

**RESIDUES OF CHLORPYRIFOS AND PROFENOFOS
ON GREEN BEAN (*Phaseolus vulgaris*. L) AND
SQUASH (*Cucurbita pepo*, L) FRUITS AND THEIR
SIDE EFFECT ON SOME QUALITY PROPERTIES**

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ABSTRACT

The residue levels of the two organophosphorus insecticides, Chlorpyrifos and Profenofos in fruits of green bean and squash in relation to their side effect on some internal quality properties were studied. The results showed that 10, 14 and 7, 14 days after application on green bean and squash is enough to reduce the Chlorpyrifos and Profenofos residues, respectively below the maximum residue limits (MRL). However, Chlorpyrifos appeared to have relatively longer persistence with $t_{1/2}$ of 2.88 and 1.50 days than Profenofos with 1.20 and 0.85 days on green bean and squash fruits, respectively. As for the internal quality parameters of green bean, Chlorpyrifos treatment was significantly decreased the total soluble sugars, % acidity, ascorbic acid (vitamin C), total nitrogen content, crude protein, total soluble solids (T.S.S.), β -carotene and total crude fats content. The Profenofos treatment was significantly decreased the total soluble sugars, % acidity, total soluble solids (T.S.S.), β -carotene and total crude fats content while it was not significantly decreased ascorbic acid (vitamin C), total nitrogen content and crude protein content. Both insecticide residues significantly decreased the total soluble sugars, % acidity, ascorbic acid (vitamin C), total nitrogen content, crude protein, total soluble solids (T.S.S.), β -carotene and total crude fats content in squash fruit.

Keywords: Green bean, Squash, Chlorpyrifos, Profenofos, quality, residues.

INTRODUCTION

Insecticides occupy a unique position among the many hazardous chemicals that man and animals encounter daily. Insecticides are intentionally introduced into the environment to enhance agricultural production, to reduce pest damage on crops and to control disease vectors.

The common bean plant (*Phaseolus vulgaris*. L), is one of the most important economic leguminous field crops that people prefer it as a source of protein, it is the world's third most important major food leguminous. Squash (*Cucurbita pepo* L.) is one of the most popular vegetable crops grown in Egypt that is grown in more than one season (Shehata et al., 2009). In this respect, the protection of green bean and Squash crops from the attacking of pests is considered as a key factor for the mass production of fruits. However there are a wide range of pests including insects, fungi, bacteria, virus and acaros. Such pests are affecting significantly the quantity and quality of green bean and Squash production.

Generally two insecticides chloropyriphos and profenfos are officially approved in Egypt for use in vegetables with of 2 week approximately to control white fly,aphid and gross hopes. Chloropyriphos is an exceptionally

well understood and widely studied molecule (Aspelin, 1997). More than 250 studies have been conducted examining the uses and impacts of this molecule on human health and the environment (Gibson, et al., 1998). The toxicity of chloropyrifos like other OP insecticides is attributed specifically to the inhibition of the enzyme acetylcholinesterase (Ecobichon, 1996). Chloropyrifos has been shown to be non-carcinogenic (Young, et al., 1990) and does not adversely affect reproduction (Breslin, et al., 1996). The use of this insecticide continues to increase both in domestic and agricultural application, a reflection of the safety of this agent relative to the other related compounds (Roy, et al., 1998). Nevertheless, recent studies indicate that spraying of chloropyrifos in the indoor environment may pose considerable risk to public health (Gurunathan, et al., 1998).

Generally the work presented here is an attempt to study the persistence of Chlorpyrifose and profenfos on and in green bean and Squash fruits and also their side effect of the two insecticides residues on some quality parameters of fruit.

MATERIALS AND METHODS

Insecticide used:

Common name	Trade name	Chemical (IUPAC)name	Field recommended rate
Chloropyrifos	Hoky 50% E.C.	O,O-diethyl O-(3,5,6-trichloro-2-pyridinyl) phosphorothioate	1 L/fed.
Profenofos	actacron72% E.C.	O-(4-bromo-2-chlorophenyl) O-ethyl-S-propyl Phosphorothioate	0.75 L/fed.

Determine the persistence of Insecticides on and in green bean and Squash:

Green bean (*Phaseolus vulgaris*. L) and Squash (*Cucurbita pepo*, L.) were planted at Mansoura University Experimental Station, Dakahlia Governorate, Egypt, in February 22, 2014 for green bean and in June 4, 2014 for Squash. The field was subjected to normal agricultural practices. Three treatments were used including the two insecticides and the control (check). Three replicates (42 m² each) were used / plot. Treatments were arranged in completely randomized blocks design. Spraying was applied with the recommended rate of spraying for two times; March 31 and April 23 of 2014 for green bean and once at July 5, 2014 for Squash. Samples were randomly collected from the different treatments at one hour, 1, 3, 5, 7, 10 and 14 days after application. Residues of two insecticides were determined by using gas liquid chromatography (GLC).

Extraction and cleaning up:

This method was carried out according to Bowman (1980) with slight modification. Fifty grams of each sample were macerated for 3 minutes with 100 ml of acetone. The mixture was filtered on a Buchner funnel. The blender and funnel were washed with 30 ml portion of the same solvent. The filtrate

solution was then transferred to a 500 ml separately funnel and partitioned with 50, 50 and 50 ml n-hexane, respectively. After shaking the funnel, the n-hexane layer drawn off and dried by adding anhydrous sodium sulphate. The dried extract was concentrated by using rotary evaporator at 40°C.

Samples extracts were cleaned-up and analyzed according to the procedure of Bowman and Leuck (1971). In this procedure, the column was prepared by adding 2 gm of anhydrous sodium sulphate, 10 gm of silica gel mixed with 1 gm of activated charcoal and finally 2 gm of anhydrous sodium sulphate was added at the top of column. The extracted sample was added on the column and eluted with 100 ml of 20% acetone in n-hexane. The eluted components were evaporated by using a rotary evaporator at 40°C, and then the residue was dissolved in 10 ml acetone and stored in a refrigerator until determined by GLC.

Chromatographic analysis:

The gas chromatograph used was a Hewlett Packard GC Model 6890 equipped with a flame photometric detector (FPD) with phosphorus filter. A fused silica capillary (PAS- 1701) , column containing 14% cyanopropilsyloxane as stationary phase (30m length x 0.32 mm internal diameter (i.d) x 0.25 um film thickness), was used for the separation in the GC.

GC operating conditions were the following: Injector and detector temperatures were 240°C and 250°C; initial oven temperature, 200°C for 2 min, raised at 5°C/min. and then held at 240°C for 10 min. The carrier gas was nitrogen at 3 ml/min. and hydrogen and air were used for the combustion at 75 and 100 ml/min, respectively. The retention time values were 2.2, 2.9 and 6.4 minutes for chlorpyrifos and profenofos, respectively.

Recovery studies:

A series of fortified samples were prepared extracted and cleaned-up according to the examined insecticides in order to evaluate the validation of the method. Samples of Green bean (*Phaseolus vulgaris*. L) and Squash (*Cucurbita pepo*, L.) were fortified by adding known volume of each insecticide standard solution (1 and 2 ppm). The efficiency of extraction and clean-up methods for fortified plant samples were evaluated for each insecticide. The recovery percentage of chlorpyrifos, and profenofos were calculated by the following equation:

$$\% \text{ Recovery} = (\mu\text{g})_{\text{present}} / (\mu\text{g})_{\text{added}} \times 100$$

Spiked levels were 1.0 and 2.0 ppm. The obtained results were corrected according to the recovery rate.

Table (1) indicated the % recovery of the tested insecticides from the spiked samples. Data that the average recovery percent ranged between 90.22 – 82.55%, 93.53- 83.35% for Chlorpyrifos and Profenofos, respectively

Table (1): Recovery rates of Chlorpyrifos and Profenofos at spiked levels 1.0 and 2.0 ppm:

Fruits	Insecticides		
	Spiked level (ppm)	Chlorpyrifos	Profenofos
		% Recovery	% Recovery
Green bean	1.0	82.55	93.53
	2.0	82.65	84.54
Squash	1.0	90.22	83.35
	2.0	84.84	84.38

Half life:

The half life period of residue ($T_{1/2}$) for each insecticide was calculated using the following equation (Moye *et al.*, 1987).

Calculation of the residues:

The residues were calculated by applying the following equation Of (Möllhoff 1975).

Side effect of insecticides used on some quality parameters of fruit.

Analytical determination for the studied chemical quality parameters was made on treated and untreated fruit to evaluate the side effect of the tested insecticide residues on the quality of fruit. These chemical parameters included total soluble sugars were determined according to the method described by Sadasivam and Manickam, (1996), % acidity was determined according to (A.O.A.C.; 1975), Ascorbic acid (vitamin C) was determined according to the method described by Mazumdar and Majumder, (2003) using titrimetric estimation with 2, 6 dicholoro phenol dye solution. Total nitrogen content was determined as described by Jones *et al.*, (1991) Using Micro-kjeldahl apparatus, Crude protein was calculated by multiplying nitrogen percentage by the factor 5.75, Total soluble solids (T.S.S.) were estimated using Galli 110 refractometer according to (A.O.A.C.; 1975.), β -carotene was determined by the method of Ben-Amotz and Avron (1983) and Total crude fats were estimated according to (A.O.A.C. (1984)).

Statistical analysis:-

The obtained data were subjected to analysis of variance (ANOVA) by using "Genstat 11.1" (2008). The mean comparisons were performed by the least significant difference value (LSD) at 5% level of probability according to Gomez and Gomez. (1984).

RESULTS AND DISCUSSION

I- Persistence of Chlorpyrifose and profenfos in and on Green bean and Squash fruit:

Data in table (2) showed the residues of Chlorpyrifose and Profenfos in green bean and squash fruits.

A- Chlorpyrifose residues:

1- Green bean fruits:

The initial deposit of Chlorpyrifose was 1.8960 ppm one hour after application then decreased to 1.7883, 1.2104, 0.5687, 0.3126, 0.0346 and 0.0173 ppm indicated the rate loss were 5.68, 36.16, 70.00, 83.51, 98.17 and 99.09 % after 1, 3, 5, 7, 10 and 14 days respectively (table 2). The rate of

decomposition (K) was 0.24033 day⁻¹, the corresponding half life (T ½) of Chlorpyrifose in green bean fruits was 2.8843 days. The data show that green bean fruits could be safely consumed after 10 days of application according to the recommended maximum residue limit (MRL) for Chlorpyrifose in green bean (0.05 ppm). The maximum residue limits (MRL) of Chlorpyrifose was established in (European Union 2010) for green bean.

2- Squash fruits:

The initial deposit of Chlorpyrifose on and in squash was 8.3373 ppm one hour after application then decreased to 5.7697, 3.4368, 1.2486, 0.0519, 0.0312, 0.0198 ppm indicating the rate of loss 30.80 , 58.78, 85.02 , 99.38 , 99.62 and 99.76 % after 1, 3, 5, 7, 10 and 14 days respectively (table 2). The rate of decomposition (K) was 0.45985 day⁻¹, the corresponding half life (T ½) of Chlorpyrifose in squash fruits was 1.5074 days. The data show that squash fruits could be safely consumed after 7 days of application according to the recommended maximum residue limit (MRL) for Chlorpyrifose in squash (0.05 ppm). The maximum residue limits (MRL) of Chlorpyrifose was established in (European Union 2010).

Table (2): Residues of Chlorpyrifose and Profenofos in Green bean and Squash fruits:

Time after application (days)	Green bean				Squash			
	Chlorpyrifose		Profenofos		Chlorpyrifose		Profenofos	
	Residues (ppm)	% loss						
Initial*	1.8960	00.00	7.8526	00.00	8.3373	00.00	17.4393	00.00
1	1.7883	5.68	4.2483	45.90	5.7697	30.80	5.966	65.79
3	1.2104	36.16	0.776	90.12	3.4368	58.78	1.5943	90.86
5	0.5686	70.00	0.7256	90.76	1.2486	85.02	0.3569	97.95
7	0.3126	83.51	0.4505	94.26	0.0518	99.38	0.0300	99.83
10	0.0346	98.17	0.0228	99.71	0.0312	99.62	0.0176	99.90
14	0.0173	99.09	0.0019	99.97	0.0198	99.76	0.0031	99.98
K	0.24033		0.5743		0.45985		0.8105	
T ½ (days)	2.8843		1.2071		1.5074		0.8552	
MRL(ppm) (EU 2010)	0.05		0.01		0.05		0.01	
PHI(days)	10		14		7		14	

*: Samples were taken one hour after application.

K= Rate of decomposition.

T ½ = Half life period (day).

MRL =The maximum residue limits of chlorpyrifose was established in

EU= (European Union 2010). PHI = Pre-harvest interval days after application.

In fact, the present results are in same of many investigations, Sallam and El-Nabarawy (2001) reported that unwashed moloukhia leaves could be marketed safely after 15 days from spraying with Chlorpyrifose and its half life was 1.41 days. Mansoor-ul-Hassan *et al.* (2005) investigated residual persistence of chlorpyrifos residues on brinjal fruit after 3 hours, 3 days and 7 days after application. The residues on the three sampling periods (max-min) ranged from 0.075-0.039, 0.030-0.015 and 0.067-0.040 ppm, respectively. This leads to conclusion that it is safe to recommend brinjal fruit for human consumption after three days of spraying. Al-Eed and Mohammed (2006) determined the residues of Chlorpyrifos-ethyl on

greenhouse tomato and pepper fruits. The data showed that the degradation was 8.2, 0.2 and 73.2% after one, three and seven days, respectively. Chlorpyrifos-ethyl residues on tomato or pepper fruits after 3 days represented more than ten folds of the maximum residue limits on vegetables (50 µg kg⁻¹). The data also showed that the half-life $t_{1/2}$ was 0.5 and 0.9 day for chlorpyrifos-ethyl on tomato and pepper, respectively. Chao *et al.* (2013) found that the recoveries of chlorpyrifos in cabbage vegetable were 87.2–92.2% (RSD, 1.2–2.5). Lu *et al.* (2014) found that the half-lives of chlorpyrifos were 2.64 in pepper plants, 3.90 in asparagus lettuce, 3.92 in lettuce, 5.81 in brassica chinensis, 3.00 in eggplant plant, and 5.45 days in celery.

B- Profenfos residues:

1- Green bean fruits:

The initial deposit of Profenfos was 7.8527 ppm one hour after then decreased to 4.2483, 0.7760, 0.7257, 0.4505, 0.0229 and 0.0019 ppm indicated the rate loss were 45.90, 90.12, 90.76, 94.26, 99.71 and 99.97 % after 1, 3, 5, 7, 10 and 14 days respectively (table 2). The rate of decomposition (K) was 0.57427 day⁻¹, the corresponding half life (T $\frac{1}{2}$) of Profenfos in green bean fruits was 1.207 days. The data show that green bean fruits could be safely consumed after 14 days of application according to the recommended maximum residue limit (MRL) for Profenfos in green bean (0.01 ppm). The maximum residue limits (MRL) of Profenfos was established in (European Union 2010) for green bean.

2- Squash fruits:

The initial deposit of Profenfos on and in squash was 17.4393 ppm one hour after application then decreased to 5.9660, 1.5944, 0.3569, 0.0300, 0.0176 and 0.0031 ppm indicated the rate loss were 65.79, 90.86, 97.95, 99.83, 99.90 and 99.98 % after 1, 3, 5, 7, 10 and 14 days respectively (table 2). The rate of decomposition (K) was 0.8105 day⁻¹, the corresponding half life (T $\frac{1}{2}$) of Profenfos in squash fruits was 0.8552 days. The data show that squash fruits could be safely consumed after 14 days of application according to the recommended maximum residue limit (MRL) for Profenfos in squash (0.01 ppm). The maximum residue limits (MRL) of Profenfos was established in (European Union 2010).

Similar results were obtained by Shahin *et al.* (1985), who treated soybean plants with profenfos, the initial deposit was 28.50 ppm on and in the green pods, whereas residue half life was 2.35 days. Ramadan, (1991) The initial deposits of profenfos on and in unwashed tomato and okra fruits were 10.18 and 11.65 ppm, and this amounts were decreased to 0.04 and 0.025 after 15 days of spraying. Badawy *et al.* (1995) found that, the initial deposits of profenfos after one hour of application in unwashed tomato fruits was 3.20 ppm. Mohamed (1995) found that the initial deposits of profenfos on squash, cucumber and cabbage were 8.98, 7.39 and 15.47 ppm, these values decreased to 0.57, 0.46 and 1.59 ppm after 7 days from application, also the half lives were 1.88, 1.67 and 1.80 days, respectively. Hegazy and Nasr (2003) found that the initial deposit of profenfos on and in moloukhia leaves after 1 hour of spraying was 114.6 ppm, this residues decreased to 1.56 ppm after 10 days.

El-Nabarawy (1992) found that, the total residues of profenofos was safely consumed at 7th day after spraying on broad bean plants. Abdalla *et al.* (1993) found that green beans could be used safely for consumption after 11 days from spraying with profenofos and its half life was 1.6 days. Shiboob (1995) reported that, the tolerance level of profenofos on cucumber obtained after 12 days. Romeh (1999) reported that profenofos on and in unwashed green snap bean fruits was safely for consumption after 15 days of application, the median degradation time was 3 days. Sallam and El-Nabarawy (2001) reported that unwashed moloukhia leaves could be marketed safely after 18 days from spraying with profenofos and its half life was 2.17 days. Shiboob (2001) found that the permissible time for profenofos was 10 days on sweet pepper fruit and 14 days on hot-pepper and eggplant fruits, the residues half lives were 1.74, 1.83 and 1.95 days, respectively. Mohamed *et al.* (2004) found that the consumable safety time of profenofos were 10 days on sweet pepper and 14 days on hot pepper and eggplant fruits. The corresponding half-lives (t1/2) were 1.84, 1.74 and 1.96 days. Aioub (2005) found that the initial deposit of profenofos in and on green leaves of cowpea plants was 18.52 mg/kg so it could be used after 7 days of spraying. Muhammad *et al.* (2010) found that the half life of profenofos on the cabbage crop was 2.11 days.

II- Side effect of insecticides used on Green bean (*Phaseolus vulgaris*, L.) and Squash (*Cucurbita pepo*, L.) Fruits:-

The data in table (3) indicated that Chlorpyrifos treatment was significantly decreased the total soluble sugars, % acidity, ascorbic acid (vitamin C), total nitrogen content, crude protein, total soluble solids (T.S.S.), β-carotene and total crude fats content in green bean fruits. The Profenofos treatment was significantly decreased the total soluble sugars, % acidity, total soluble solids (T.S.S.), β-carotene and total crude fats content while it was not significantly decreased ascorbic acid (vitamin C), total nitrogen content and crude protein content.

Table (3): Effect of Chlorpyrifose and Profenofos on some fruit quality parameters of treated Green bean (*Phaseolus vulgaris*):

Parameters	Treatment			LSD5%
	Chlorpyrifose	Profenofos	check	
Total soluble sugars	5.223	5.803	6.390	0.0953
% Acidity	0.6833	0.7633	0.8267	0.05124
Ascorbic acid(mg/100g)	25.83	26.77*	27.90	1.039
Total nitrogen	3.233	3.503*	3.707	0.2193
Crude protein %	20.20	21.90*	23.17	1.392
Total soluble solids (T.S.S)	7.087	7.230	7.720	0.2057
β-carotene (mg/100g)	2.503	2.717	3.413	0.0916
Total fats %	1.413	1.630	1.920	0.0834

*: not significantly different at 5% level of probability according to Gomez and Gomez. (1984).

Results in table (4) indicated that chlorpyrifos and profenofos were significantly decreased the total soluble sugars, total acid, ascorbic acid, total nitrogen, crude protein, total soluble solids, β -carotene and total fats in squash fruit throughout the experiment. Profenofos caused reduction effect higher than other insecticide in treated fruit when compared with the control.

Table (4): Effect of Chlorpyrifose and Profenofos on some fruit quality parameters of treated squash (*Cucurbita pepo*, L.)

Parameters	Treatment			
	Chlorpyrifose	Profenofos	check	LSD5%
Total soluble sugars	2.19	2.03	2.760	0.0822
% Acidity	0.58	0.59	0.7267	0.05886
Ascorbic acid(mg/100g)	13.70	13.13	15.70	0.905
Total nitrogen	1.23	1.14	1.4400	0.02048
Crude protein %	7.71	7.13	9.007	0.1230
Total soluble solids (T.S.S)	6.28	6.12	6.797	0.0941
β -carotene(mg/100g)	4.59	4.27	5.340	0.1115
Total fats %	0.92	0.85	1.177	0.0894

*: not significantly different at 5% level of probability according to Gomez and Gomez. (1984).

It is well established that certain insecticides influence the chemical composition of the plants after they are applied. Othman *et al.* (1987) reported that dimethoate and methomyl residues had significant effects on ascorbic acid contents in tomato fruits. Dimethoate also showed significant effects on total soluble solids in tomato fruits. Habiba *et al.*, (1992) reported that profenofos residues increased protein and ascorbic acid content in potatoes. Agrawal *et al.*, (1993) found that fenthion reduced ascorbic acid contents in rice plants. Edrisha and Badr (1994) found that Pirimiphos-methyl and profenofos decreased the ascorbic acid content. Shallendra *et al.* (2013) found that the imidacloprid insecticide treatment decreased the ascorbic acid contents of potatoes but increased the total protein content. Ismail *et al.* (1993) found that profenofos increased T.S.S and acidity, but decreased the glucose, protein and ascorbic acid content of tomatoes. Radwan *et al.* (1995) reported that primiphos- methyl residue appeared to have significant adverse effects on the total soluble sugars and ascorbic acid content of tomato fruit and broad bean seeds. Radwan *et al.* (2001) reported that primiphos- methyl exhibited a significant increase on total soluble sugars and % acidity of grape berries, where as there was no effect on refractometric T.S.S. Radwan *et al.* (2004) reported that pirimiphos-methyl treatment significant increase the total soluble sugars, % dry matter, total protein and β -carotene content in green pepper fruit. The profenofos treatment significantly decreased the total soluble sugars, % dry matter and total protein and has no adverse effect on the % acidity, ascorbic acid and β - carotene content. Both insecticide

residues increased ascorbic acid content and decreased the total soluble sugars, % acidity, T.S.S. in eggplant fruit. El-Shafey and EL-Akkad (1994) reported that Actellic induced depletion of the protein content in both shoots and roots of Phaseolus plant. Osman *et al.* (2006) reported that Chlorpyrifos increased significantly Protein content in cottonseeds.

From the previously mentioned results it could be said that the vegetables treatments could be safely consumed after few days but, it is necessary to research effect of compounds that reduce the negative effect on the fruit contains, and at the same time exerts excellent control against pests, especially on vegetables and has different mode of action.

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متبقيات مبيد الكلوبريفوس والبروفينفوس فى ثمار الفاصوليا الخضراء والكوسة وتأثيرهم الجانبى على بعض خصائص الجودة
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*** قسم المبيدات - كلية الزراعة - جامعة المنصورة- مصر**

تم دراسة مستوى المتبقيات لاثنتين من المبيدات الفوسفورية العضوية الكلوبريفوس والبروفينفوس فى ثمار الفاصوليا الخضراء والكوسة وعلاقة ذلك بالتأثير على بعض صفات الجودة للمحصولين. وأظهرت النتائج ان 10 ايام بعد الرش على الفاصوليا الخضراء والكوسة كافية لخفض متبقيات كلا المبيدات إلى أقل من الحد المسموح به، كذلك وجد أن الكلوبريفوس نسبيا أكثر بقاء (فترة نصف العمر هى 2,88 و 3,50 يوم) بالمقارنة بالبروفينفوس (فترة نصف العمر 1,20 و 0,85 يوم) على الفاصوليا الخضراء والكوسة على التوالي. ودراسة تأثير متبقيات كلا المبيدات على صفات الجودة فى ثمار الفاصوليا الخضراء وجد ان الكلوبريفوس قد اظهر انخفاضاً معنوياً فى كلا من السكريات الذائبة الكلية، الحموضة، حمض الاسكوربيك، محتوى النيتروجين الكلى، البروتين الكلى، المواد الصلبة الذائبة الكلية، محتوى الكاروتين و محتوى الدهون الكلية. اما البروفينفوس فقد احدث انخفاضاً معنوياً فى كلا من السكريات الذائبة الكلية، الحموضة، المواد الصلبة الذائبة الكلية، محتوى الكاروتين و محتوى الدهون بينما اظهر انخفاضاً غير معنوى فى كلا من حمض الاسكوربيك، محتوى النيتروجين الكلى و محتوى البروتين الكلى. بينما فى ثمار الكوسة فان كلا المبيدات قد احدثا انخفاضاً معنوياً لكلا من السكريات الذائبة الكلية، الحموضة، حمض الاسكوربيك، محتوى النيتروجين الكلى، البروتين الكلى، المواد الصلبة الذائبة الكلية، محتوى الكاروتين و محتوى الدهون الكلية.