Comparison Studies of Different Weeds Resistance Methods in Citrus Orchards of Dakahlia Governorate
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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 sheepping 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), Fusilade (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 (Gramaxon, 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 Dakahila governatorate 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, Dakahila governatorate 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).
3. Mechanical hoeing (Machine tillage) in mid-August.
4. Herphosate (Glyphosate-Isopropylamine 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-August 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 (cm²) 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 the 1st 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 refractometer. 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 venatehd 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 spectrophotometer.
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>
<thead>
<tr>
<th>Treatments</th>
<th>Shoot length 2014</th>
<th>Leaf number 2014</th>
<th>Leaf area (cm²) 2014</th>
<th>Yield(kg)/tree 2014</th>
<th>Yield(Ton)/Feddan 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>9.65</td>
<td>9.01</td>
<td>7.36</td>
<td>6.98</td>
<td>21.68</td>
</tr>
<tr>
<td>Hand resistance</td>
<td>11.08</td>
<td>11.54</td>
<td>8.43</td>
<td>8.08</td>
<td>24.80</td>
</tr>
<tr>
<td>Machine tillage</td>
<td>10.79</td>
<td>10.14</td>
<td>8.34</td>
<td>7.98</td>
<td>23.93</td>
</tr>
<tr>
<td>Herphosate</td>
<td>12.16</td>
<td>12.17</td>
<td>9.47</td>
<td>8.64</td>
<td>25.03</td>
</tr>
<tr>
<td>Sting</td>
<td>12.69</td>
<td>12.58</td>
<td>9.25</td>
<td>8.71</td>
<td>25.35</td>
</tr>
<tr>
<td>Roal</td>
<td>12.77</td>
<td>12.64</td>
<td>9.63</td>
<td>8.83</td>
<td>26.68</td>
</tr>
<tr>
<td>New LSD 5%</td>
<td>1.02</td>
<td>0.89</td>
<td>0.45</td>
<td>0.74</td>
<td>2.12</td>
</tr>
</tbody>
</table>

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

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 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

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fruit weight 2014</th>
<th>Rind thickness 2014</th>
<th>TSS (%) 2014</th>
<th>Total acidity (%) 2014</th>
<th>Vit. C mg/100ml juice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>211.05</td>
<td>2007.9</td>
<td>4.77</td>
<td>4.70</td>
<td>11.66</td>
</tr>
<tr>
<td>Hand resistance</td>
<td>224.27</td>
<td>218.46</td>
<td>4.64</td>
<td>4.73</td>
<td>11.79</td>
</tr>
<tr>
<td>Machine tillage</td>
<td>215.87</td>
<td>210.27</td>
<td>4.69</td>
<td>4.62</td>
<td>11.74</td>
</tr>
<tr>
<td>Herphosate</td>
<td>233.48</td>
<td>230.84</td>
<td>4.58</td>
<td>4.59</td>
<td>11.84</td>
</tr>
<tr>
<td>Sting</td>
<td>239.48</td>
<td>234.67</td>
<td>4.48</td>
<td>4.50</td>
<td>11.86</td>
</tr>
<tr>
<td>Roal</td>
<td>247.16</td>
<td>242.67</td>
<td>4.52</td>
<td>4.53</td>
<td>11.91</td>
</tr>
<tr>
<td></td>
<td>7.65</td>
<td>6.95</td>
<td>N.S.</td>
<td>N.S.</td>
<td>N.S.</td>
</tr>
<tr>
<td>----------------</td>
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</tr>
</tbody>
</table>

*Hikal, A. R. F. and M. N. Esmaeil.*
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

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Yearly costs (approximately)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
</tr>
<tr>
<td>Hand resistance</td>
<td>650</td>
</tr>
<tr>
<td>Machine tillage</td>
<td>470</td>
</tr>
<tr>
<td>Chemical weed control:</td>
<td>210</td>
</tr>
<tr>
<td>Chemical weed control:</td>
<td>190</td>
</tr>
<tr>
<td>Chemical weed control:</td>
<td>160</td>
</tr>
</tbody>
</table>

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, Dakahli governorate, Egypt.

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).

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

REFERENCES


دراسات مقارنة لطرق مقاومة الحشائش المختلفة بمزارع الموالح في محافظة الدقهلية

علي زقق فرحات هيكل و محمد نجيب حسن إسماعيل

قسم بحوث الحشائش – مركز بحوث البساتين - مركر البحوث السريعية – الجيزة - مصر

أجريت هذه الدراسة خلال عام 2015 على أشجار البرتقال أمو سرحان طيني مطوعة على أصل التاج من نزوحه بالمزرعة المحلية بالبرامون دقلية تحت ظروف منطقة شمال الدلتا بزراعة طرق مقاومة الحشائش-(كترول-بدوية-ميثيلاتيك، كيماوية مثل هروستس إستيج، رول)، وكانت المعالمات: كترول، مكاوية بدوية (القاح): في منتصف إبريل و منتصف أغسطس. هروستس كلما في منتصف وإبريل و منتصف أغسطس. وتلخصت النتائج فيما يلي: النتائج المختصرة من كل الطرق زودت طول الأفعال، عند الأوراق، منحة الورقة والمحصول (كجم/شجرة- المخازن / حان). أعلى القيم لوزن الورقة وأقل القيم للنسبة المئوية للنسبة الكمية للورقة و وجدت مع المقاومة الكيميائية مركب (روي). لكن لم تتأثر سامقة القشرة بنسبة المئوية للمواد الصلبة ذاتية الكمية متحورة الثمرة من فيتامين ج، بالثمرة، 100 مللي عصير بأي طريقة من طرق المقاومة. أيضا، زودت مقاومة الحشائش عن طريق الرش بمادة (روي) محتويات الورقة المعدنية من النتروجين، الفوسفور، الهيوباليوم، الحديد، الزئبق والمنجنيز. وكانت مادة (روي) الأقل تكلفة في هذه التجربة.