatible with the active ingredient under all conditions of storage (Caswell, 1980). Emulsifiable concentrate (EC) consists of the toxicant, the solvent and the emulsifier. The solvent and its concentration determine the solubility characteristics of the pesticidal chemical particularly for the purpose of storage conditions. In addition, at a given concentration, the physical nature of the combination of pesticidal chemical and the solvent determines the type of emulsifier and emulsifier balance to be used. Therefore, the selection of solvent and emulsifier is a critical issue representing the initial phase of emulsifiable concentrate development (Frear, 1955). Surfactants can readily penetrate leaf cuticle and be absorbed into the underlying cells where they can affect cellular processes (Silcox and Holloway, 2018). The pH of water can negatively affect the stability of some pesticides. Under alkaline conditions, alkaline hydrolysis occurs which degrades the pesticide to non-toxic (inactive) forms. In general, insecticides (particularly organophosphates and carbamates) are more susceptible to alkaline hydrolysis than are fungicides, herbicides or growth regulators. Water may become acidic after addition of several compounds (Dimethoate, MSR, Orthene, Malathion), or may not change so much for others (Diazinon), and actually became more alkaline after addition of others as Lorsban (Palumbo *et al*., 2001). Also, no significant changes were found in pH levels after the addition of spinosad, regardless of the buffer concentration. However, reports from Dow Agrosciences have suggested that the performance of Success® (Spinosad) is thought to be altered when mixed and sprayed under moderately acidic (pH < 6) conditions (Saunders and Brett, 1997). Water pH can affect a pesticide chemical breakdown (hydrolysis) in spray solution. It has been documented that certain insecticides degrade or undergo hydrolysis faster in water with a high pH (Boerboom, 1995). Hock (1995) indicated that if the water supply is alkaline, especially if the pH is 8 or more, and the applied pesticide is sensitive to hydrolysis, it should lower the pH of the water in the spray tank. Boerboom (1995). This means that the degree of pest control may be somewhat less than desirable, or even nonexistent, because certain amount of the active ingredient may be decomposed to an inactive form before it reaches the plant and the pest. Addition of a buffering agent to the spray preparation is an easy and economical way to guarantee maximum results from pesticide applications (Hock, 1995; Fishel and Ferrell, 2007). The present study aimed to prepare certain formulations that contain an acaricide (abamectin) and one of plant growth regulator (β-Naphthoxy acetic acid [NAA] or 6-benzylaminopurine [6-BAP]). The study also

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investigated the effect of pH and total soluble salts of diluted water collected from certain sources on the physical and chemical properties of the prepared formulations.

MATERIALS AND METHODS

Tested Formulations:

Prepared plant growth regulators.

Beta 410® (Appendix 1) is a formulation that consists of: 2-naphthoxyacetic acid (NAA) 10g/100 ml, Polysorbate 20 (Twin 20®) (surfactant) 12g/100 ml, Propylene glycol (humectants) 3g/100 ml and DMF (dimethyl formamide), organic solvent has been used to make final volume to be100 ml.

Cyto G5%® (Appendix 2) consists of**:** 6-benzyamino purine 2.5g/100 ml**,** Gibberellic acid 2.5 g/100 ml**,** Polyrbate 20 (Twin 20®) (surfactant) 12g/100 ml**,** Propylene glycole (humectants) 3g/100 ml, Carboxy methyl cellulose (CMC) (dispersant thickner) 0.2g/100 ml and Dimethyl formamide (DMF) solvent up to 100 ml.

Acaricide. Abalone® 1.8%: It is an acaricide that contains abamectin (1.8%).

Certain formulation: formulation A: consists of (2-Naphthoxyacetic acid 10% + abamectin 1.8%).

Formulation B: consists of **(**6-benzyl amino purine 2.5%, gibberellic acid 2.5% and Abamectin 1.8%).

Table (1): The main components of the different tested formulations (within an emulsifiable concentrate of a volume of 100 ml)

Formulation**	Main component (s)	Concentration of active ingredients (%)
Beta 410®	2-Naphthoxy acetic acid (NAA)	10
Cyto G 5%®	6-benzylamino purine (6-BAP) +	2.5
	Gibberellic acid (GA) +	2.5
	(Carboxy methyl cellulose) (CMC)	0.2
Abalone® 1.8%	Abamectin (an acaricide)	1.8
Formulation A	2-Naphthoxyacetic acid (NAA) +	10
	Abamectin	1.8
Formulation B	Cyto G :	
	(6-benzylamino purine (6-BAP) +	2.5
	Gibberellic acid (GA) +	2.5
	Carboxy methyl cellulose) (CMC)	0.2
	+ Abamectin	1.8

** All tested formulations (except Abalone® 1.8%) contain polysorbate 20 (Twin 20®) (12 g), propylene glycol (3 g) and dimethyl formamide as a solvent to complete the final volume of the formulation to 100 ml.

Water samples:

Waters were sampled from five sources at El-Sharkia Governorate; two of them from Nile River and two underground water as well as tap water. Nile River surface water samples were sampled from two locations of Ismailia River branch and two locations of ground water from El-Sharkia farm were selected. A single grab water sample was collected in 2 l glass bottles. The samples were collected at a depth of 10-20 cm below the water surface.

Estimation of pH and total soluble salts of the sampled water.

Water samples were submitted to analyses on the same day as they were collected. The pH values before and half an hour after the addition of each tested compounds at concentrations of a final spray solution. Values were estimated in 100 ml sample of each dilution using with a high accuracy electrochemistry test pen (pH PAL, *ti* Trans instruments, TI99-13154, UAS). Three replicates were employed for each sample because the average of pH values deviated by a maximum of 0.2 pH unit for any treatment, statistical analysis was not conducted. The pH value of each mixture with water or of an undiluted aqueous formulation was determined by means of a pH meter and an electrode system, pH Meter (Model: Jeway 3510) that has been initially standardized using J.T. Baker buffered solution of pH 4 and 7 (Park, Scientific Limited, Northampton, UK). One gram was weighed from sample into 100 ml distilled water in a beaker and shaken vigorously to be mixed completely. The electrode was immersed into the sample and left for 5 min without stirring during the measurement at a room temperature to allow the pH value to stabilize. The instrument must be calibrated before the measurement. The electrode was washed thoroughly between samples readings using a stream of distilled water to remove all traces of the previous sample (CIPAC, 1999). The conductivity of spray solutions was measured by

Conductivity and Salinity meter "Thermo Orion model 115A+, USA". The measurements were made at 25±2°C. Before the measurement, the conduct meter was calibrated with 0.01 M KCl solution (CIPAC, 1995). One gram was weighed from sample into 100 ml distilled water in a beaker and shaken vigorously to be mixed completely; it was immersed into sample and left for 1-2 min during the measurement at a room temperature to allow the conductivity value to stabilize. Total soluble salts and pH of water was done according to WHO (1973). This test is suitable for emulsifiable concentrate (EC) and emulsion oil in water (EW) pesticide formulations and it has been modified by CIPAC (1999).

Emulsion stability:

Emulsion characteristics were investigated by adding 5 ml of each of the obtained formulation to the sampled water in a 100 ml measuring cylinder to produce 100 ml of aqueous emulsion. The cylinder was stoppered and inverted up down 10 times. Subsequently, the amount of free oil or cream that separated at the top or the bottom of the emulsion was recorded. The emulsion was allowed to stand undisturbed for certain time intervals (initial time, 0.5h and 24h for re-emulsification).

Field experiment:

The Effect of the tested different formulations (Abalone® and formulations A&B) on the moving stages of the two spotted spider mite, *T. urticae* was investigated. These experiments were carried out in El-Housssinea region, EL-Sharkia Governorate and designed as randomized complete block where the plot area was 7*12 m (*i.e.* 84 m^2) and 4 replicates were set up for each treatment to evaluate the efficiency of the evaluated formulations against the two spotted spider mite *T. urticae* infesting tomato. Tomato plants (variety Hadeer) received two sprays, the first one when their age was 38 days and the second after one week (7 days) where their age reached 45 days. The Knapsack sprayer 20 litters capacity was used for the application and samples were taken after 3, 7, 9 days post-application. A sample of 10 leaves were picked up from each replicate, thus the final sample size for each treatment were 40 leaves. One Squared $inch^2$ from the upper and lower sides of each leave was examined using a stereo microscope; the live moving stages of the mite were counted on each leaf. The average numbers in treated and untreated leaves were calculated and the percentages of reductions in infestation were calculated according to the Henderson and Tilton (1955) equation as follows:

$$\textbf{Percentage of reduction in infestation} = \left(1- \frac{A \times B}{C \times D} \times 100\right)$$

Where:

A= the average number in untreated plot before treatment.
B = the average number in treated plot after treatment.
C= the average number in untreated plot after treatment.
D= the average number in treated plot before treatment.

RESULTS AND DISCUSSION

The prepared formulation Beta 410®, Naphthoxy acetic acid (NAA) is a plant growth regulator which promotes fruits setting and flowering. Also, it has been used for controlling of pre-harvest fruit drop especially on grapes, pine apples, strawberries and tomato. The main active ingredients of the prepared formulation Cyto G5%® are 6-benzylaminopurine (6-BAP) and gibberellic acid (GA), stimulate cell elongation, regulate growth and produce fruits without seeds. The tested formulation Abalone® 1.8% is an acaricide that contains abamectin (1.8%). Abamectin is acting as acaricide and insecticide with contact and stomach action. It is a broad-spectrum acaricide with additional insecticidal action on a limited number of insects (leaf miners, suckers and Colorado beetles). It was used alone at the rate of application of 0.5 cm^3/l. The prepared formulation A is a plant growth regulator which promotes fruits setting and flowering with abamectin is a broad-spectrum acaricide with additional insecticidal action on a limited number of insects. The prepared formulation B acts as a broad-spectrum acaricide with additional insecticidal action on a limited number of insects with PGRs that stimulate cell division and lateral buds' emergence. The main components of the different prepared and tested formulations are shown in Table (1). All tested formulations were sprayed at a rate of application of 50 ml/100liters.

Physic-chemicals properties of the sampled water

This part involved the estimation of physical and chemical properties of the sampled water. The pH values, total dissolved salts (TDS) and the electrical conductivity (EC) were the parameters that have been taken into consideration. The results in Table (2) showed that the ground water collected from Abo-Baker farm, El-Houssinia (source D) has the highest value of pH (8.1) and the concentration of the dissolved salts reached the highest level of 932 ppm. On the other hand, tap water was found to be more neutral with the lowest detected pH of 7.3. This water also had the lowest concentration of dissolved salts (198 ppm). According to Yates (2004) each pesticide application needs to be made under conditions that will yield maximum activity. An area that deserves more attention is the effect of water quality on efficacy of many pesticides. However, it has been shown that in many areas of El-Beheira Governorate water supplies have sufficient natural alkalinities to cause hydrolysis of certain pesticides. This means that a pesticide may begin to break down as soon as it is added to the tank. In practical terms, according to Boerboom (1995), this means that the degree of pest control may be somewhat less than desirable, or even nonexistent, because certain amount of the active ingredient maybe decomposed to an inactive form before it reaches the plant and the pest. These results should serve as a useful guideline as water pH levels from different sources may change when considering the use of insecticide. However, prior to mixing spray solution it is good to check the pH of the water before and after mixing pesticides.

Table (2): pH, total dissolved salts and conductivity (EC) of the sampled water

Water source	pH Value	Total dissolved salts (TDS) (ppm)	Conductivity* EC (µS/cm)
Nile water - El Kasara bridge area - Faqous (Source A)	7.65	225	0.35
Nile water - El Ismailia river -Elqusasin area (Source B).	7.8	238	0.371
Ground water - Eldoha farm -Faqous - Sharkia (Source C)	8.0	745	1.164
Ground water - Abo-Baker farm -El-Houssinia (Source D)	8.1	932	1.456
Tape water	7.3	198	0.309

*EC= TDS/640 (constant)

Effect of Beta 410®, Cyto G 5%® and Abalone® on pH, TDS and the conductivity of the tested different collected samples of water

It was of interest to investigate the effect of Beta 410® and Cyto G 5%® on pH, TDS and the electrical conductivity (EC) of the tested different water samples collected from different sources as they were diluted with; the results are shown in Tables (3). The results indicated that Beta 410® and Cyto G 5%® reduced the pH value for all tested water sources to be in the acid range (5.5-6.5), such effect concluded that Beta 410® is very useful for lowering pH value of water especially those sample of ground water. The successful formulation that lowered pH would improve the stability of the formulation in the spray tank, also the acidity condition resulted from the usage of Beta410® enhanced the penetration of essential active ingredient mixed in the spray tank. Both Beta 410® and Cyto G 5%® acted as plant growth regulator and they were useful for lowering the pH of the ground water that has been used for dilution. Therefore, they can act as buffering agents where the ground water is still being used for dilution of pesticides.

Table (3): Effect of Beta 410®,Cyto G 5%® and Abalone® on pH, TDS and the conductivity of the sampled water

Formulations	Water sources	Parameters					
		pH Values		Total dissolved salts TDS(ppm)		Conductivity (µS/cm)(EC)	
		*Before addition	**After addition	*Before addition	**After addition	*Before addition	**After addition
Beta 410®	Source A	7.65	5.7	225	560	0.35	0.875
	Source B	7.80	5.5	238	575	0.371	0.898
	Source C	8.00	5.8	745	1115	1.164	1.742
	Source D	8.10	6.0	932	1302	1.456	2.034
	Tape water	7.30	5.6	165	544	0.257	0.85
Cyto G 5%®	Source A	7.65	6.00	225	390	0.351	0.609
	Source B	7.80	5.80	238	405	0.371	0.632
	Source C	8.00	6.10	745	922	1.164	1.440
	Source D	8.10	6.30	932	1107	1.456	1.729
	Tape water	7.30	5.90	165	382	0.257	0.596
Abalone®	Source A	7.65	6.70	225	238	0.351	0.371
	Source B	7.80	6.65	238	255	0.371	0.398
	Source C	8.00	6.50	745	795	1.164	1.242
	Source D	8.10	6.60	932	994	1.456	1.553
	Tape water	7.30	6.62	165	174	0.309	0.271

*Before addition: values for water sources alone without adding the formulation
**After addition: values for the formulations diluted in water source.

The results presented in Table (3) show the effect of Abalone® as acaricide on pH, TDS and the electrical conductivity of the sampled water which have been used to dilute the acaricide EC formulation. The results indicated that Abalone® also lower pH values of the tested water samples, while both TDS and EC values were increased, but with lower level as compared withBeta410® and Cyto G 5%®. These indicated results are in agreement with those reported by (Hock, 1995) who documented that spray solution with high pH or high mineral content can reduce pesticide performance by causing rapid breakdown in the spray tank or limiting uptake into the plant. Several commercial products are marketed to adjust the pH of spray solution, in part to protect pesticides from rapid hydrolysis. Addition of a buffering agent to the spray preparation is an easy and economical way to guarantee maximum results from pesticide applications. It could be said that both Beta 410® and Cyo G 5% ® can act as plant growth regulators and also can act as buffering agents that can be added to the spray solution. Therein, the all tested formulations lowered the alkalinity and the prepared solutions tended to be more acidic where pH values were less than 7.

Table (4): The effect of formulation A (Beta 410 + abamectin) and formulation B (Cyto G + abamectin) on physic-chemical properties of water samples.

Formulations	Water sources	pH Values		Total dissolved salts TDS (ppm)		Conductivity (µS/cm) (EC)	
		*Before addition	**After addition	*Before addition	**After addition	*Before addition	**After addition
formulation A (Beta 410 + abamectin)	Source A	7.65	5.81	225	562	0.351	0.878
	Source B	7.80	5.72	238	578	0.371	0.903
	Source C	8.00	5.94	745	1119	1.164	1.748
	Source D	8.10	6.21	932	1307	1.456	2.042
	Tape water	7.30	5.73	165	539	0.257	0.842
formulation B (Cyto G + abamectin)	Source A	7.65	6.21	225	394	0.351	0.615
	Source B	7.80	6.10	238	409	0.371	0639
	Source C	8.00	6.33	745	928	1.164	1.450
	Source D	8.10	6.54	932	1113	1.456	1.739
	Tape water	7.30	5.98	165	316	0.257	0.493

* Before addition: values for water sources alone without adding the formulation
**After addition: values for the formulations diluted in water sources

The results indicated that pH value was decreased, while total dissolved salts (TDS) and the conductivity (EC) were increased in different water sample after adding 2-naphthoxyacetic acid 10% + abamectin 1.8%. 2-naphthoxyacetic acid improved the stability of abamectin on the spray tank and abamectin enhanced the penetration of 2-naphthoxyacetic acid as applied to plants. Water pH can affect a pesticide chemical breakdown (hydrolysis) in spray solution. It has been documented that certain insecticides degrade or undergo hydrolysis faster in water with a high pH (Boerboom, 1995). Moreover, Hock (1995) indicated that if the water supply is alkaline, especially if the pH is 8 or greater, and the applied pesticide is sensitive to hydrolysis, it should lower the pH of the water in the spray tank. According to Cloyd (2000), it is very important to double check a spray solution's pH before application. Spray solutions for most pesticides should have a pH close to neutral (pH = 7). If the pH is higher, it may reduce the efficacy of the applied product. Herein, the presented results showed that formulation A (NAA + abamectin) decreased the pH values of the different water types of high pH values and such formulation would also be useful to be used for controlling the two spotted mite *Tetranychus urticae* in those area that depend on the ground water. Meanwhile, this formulation will act as plant growth regulator. Formulations A and B reduced pH values from the range of pH of 8 – 7.30 to a range of 6.5–5.7which is considered to be the suitable and effective range of pH according to El-Aw (2008) who showed that acidic spray solutions decreased the residual efficacy of the tested bio-insecticides such as emamectin benzoate against the cotton leaf worm. The residual mortality reduced from 100% (pH 6 or 7) to 57.5% (pH 4) of *Spodoptera littoralis* treated larvae with emamectin benzoate. Also, he showed that the mortality percentages of *S. littoralis* larvae did not change between the three tested insecticides sprayed in acidic or neutral solutions (pH 6 and 7). However, according to Fishel and Ferrell (2007) determination of the pH of the spray mix water is most important and adding an acidifier (a type of pesticide spray mix adjuvant) is also important if necessary even it was inexpensive compared to the cost of losing a pesticide's effectiveness. It is also noticed that the addition of formulation B to the all types of water samples collected from different sources increased the electrical conductivity and the total dissolved salts of the producing solutions.

Emulsion stability of different tested ingredients alone or combined as in formulations A and B

Each component alone (Beta 410®, Cyto G® and Abalone®) showed that these tested ingredient were stable in all tested water samples while the components of formulation A failed to be stable in water sample (D) that obtained from underground water which had higher pH (8.1) and higher TDS (932 ppm) and EC (1.45µS/cm). Also, formulation B failed to be stable in water samples collected from source C and D (ground water). From the above-mentioned results, it could be concluded that when the water source having higher pH than 8, TDS>725 ppm and EC > 1, the formulation will fail to pass the emulsion stability test. El-Aw (2008) indicated that pH values of tested five Nile River water collected samples were alkaline; as they were significantly different and ranged from 7.8 to 8.2, while the pH of tap water was 7.4. The results showed that the spray solutions remained alkaline following addition of the tested insecticides. Mortality percentages of the 4*th* instar larvae of *S. littoralis* significantly decreased when profenfos diluted in alkaline phosphate buffer (pH 8 or more). Also, diluting emamectin benzoate and spinosad in phosphate buffer (pH 4 to 9) revealed that the optimal pH of spray solutions was ranged between 6 and 7.

Table (5): Emulsion stability for five successful prepared formulations with different types of water collected from different sources

Formulation	Source A (RW**)	Source B (RW)	Source C (GW)	Source D (GW)	Tape water
Beta 410®	Nil*	Nil	Nil	Nil	Nil
Cyto G 5%®	Nil	Nil	Nil	Nil	Nil
Abalone1.8%®	Nil	Nil	Nil	Nil	Nil
Formulation (A)	Nil	Nil	Nil	>2	Nil
Formulation(B)	Nil	Nil	>2	>2	Nil

*Nil=No creamy or oily layer was found after stability test
**RW=River water and GW=ground water

Field Experiments

This part of the investigation was carried out to through some light on the efficacy of some evaluated blended chemical formulations. The formulations were Abalone® (abamectin 1.8%) alone, abamectin plus Beta 410 (formulation A) and abamectin plus Cyto G (formulation B). The efficacy included two targets one of them is the plant physiology, flowering, setting and blooming through the application of 2-naphthoxyacetic acid, 6-benzyl amino purine and gibberellic acid (plant growth regulator), the other target was the acaricide (abamectin) itself. The study in this part of the study concerned on the second target (abamectin) and its efficacy against the population of the two spotted spider mite *T. urticae* infesting tomatoes plants (variety Hadeer) grown under filed conditions. Mean numbers of the two spotted spider mite *T. urticae* individuals/inch^2 infesting tomato plants and the reduction percentages of the two spotted spider mite under field condition applied by different formulations diluted with sampled water are presented in Tables (6).

The obtained data revealed that all the evaluated treatments significantly reduced the mean numbers of the moving stages of the mite population as compared with the untreated control in all counts. Finally, according to the mean value of the reduction percentage of infestation after nine days, Abalone® was close or equal in its efficacy to formulations (A) and (B) against the two spotted spider mite.

CONCLUSIONS

The present study aimed to prepare certain potential formulations that contain two active ingredients; one of them is an acaricide (abamectin) and the other is a plant growth regulator (β-Naphthoxy acetic acid [NAA] and/or 6-benzylaminopurine [6-BAP]). The study also investigated the effect of pH and total soluble salts of different types of water collected from different sources onthe physical and chemical properties of those formulations that have been diluted with these types of water. The purpose of combining the two active ingredients (acaricide and a plant growth regulator) is to save time, money and efforts instead of applying each active ingredient alone and that will be of great importance.

Water analysis results showed that different types of collected water from different sources had an alkaloid level where pH values were more than 7.0 with a range of 7.3- 8.1. It can also be seen that the ground water collected from Abo-Baker farm, El-Houssinia (source D) had the highest value of pH (8.1) and the concentration of the dissolved salts reached the highest level of 932 ppm. On the other hand, tap water was found to be more neutral with the lowest detected pH of 7.3 and this water also had the lowest concentration of dissolved salts (198 ppm). The results indicated that Beta 410® and Cyto G 5%® reduced the pH value of all tested water sources to be in the acid range, such effect concluded that Beta 410® was very useful for lowering pH value of water especially those samples of ground water. The successful formulation that lowered pH would improve the stability of the formulation in the spray tank, moreover the acidic condition resulted from usage of Beta 410® enhanced the penetration of essential active ingredient mixed in the spray tank. Both Beta 410® and Cyto G 5%® acted as plant growth regulators and they were useful for lowering the pH of the ground water that has been used for dilution. Therefore, they can act as buffering agents where the ground water is still being used for dilution of pesticides. The results showed that Abalone® lowered the pH values of different water samples, while both TDS and EC values were increased, but with lower level as compared with Beta 410® and Cyto G 5%® because each one of the plant growth formulations contains a carboxylic group in their active ingredients.The study also investigated the effect of salinity of different tested types of water on the stability of the prepared emulsifiable concentrate formulations. The results of testing each component alone (Beta 410®, Cyto G® and Abalone®) showed that these tested ingredient were stable in all tested water samples however the components of formulation A failed to be stable in water sample (D) that obtained from ground water which had higher pH (8.1) and higher TDS (932 ppm) and EC (1.45 µS/cm). Also, formulation B failed to be stable in water samples collected from sources C and D (ground water). Thus, it could be concluded that when the water source having higher pH than 8 and TDS>725ppm and EC > 1, the formulation will fail to produce stable emulsion stability test.The last conclusion from the results of the field experiment shows that the two formulations A and B have double effects of efficacy as plant growth regulators as well as efficacy in controlling the two spotted spider mite when diluted with the all sampled water.

Table (6): Field application of abalone, formula A and B diluted in the different water sources on the two spotted spider mites *T. urtica* infesting tomato plants

Water sources	Treatments	*Mean numbers of the two spotted spider mite *T. urticae*/inch²				**Reduction % of the two spotted spider mite *T. urticae* after treatment		
		Before treatment	Days post treatment			Days post treatment		
			3	7	9	3	7	9
Source A	Abalone 1.8%®	33.89	6.42	2.78	1.05	81.05	91.79	96.90
	Formula A	34.12	6.43	2.61	1.04	81.15	92.35	96.95
	Formula B	33.40	7.80	3.22	1.11	76.64	90.35	96.67
	Untreated	40.10	57.22	63.23	61.40	—	—	—
Source B	Abalone 1.8%®	34. 62	6.40	3.00	1.06	81.51	91.33	96.93
	Formula A	35.14	6.35	2.85	1.05	81.92	91.88	97.01
	Formula B	34.52	7.95	3.20	1.07	76.96	90.73	96.90
	Untreated	46.10	53.32	67.26	65.88	—	—	—
Source C	Abalone 1.8%®	34. 62	6.90	3.30	1.23	80.06	90.46	96.44
	Formula A	35.14	6.75	2.99	1.21	80.79	91.49	96.55
	Formula B	34.52	8.30	3.63	1.26	75.95	89.48	96.34
	Untreated	46.10	53.32	67.26	65.88	—	—	—
Source D	Abalone 1.8%®	34. 62	7.30	3.62	1.23	78.91	89.54	96.44
	Formula A	35.14	7.57	3.44	1.42	78.45	90.21	95.95
	Formula B	34.52	9.35	4.10	1.77	72.91	88.12	94.87
	Untreated	49.10	57.44	71.52	68.78	—	—	—
Tape water	Abalone 1.8%®	33.89	6.40	2.76	1.01	81.11	91.85	97.01
	Formula A	34.12	6.41	2.78	1.03	81.21	91.85	96.98
	Formula B	33.40	7.78	3.20	1.07	76.70	90.41	96.79
	Untreated	40.10	57.22	63.23	61.40	—	—	—

*Mean numbers of the two spotted spider mite *T. urticae*/inch² infesting tomato plants under filed conditions applied with the acaricide and formulation A and B diluted in water sources.

**Reduction % of the two spotted spider mite *T. urticae* infesting tomato plants under field condition applied with the acaricide and formulation A and B diluted in water sources according to Henderson and Tilton (1955) equation.

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مستحضرات ذات تأثير مزدوج لمنظمات نمو النبات في خليط مع مبيد الأبامكتين والتخفيف فى مصادر مياه مختلفة

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تهدف الدراسة إلى تحضير مستحضرات تحتوى على المبيد الأكاروسى أبالون (أبامكتين) وإحدى منظمات النمو للنبات وهما بيتا نافثوكسى اسيتك اسيد (بيتا ٤١٠) أو ٦- بينزيل أمينو بيورين (سيتوجى). تشمل الدراسة – أيضا - دراسة تأثير درجة الحموضة والأملاح الكلية الذائبة للمياه المستخدمة في تخفيف المستحضرات والتي تم جمعها من مصادر مختلفة على الخواص الكيميائية والفيزيائية للمستحضرات. أظهرت نتائج تحليل مياه النيل أنها تميل إلى القلوية حيث سجلت درجة الحموضة اكبر ٧، في حين بلغت في مياه الآبار ١ و ٨. لوحظ انخفاض درجة الحموضة في مستحضرات منظمات النمو عند إضافة ماء التخفيف. لذلك يمكن استخدامهما كمنظمات نمو نباتية وأيضا منظم لدرجة حموضة المياه الجوفية التي لازالت تستخدم في تخفيف ورش مستحضرات المبيدات. عموما لم تؤثر المياه المستخدمة على حالة ثبات المستحضرات باستثناء ماء الآبار عند إضافتها للمستحضر (أبالون + سيتوجى).