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Comparison Studies of Different Weeds Resistance Methods in Citrus Orchards of Dakahlia Governorate

Hikal, A. R. F. and M. N. Esmaeil.
Hort. Res. Institute Agric. Res. Center, Giza

ABSTRACT

This study was carried out during 2014 & 2015 seasons on Washington navel orange trees 20-years-old, in research orchard situated at Baramoun, Mansoura region, Dakahlia governorate. Aiming to evaluate the effect of different weed control methods and their relationship to the growth, yield and fruit quality of Washington navel orange trees. Four weed control methods were tested, control, hand resistance, mechanical hoeing and three herbicides (Herphosate, Sting, Roal). The obtained results indicated that all used treatments significantly increased shoot length, number of leaves, leaf surface area and yield (kg) /tree, ton/feddan. The highest values of fruit weight and the lowest value of acidity % were found under chemical weed control (Roal), where, rind thickness, TSS% and vitamin C were not affected by any type of herbicides used. Also, chemical weed control (Roal) was increased leaf chemical composition (N, P, K, Fe, Zn and Mn). In addition, chemical herbicides (Roal) was the lowest costs in this respect.

INTRODUCTION

The present high cost of maintenance is a key factor in every sector of citrus production. This economic factor accounts for the wide range of materials used. In citrus orchards, weeds play an important dangerous role in fruit production, as the damage resulting from weeds exceeds the damage resulted from all the other pests (Anonymous, 1964). In addition, weeds compete the trees for: water, nutrients, light (especially in young orchards) their harbor insects, diseases and rodents which attack trees. It is suggested that competitive effects are caused in part by phytotoxic substances produced by the weeds (Horowitz, 1973) as well as they interfere with orchard management and harvesting operations.

In spite of, undesirable effects of weeds which are mentioned above, weeds are very important for citrus groves during flowering and setting stage (a critical period for the yield) according to Azab (1976). Finally, weed competition directly reduces growth, quality and yield of harvest fruits, crop production losses by weeds were ranged between 15 to 20 % (Ashton *et al*., 1961 and Jackson, 1986). Therefore, weed eradication is necessary in all orchards including citrus.

Eradication of weeds in citrus orchards is rarely economically feasible or practical. The desired level of weed control must depend upon the cost of weed control, caused losses in relation to the cost of control methods and fruit yield. Thus, objective of weed control programs, whether they involve direct plant destruction or prevention of reproduction, is top reduce or climate conditions as well as with the live cycles population levels, and methods of reproduction of weed species present in an orchard (Jordan and Day, 1973).

Several investigators reported that mechanical and chemical methods gave excellent weed control in citrus orchards and increased yield of harvested fruit. Chemical weed control is now widely accepted, therefore, it can solve the problem of perennial weed control. Timing, rates and type of herbicides are very important as soil active herbicides treatments. Glyphosate is actually more effective when applied to perennial grass at seed-head stage due to better translocation (Ashton and Crafts, 1973 and Ivakh *et al*., 1984). Moreover, all herbicides treatments were more economic than other treatments. Therefore, herbicides became more efficient, time saving and cheaper than mechanical methods, and there no phytotoxic effects of these herbicides on the trees (Prates et al., 1980; and Choudhaki and Rahi, 1980).

Nasreia *et al*., (1987) found that hand hoeing and chemical weeds control (Gramoxone) increased the yield of Washington navel orange trees than the control, also they noticed that fruit weight, size and average yield / feddan increased significantly by different methods of weeds control than the unweeded. And, they found that the chemical method by using Garamoxone is the sheeping methods and the hand hoeing is the highest costs method. Baruah and Sharma (1990) reported that all weed control treatments (glyphosate, diuron or linuron) increased citrus leaf N content from 1.37% DW (control) to between 2.02 and 2.24%, whereas the effect on Zn content (16.7 ppm in controls) was variable, treatments resulting in between 14.1 and 18.4 ppm. The highest crop leaf N and Zn content was a result of Glyphosate application every 30 d until 150 d. Sinbel *et al*., (1997) observed that mulch and herbicides treatments (Gramoxone and Round up) increased vegetative growth, number of fruits/tree, average fruit weight, yield, T.S.S% and maturity ratio (TSS/ Acid) over control (hand hoeing) and decreased, juice acidity and juice contents of ascorbic acid (V. c). Likewise, round up increased vegetative growth, fruit weight, TSS/ Acid ratio and decreased juice acidity comparing with gramoxone. Kouka and Salim (2000) mentioned that both of growth intensity and leaf area of Washington navel orange trees were not affected by weed control methods. But, they found herbicides (Goal and Basta) gave high shoot length and number of leaves/shoot. Weed control herbicides treatments significantly increased number of fruits /tree, total yield /tree (kg), average fruit weight and juice weight /fruit. While, reduced total acidity, vitamin C, TSS were not significantly affected. Abd El-Rhman et al., (2001) noticed that chemical weed control (Glyphosate and Gramoxone) improved tree growth, yield and fruit quality of Washington navel orange trees. Generally, the best results of fruit quality were obtained with Glyphosate (high volume), Fuzilade (high and low volume) and Gramoxone (1 L/ fed 3 times) applications.

El-Hossiny and Sallam (2003) studied the effect of 7 weed control treatments [control, mechanical methods (hand hoeing, rice straw mulching and chisel plough), chemical methods (Gramakson, Lancer) and cover crops treatment] on orchard of Washington navel orange trees, and noticed that the highest yield was obtained by using cover crops followed by chemical and mechanical treatments.

The aim of work was designed to evaluate weeds control methods in citrus orchards of Dakahlia governorate and their relationships to the growth, yield and fruit quality of Washington navel orange trees.

MATERIALS AND METHODS

This investigation study was conducted during 2014 & 2015 growing seasons in order to evaluate the effect of six weed control methods on involved mature trees of Washington navel orange (*C. sinensis*, Osbeck) budded on sour orange (*C. aurantium* L.). Trees were 20-years-old, grown at research orchard situated at Baramoun, Mansoura region, Dakahlia governorate and were planted at 5x5 m a part. The experimental orchard was subjected to the normal agricultural practices during the period of investigation with the exception of weed control treatments

Thirty six trees, uniform in growth and in good physical condition were selected and grouped under six treatments, each treatment consisted of three replicates and each replicate was represented by two trees. Besides the major hoeing in January for all treatments, the treatments were established as follow:-

1- Control (without any weed control).
2- Hand resistance (Alfas) in mid-August.
3- Mechanical hoeing (Machine tillage) in mid-August.
4-Herphosate (Glyphosate-Isopropyilamine 48% Inter Ingredients 52%) at 2.5 L/125 L.
5-Sting (N - (Phosphonomethyl) glycine - Isopropyl ammonium) at 1.5 L/150 L.
6-Roal {(2-chloro-a a, a trifluoro-p-tolyl 3-ethoxy-4-nitrophenyl ether} at 1.0 L/500 L.
* Chemical weed control sprayed in mid-April and mid-August.

The evaluation and comparison used in this study were as in the following items:-

Vegetative growth and yield

In order to determine vegetative growth (shoot length, number of leaves and leaf surface area) of spring cycle were measured by selecting six secondary branches around each tree and labelled in February of both years, leaf surface area (cm^2) was measured (using mature leaf at the second week of September) by laser leaf area meter (model CI-203CA from CID. Inc. company).The yield (kg/tree and ton/ feddan) was calculated annually at harvest date (mid-November).

Fruit physico-chemical characteristics

In order to determine fruit quality characters, a random sample of 20 fruits was taken from each replicate at random at the1st week of January to determine fruit weight (g) and rind thickness (mm). Total soluble solids percentage (TSS) in fruit juice was determined by using Carl Zeiss hand referactometer. Moreover, total titratable acidity percentage in fruit juice was determined by titration against sodium hydroxide solution (0.1 N) and acidity was expressed as gm citric acid / 100 ml of juice (A.O.A.C.1990). Finally, vitamin C as mg ascorbic acid were determined and estimated per mg /100 ml fruit juice according to A.O.A.C. (1990).

Costs

The costs of each weeds control treatment were calculated by Egyptian pound.

Leaf minerals contents

On March of both seasons, twenty spring non-fruiting shoots from all over the outer circumference of each treated tree were labeled for leaf samples. From each replicate, a sample of about 60 leaves was taken in the first week of October (each year) for the chemical analysis.

The collected leaf samples were washed with tape water, rinsed three times with distilled water and then oven dried at 70° C to a constant weight. Leaf dried materials were ground in a stainless steel rotary knife with a mill 20 mesh. The dried ground sample was digested with sulphuric acid and hydrogen peroxide according to Evenhuis and De Waard (1980). Suitable aliquots were taken for the determination of N, P, K, Mn, Zn and Fe.

1-**Total nitrogen percentage** was determined by using the microkjeldahal method as described by A.O.A.C. (1990).
2-**Phosphorus** was determined by using ammonium venedate method as described by Chapman and Pratt (1961).
3-**Potassium** was determined by flame photometer according to Brown and Lilleland (1946).
4-**Zinc** was determined according to Chapman (1961) directly in the original solution by using atomic absorption spectorphotometer.
5-**Fe and Mn** were determined according to (Evenhuis and De Waard 1980).

Statistical analysis

All obtained data were subjected to analysis of variance according to the complete randomized blocks design (Snedecor and Cochran 1980) and means were differentiated using least significant differences test New LSD at 5% level of probability.

RESULTS AND DISCUSSION

Vegetative growth:

Regarding the effect of weeds control methods on Washington navel orange trees, it was quite evident from Table (1) that those treatments had significantly increase higher values of shoot length, number of leaves and leaf surface area compared to control in both 2014 and 2015 experimental seasons. The highest value of shoot length was recorded by chemical weed control of (Roal) followed by (Sting), but the lowest value was obtained from control treatment in both seasons. Moreover, number of leaves and leaf surface area gave the same trend. The highest value was obtained by using chemical followed by hand control followed by machine tillage.

The obtained results goes in the line with finding of Sinbel *et al*., (1997) observed that herbicides treatments (Gramoxone and Round up) increased vegetative growth. Kouka and Salim (2000) found that herbicides (Goal and Basta) gave increase of shoot length and number of leaves/ shoot, but they mentioned that both of growth intensity and leaf surface area of Washington navel orange trees were not affected by weed control methods. Abd El-Rhman et al., (2001) noticed that chemical weed control (Glyphosate and Gramoxone) improved tree vegetative growth.

Yield:

Concerning the fruit yield (kg) per tree, data in Table (1) showed that all the treatments were superior over control in both seasons of Washington navel orange trees. Data concerning the average yield (ton) per feddan indicated that total yield took the same trend in both seasons. Generally, the highest values were found chemical treatments followed by hand resistance and machine tillage, respectively.

The increasing in yield either as (kg)/ tree or ton /feddan due to different treatments may be attributed to the fact that trees under hand, mechanical and chemical treatments were in better state of growth with sufficient amounts of available nutrients, organic matter and adequate level of internal water balance. All these together may lead to higher percentage of fruit set or decreased percentage of fruits drop. In other words, weed control treatments reduced competition between the trees and weeds for water and nutrition.

These findings confirm those reported by Nasreia *et al*., (1987) found that hand hoeing and chemical weeds control (Gramoxone) increased the yield of Washington navel orange trees than the control, also they noticed that average yield / feddan increased significantly by different methods of weeds control than the unweeded. Sinbel *et al*., (1997) observed that mulch and herbicides treatments (Gramoxone and Round up) increased number of fruits/tree and yield. Kouka and Salim (2000) mentioned that weed control herbicides treatments significantly increased number of fruits /tree and total yield /tree (kg). Abd El-Rhman et al., (2001) noticed that chemical weed control (Glyphosate and Gramoxone) improved yield of Washington navel orange trees.

Table 1. Effect of different weeds resistance methods on shoot length, leaf number, leaf area, yield (kg) / tree and (Ton) / feddan of Washington navel orange trees during 2014 and 2015 seasons

Treatments	Shoot length		Leaf number		Leaf area (cm^2)		Yield(kg) /tree		Yield(Ton) /Feddan	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	9.65	9.01	7.36	6.98	21.68	20.16	112.68	108.06	18.93	18.15
Hand resistance	11.08	11.54	8.43	8.08	24.80	22.45	122.47	124.14	20.57	20.86
Machine tillage	10.79	10.14	8.34	7.98	23.93	21.47	118.23	115.72	19.86	19.44
Herphosate	12.16	12.17	9.47	8.64	25.03	24.36	126.42	129.80	21.24	21.81
Sting	12.69	12.58	9.25	8.71	25.35	24.54	131.17	130.67	22.04	21.95
Roal	12.77	12.64	9.63	8.83	26.68	24.87	134.22	134.20	22.55	22.55
New LSD 5%	1.02	0.89	0.45	0.74	1.24	1.13	5.21	5.07	0.87	1.05

Fruit physico-chemical characteristics

Table (2) showed that all treatments significantly increased fruit weight compared to the control in both seasons, while rind thickness , TSS% and vitamin C was not significantly affected compared to control, whereas, all the used treatments significantly decreased the total acidity of fruit juice .

These results are in harmony with Nasreia *et al*., (1987) found that hand hoeing and chemical weeds control (Gramoxone) increased significantly fruit weight of Washington navel orange trees than the control. Sinbel *et al*., (1997) observed that mulch and herbicides treatments (Gramoxone and Round up) increased average fruit weight over control (hand hoeing) and decreased juice acidity. Likewise, round up increased fruit weight and decreased juice acidity comparing with Gramoxone. On the other hand, they found that mulch and herbicides treatments (Gramoxone and Round up) increased TSS % over control (hand hoeing) and decreased juice contents of ascorbic acid (V. C). Kouka and Salim (2000) mentioned that weed control herbicides treatments significantly increased average fruit weight. While, reduced total acidity, vitamin C, TSS were not significantly affected. Abd El-Rhman *et al.*, (2001) noticed that chemical weed control (Glyphosate and Gramoxone) improved tree growth, yield and fruit quality of Washington navel orange trees.

Table 2. Effect of different weeds resistance methods on fruit weight, rind thickness, TSS, total acidity and vitamin C (mg/100 ml juice) of Washington navel orange trees during 2014 and 2015 seasons

Treatments	Fruit weight		Rind thickness		TSS (%)		Total acidity (%)		Vit. C mg/100ml juice	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	211.05	2007.9	4.77	4.70	11.66	11.54	0.97	0.89	44.97	42.98
Hand resistance	224.27	218.46	4.64	4.73	11.79	11.67	0.90	0.85	46.73	44.64
Machine tillage	215.87	210.27	4.69	4.62	11.74	11.56	0.93	0.80	45.67	44.02
Herphosate	233.48	230.84	4.58	4.59	11.84	11.73	0.86	0.73	47.04	46.37
Sting	239.48	234.67	4.48	4.50	11.86	11.80	0.78	0.68	47.64	46.69
Roal	247.16	242.67	4.52	4.53	11.91	11.86	0.80	0.70	48.32	48.07

New LSD 5%	7.65	6.95	N.S.	N.S.	N.S.	N.S.	0.03	0.2	N.S.	N.S.

Leaf minerals contents

Data in Table (3) indicated that all treatments significantly increased N %, P% and K% compared to the control in both seasons except machine tillage in the second season for N%, first season for P% and second season for K%.

Also Table (3), different weeds control methods significantly affected on leaf microelement (Fe, Zn, Mn). However, the largest value was recorded with herbicide (Roal).

These results are in harmony with those reported by Baruah and Sharma (1990).

Table 3. Effect of different weeds resistance methods on leaf chemical composition of Washington navel orange trees during 2014 and 2015 seasons

Treatments	N %		P %		K %		Fe ppm		Zn ppm		Mn ppm	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	2.15	2.09	0.14	0.11	1.23	1.22	75	70	31	24	28	20
Hand resistance	2.39	2.28	0.19	0.15	1.42	1.39	91	89	43	34	40	32
Machine tillage	2.28	2.16	0.17	0.14	1.38	1.28	86	84	39	33	36	28
Herphosate	2.46	2.39	0.21	0.18	1.47	1.37	98	91	41	38	38	34
Sting	2.42	2.38	0.24	0.18	1.50	1.43	96	94	46	38	37	35
Roal	2.51	2.47	0.25	0.20	1.56	1.44	103	97	47	40	42	39
New LSD 5%	0.12	0.11	0.04	0.03	0.08	0.07	5.6	5.2	4.3	4.1	4.2	3.8

Costs

As for the economic costs of the different methods of weed control , it seems clear that the chemical method by using Roal in controlling weeds is sheeping methods (160 E. P. per feddan) and the hand resistance is the highest costs methods (650 E. P. per feddan) as shown in Table (4) .

These results were agreement with those obtained by Nasreia *et al*., (1987), who found that the chemical method by using Garamoxone is the sheeping methods and the hand hoeing is the highest costs method.

Table 4. The economic costs (Egypt pound) of different weeds resistance methods of Washington navel orange trees during 2014 and 2015 seasons

Treatments	Yearly costs (approximately)
Control	----------
Hand resistance	650
Machine tillage	470
Chemical weed control: Herphosate	210
Chemical weed control: Sting	190
Chemical weed control: Roal	160

Finally, it could be concluded that the chemical herbicides such as Roal can be used for weed control of citrus orchards in research orchard situated Baramoun, Mansoura region, Dakahlia governorate, Egypt.

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دراسات مقارنة لطرق مقاومة الحشائش المختلفة بمزارع الموالح في محافظة الدقهلية

علي رزق فرحات هيكل و محمد نجيب حسن إسماعيل

قسم بحوث الموالح – معهد بحوث البساتين- مركز البحوث الزراعية – الجيزة- مصر

أجريت هذه الدراسه خلال عامي ٢٠١٤ & ٢٠١٥ على أشجار البرتقال أبو سره واشنجطن مطعومه على أصل النارنج منزرعه بالمزرعه البحثية بالبرامون دقهلية تحت ظروف منطقة شمال الدلتا , بأربعة طرق لمقاومة الحشائش (كنترول , يدوية , ميكانيكية , كيماوية مثل هرفوست ,إستنج , رول) , وكانت المعاملات :-كنترول .مقاومة يدوية (الفأس): في منتصف إبريل ومنتصف أغسطس. مقاومة ميكانيكية (العزاقة): في منتصف أغسطس.هرفوست بمعدل ٢.٥ لتر / ١٢٥ لتر ماء. إستنج بمعدل ١.٥ لتر / ١٥٠ لتر ماء.رول بمعدل ١.٠ لتر / ٥٠٠ لتر ماء.* المقاومة الكيماوية في منتصف إبريل ومنتصف أغسطس. وتلخصت النتائج فيما يلي:-* النتائج المتحلصة من كل المعاملات زودت طول الأفرع , عدد الأوراق , مساحة الورقة والمحصول (كجم/شجرة و الطن / فدان) .* أعلي القيم لوزن الثمرة وأقل القيم للنسبة المئوية للحموضة الكلية للثمرة وجدت مع المقاومة الكيماوية بمركب (رول) .* لكن لم تتأثر سمك القشرة , النسبة المئوية للمواد الصلبة الذائبة الكلية ومحتوى الثمرة من فيتامين ج بالجرام/ ١٠٠ مللي عصير بأي طريقة من طرق المقاومة .* أيضاً , زودت مقاومة الحشائش عن طريق الرش بمادة (رول) محتويات الورقة المعدنية من النتروجين , الفوسفور , البوتاسيوم , الحديد , الزنك والمنجنيز . وكانت مادة (رول) الأقل تكلفة في هذة التجربة.