# CITRUS TREE BORERS: 2) EFFICACY OF HORTICULTURAL, MECHANICAL, MICROBIOLOGICAL AND LOCAL CHEMICAL TREATMENTS AS ALTERNATIVE CONTROL MEANS AGAINST *CHLOROPHORUS VARIUS* (COLEOPTERA: CERAMBYCIDAE) IN EGYPT

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***Abstract***

Ten non-conventional means of control (horticultural, microbiological, and local chemical treatments) were evaluated in an infested citrus orchard located at Tokh district, Qalubia governorate during 1 and 2 successive years (December 2002 / to November 03 and 2003 / 04) against *Chlorophorus varius*. The rate of reduction of *C. varius* with winter pruning treatment revealed 21.60 and 29.44%, summer pruning treatment (1.38 and 3.73%), winter and summer pruning treatments (27.45 and 35.05%), worming treatment (10.20 and 14.95%), fungal treatment (4.58 and 6.07%), bacterial treatment (4.31 and 5.14%), local spraying treatments (66.12 and 72.90%), local painting treatment (67.09 and 75.23%), winter & summer pruning and local spraying treatments together (77.71 and 87.38%), winter & summer pruning and local painting treatments together (80.65 and 89.72%), when applied for 1 and 2-successive years, respectively.

# INTRODUCTION

The wasp beetle, *Chlorophorus varius* (Coleoptera: Cerambycidae) is a considerable pest in citrus orchards in Egypt. Larvae bore tunnels inside the tree stem and branches, consume a large amount of wood, causing weakness, reducing the production, and finally death of trees. Batt *et al.* (1993) stated that infestation approximated 5-19%, and sweet lemon showed highest infestation with, while mandarin, lemon and kumquat showed high tolerance to infestation.

Accordingly, bores are difficult to be controlled, and chemical control programs with insecticides are the only available means of control in citrus orchards (76 – 83% reduction of infestation, El-Sherif and Tadros, 1985). Therefore, the effectiveness of non-conventional means of control was evaluated in citrus orchards to check the ravages of *C. varius*. These means are safe, eliminate the environmental pollution, reduce the resistant biological races of the pest, and magnify the role of biological control agents (parasitoides, predators and pathogens, Kamburov, 1987).

Owing to the profitable income, citrus plantations are occupying the main horticultural area in Egypt, in old Delta lands as well as in the newly reclaimed lands. This study is a pioneer attempt to control one of the most economically important

insect borers (*C. varius*) using non-conventional means of control for environmental, human and animal safety during consumption.

The main aim of this study was to prevent the yield losses due to this alternative methods, eliminate the pesticide residues, prevent the outbreaks of secondary species, decrease the environmental pollution, magnify the role of the biological control agents and obtain better and healthy production of decontamination of fruits through using non traditional approaches for controlling *C. varius*.

## MATERIALS AND METHODS

Trails to control *Chlorophorus varius* were conducted in an infested citrus orchard (five feddans and 15 years old) located at Tokh district, Qalubia governorate, during the two successive seasons of 2002 / 2003 and 2003 / 2004 (from December to November of the following year). The following 10 horticultural, mechanical, microbiological, and local chemical treatments alone or in combination with each other were evaluated using completely randomized design. Ten trees as replicates for each treatment were used.

**A. Effect of one single year treatments (direct effect):**

**a. Effect of horticultural treatments:**

1. **Winter pruning treatment:** During December /January, the regular horticultural winter pruning was carried out including the infested branches and stubs using sharp saw.
2. **Summer pruning treatment:** During July, the infested branches were also pruned.
3. **Winter and summer pruning treatments:** The previous two treatments were conducted together.

**b. Effect of mechanical treatment:**

4. **Worming treatment:** Killing larvae and pupae as possible inside their tunnels by jack knife and wire.

**c. Effect of microbiological treatments:**

5. **Bacterial treatment:** The commercial bacterial compound "Diple 2X" (a.i. *Bacillus thuringiensis* var. *kurstaki* (Berliner), 3200 International Units Ak / mg) at the rate of 200 cc per 100 liters of water was locally sprayed on the stem, main branches and pruning sites four times each season. A compressed air knapsack sprayer was used in spraying at monthly intervals on May, June, July and August.
6. **Fungal treatment:** The commercial fungal compound "Biofly FC" (a.i., *Beauveria bassiana*, 3 x $10^7$ spores / mg) at the rate of 400 cc per 100 liters of water were locally sprayed on the stem, main branches and pruning sites four times each season. A compressed air knapsack sprayer was used in spraying at monthly

intervals on May, June, July and August.

**d. Effect of local chemical treatments:**

7. **Local painting treatment:** Stemex insecticide (3% Anthracine + 18% Naphthalene) was used to paint the infested sites on the stem and main branches four times a year at monthly intervals during May, June, July, and August. Painting was applied by a brush.
8. **Local spraying treatment:** The recommended Basudin (Diazinon) 60% EC and Cidial L (fenthoate) 50% EC each at the rate of 300 cc / 100 liters water were locally sprayed alternatively four times a year at monthly intervals (May, June, July, and August). Spraying was directed mainly to the infested sites on the stem and branches. A compressed air knapsack sprayer was used in spraying.

**e. Effect of combined treatments:**

9. **Pruning and local painting treatments:** Treatments number 3 and 7 were carried out altogether as previously mentioned.
10. **Pruning and local spraying treatments:** Treatments number 3 and 8 were carried out altogether as mentioned before.

**f. Control treatment:**

11. **Untreated check:** Trees of this treatment did not receive any horticultural microbial or insecticidal treatments, and considered as a comparative treatment.

The previous treatments were conducted from December 2002/ November 2003 on 10 trees "replicates" each treatment. In the next season (2003/2004), the same previous treatments were repeated on another 10 trees "replicates" each treatment, in another orchard in the same locality with the same technique for confirmation.

**B. Effect of two successive years treatments:**

The same 10 previously mentioned one-year treatments of 2002/2003 were repeated on 10 of the previously year treated trees "replicates" (each treatment) in the same citrus orchard with the same technique during 2003/2004 seasons to evaluate the effect of the cumulative effect of two successive years.

The efficiency of the 1$^{st}$ year treatments was evaluated during December 2003 (before pruning treatment of the next year) in 10 trees "replicates" using a sharp jack knife to reach the larvae and pupae in their tunnels and count the live larvae in the treated and untreated trees. During December 2004, the efficiency of the two successive year's treatments was evaluated in the same way.

**Statistical analysis:**

The experimental design was completely randomized design, with 10 trees (replicates) each treatment. The efficiency of treatments was based on the percentage reduction of infestation (Henderson and Tilton, 1955) as follow:

% Reduction of infestation = [(C - T) / C] X 100

Where: C: Mean number of alive larvae in the untreated trees.

T: Mean number of alive larvae in the treated trees.

Analysis of variance (F test) and Least Significant Difference (LSD) (Snedecor and Cochran, 1990) were used for differentiation between treatments.

## RESULTS AND DISCUSSION

The effect of alternative environmentally safe means of control treatments separately or in combination on the reduction of *C. varius* infestation was studied in citrus orchards at Tokh, Qalubia governorate during one and two successive years (2002/03 and 2003/04). Obtained data concluded the following results:

**A. Effect of one single year treatments (direct effect):**

Statistical analysis of data of the mean number of alive larvae per tree in citrus orchards indicated significant differences between the different treatments when applied for one year (Table, 1). However, some treatments showed insignificant differences between them.

**a. Effect of horticultural treatments:**

There was insignificant difference between winter pruning and both winter and summer pruning, but they significantly differed from summer pruning.

1. **Winter pruning treatment** somewhat reduced infestation showing 21.60% (range, 20.73–22.47%). This was due to the borer infestation that mainly attacked main branches and stubs, which mostly did not include in the winter pruning.
2. **Summer pruning treatment** was the least effective one, as the percentage reduction in *C. varius* infestation averaged 1.38% (range, 0.52–2.25%). This was because infestation did not occur in the smaller pruned branches.
3. **Winter and summer pruning treatments** applied together reduced infestation with only 27.45% (range, 26.40-28.50%). This relatively low reduction of infestation was because larvae feed and habitat deep inside the stem, main branches and stubs that are rarely included in pruning.

**b. Effect of mechanical treatments:**

4. **Worming treatment** was not effective (average, 10.20%, and range, 8.99-11.40% reduction of infestation) owing to the deep larval habitat inside the citrus wood. There were insignificant differences between the worming and pruning or microbiological treatments.

**c. Effect of microbiological treatments:**

Bacterial and fungal treatments were insignificantly different, also there were insignificant differences between the microbiological, worming and pruning.

5. **Bacterial treatment** had insufficient results (average, 4.31%, and range, 3.93-4.66% reduction of infestation). This may be due to that bacteria were highly

affected by the weather factors and the difficulty to reach the larvae inside their tunnels.

6. **Fungal treatment** showed almost similar results, as the percentage reduction of infestation averaged 4.58% (range, 4.15 to 5.06%).

Table 1. Effect of one single year treatments on the percentage reduction in *chlorophorus varius* infestation in citrus orchards at Qalubia governorate during 2002/03 and 2003/04 seasons.

| Treatments | 1st year 2002 / 03 | | 2nd year 2003 / 04 | | Mean | |
|---|---|---|---|---|---|---|
| | No. of larvae / tree* | % R.I. | No. of larvae / tree* | % R.I. | No. of larvae / tree | % R.I. |
| A: Horticultural Treatments: | | | | | | |
| 1- Winter pruning | 15.3±3.8 (12-19) | 20.73 | 13.8±3.1 (11-17) | 22.47 | 14.55 B | 21.60 |
| 2- Summer pruning | 19.2±4.1 (14-23) | 0.52 | 17.4±3.9 (11-19) | 2.25 | 18.30 C | 1.38 |
| 3- Winter & summer pruning | 13.8±2.9 (10-17) | 28.50 | 13.1±3.2 (9-16) | 26.40 | 13.45 B | 27.45 |
| B: Mechanical Treatments: | | | | | | |
| 4- Worming | 17.1±3.6 (12-20) | 11.40 | 16.2±4.1 (11-21) | 8.99 | 16.65 BC | 10.20 |
| C: Microbiological Treatments: | | | | | | |
| 5- Bacterial | 18.4±3.9 (14-22) | 4.66 | 17.1±4.5 (10-19) | 3.93 | 17.75 BC | 4.31 |
| 6- Fungal | 18.5±5.3 (13-24) | 4.15 | 16.9±5.3 (9-21) | 5.06 | 17.7 BC | 4.58 |
| D: Local Chemical Treatments: | | | | | | |
| 7- Local painting | 6.2±4.3 (2-8) | 67.88 | 6.0±4.2 (3-9) | 66.29 | 6.10 A | 67.09 |
| 8- Local spraying | 6.9±5.1 (3-10) | 64.25 | 5.7±4.8 (2-9) | 67.98 | 6.30 A | 66.12 |
| E: Combined Treatments: | | | | | | |
| 9- Treatments, 3+7 | 4.3±4.6 (1-8) | 79.27 | 3.2±3.4 (0-5) | 82.02 | 3.75 A | 80.65 |
| 10- Treatments, 3+8 | 4.7±3.5 (2-7) | 75.65 | 3.6±3.2 (1-6) | 79.78 | 4.15 A | 77.71 |
| F: Untreated: | | | | | | |
| 11- Check | 19.3±4.4 (13-25) | -- | 17.8±3.6 (12-21) | -- | 18.55 BC | -- |

Values within a column followed by different letter are significantly different (P> 0.05)
Duncan [1951 as described by computer Ms tat program, 1987] multiple ranges test.
*% R.I.: Percent reduction of infestation.

**d. Effect of local chemical treatments:**

There were significant differences between local painting and local spraying, but local chemical and the combined treatments were insignificantly different.

7. **Local painting treatment** markedly reduced the borer infestation resulting in 67.09% (range, 66.29–67.88%). This high percent reduction was due to the unsuccessful trails of the borer to re-infest treated sites.
8. **Local spraying treatment**, to some extend, hindered the beetle oviposition, hatching and larval entry inside the citrus wood. However, this type of treatment reduced the borer infestation approximated by 66.12% (range, 64.25–67.98%).

**e. Effect of combined treatments:**

There were insignificant differences between the combined treatments. Combined treatments were insignificantly different from local chemical treatments.

9. **Winter and summer pruning together with local painting treatments** significantly increased reduction of infestation resulted in an average of 80.65% (range, 79.27–82.02%). These combined treatments were satisfactory.
10. **Winter and summer pruning together with local spraying treatments** revealed almost equal results as the average reduction of infestation 77.71% (range, 75.65–79.78%).

**B. Effect of two successive year treatments (Cumulative effect):**

Statistical analysis indicated significant differences between certain treatments, while there were insignificant differences between some of them (Table, 2).

**a. Effect of horticultural treatments (pruning):**

Pruning in winter somewhat reduced *C. varius* infestation when applied for two successive years. This relatively low percentage reduction of infestation (29.44%) was because the concentration of larval infestation in the stem and main branches. However, winter pruning somewhat shared in reducing the borer infestation.

Summer pruning had slight effect on a reduction of infestation (3.73%) although it was repeated for two successive years. Accordingly, summer pruning should not include in the integrated control program of the pest.

Applying winter and summer pruning together was of some effect on the reduction of infestation (35.05%), so this treatment must be applied year after another.

Table 2. Effect of two successive year treatments on the percentage reduction in *chlorophorus varius* infestation in citrus orchards at Qalubia governorate during 2002 / 04 seasons.

| Treatments | No. of larvae / tree* | % R.I. |
|---|---|---|
| A: Horticultural Treatments: | | |
| 1. Winter pruning | 15.1±4.0 BC (10-19) | 29.44 |
| 2- Summer pruning | 20.6±4.7 C (15-26) | 3.73 |
| 3- Winter & summer pruning | 13.9±3.9 BC (8-18) | 35.05 |
| B: Mechanical Treatment: | | |
| 4- Worming | 18.2±4.2 BC (12-21) | 14.95 |
| C: Microbiological Treatments: | | |
| 5- Bacterial | 20.3±5.0 C (16-28) | 5.14 |
| 6- Fungal | 20.1±4.9 C (14-24) | 6.07 |
| D: Local Chemical Treatments: | | |
| 7- Local painting | 5.3±2.5 A (3-8) | 75.23 |
| 8- Local spraying | 5.8±2.8 A (2-9) | 72.90 |
| E: Combined Treatments: | | |
| 9- Treatments, 3 + 4 + 7 | 2.2±3.6 A (0-5) | 89.72 |
| 10- Treatments, 3 + 4 + 8 | 2.7±4.1 A (0-7) | 87.38 |
| F: Untreated: | | |
| 11- Check | 21.4±5.1 C (17-29) | -- |

Values within a column followed by different letter are significantly different (P> 0.05) Duncan [1951 as described by computer Mstat program, 1987] multiple ranges test.
*% R.I.: Percent reduction of infestation.

There was insignificant difference between the winter pruning and both winter and summer pruning together, but they significantly differed from summer pruning.

**b. Effect of mechanical treatment (worming):**

Killing larvae, pre-pupae, and pupae stages through worming treatment was very hard and slightly reduced infestation although this treatment was repeated year after another (14.95%). Statistically, there were insignificant differences between the worming and pruning or microbiological treatments.

**c. Effect of microbiological treatments (bacteria or fungus):**

Microbiological treatments whether with the pathogenic bacteria or fungus were highly affected with the weather factors and was relatively useless even when applied cumulatively year after another (5.14 and 6.07% reduction of infestation, respectively).

There were insignificant differences between microbiological treatments, worming or pruning.

**d. Effect of local chemical treatments (painting or spraying):**

Local painting and local spraying were quite effective in the reduction of infestation when they were applied for two years (75.23 and 72.90%, respectively).

There were insignificant differences between the local painting and local spraying and also, between the local chemical treatments and the combined treatments.

**e. Effect of combined treatments:**

Applying pruning in winter with the summer pruning, and local painting or spraying treatments in different combinations resulted in adequate reduction in *C. varius* infestation (89.72% or 87.38%, respectively) especially when carried out year after another.

There were insignificant differences between the different combined treatments and also, between the combined treatments and the local chemical treatments.

**C: The relative effectiveness and General grouping of the treatments applied for one and two years:**

Statistical analysis of variance (F test) and LSD resulted in the following groups:

**a- The superior group (80 - 100% reduction of infestation):**

1- Winter & summer pruning, and local painting together applied for two successive years (89.72%)

2- Winter summer pruning, and local spraying together applied for two successive years (87.38%)

3- Winter & summer pruning, and local painting together applied for one year (80.65%)

**b. The moderate group (60 - 79% reduction of infestation):**

1- Winter & summer pruning, and local spraying together applied for one year (77.71%)

2- Local painting applied for two successive years (75.23%)

3- Local spraying applied for two successive years (72.90%)

4- Local painting applied for one year (67.09%)

5- Local spraying applied for one year (66.12%)

**c. The less group (20 - 39% reduction of infestation):**

1- Winter and summer pruning applied for two successive years (35.05%)

2- Winter pruning applied for two successive years (29.44%)

3- Winter and summer pruning applied for one year (27.45%)

4- Winter pruning applied for one year (21.60%)

**d. The least group (less than 20% reduction of infestation):**

1- Worming applied for two successive years (14.95%)

2- Worming applied for only one year (10.20%)

3- Fungal treatment applied for two successive years (6.07%)

4- Bacterial treatment applied for two successive years (5.14%)

5- Fungal treatment applied for only one year (4.58%)

6- Bacterial treatment applied for only one year (4.31%)

7-Summer pruning applied for two successive years (3.73%)

8- Summer pruning applied for only one year (1.38%)

Although the different treatments applied for different years ranked in the previously mentioned groups, yet an interaction were noticed between the treatments in the four groups.

## CONCLUSION AND DISCUSSION

It could be concluded that the effect of treatments varied from one treatment to another and of repeating these treatments year after another magnified the reduction of *C. varius* infestation in citrus orchards (Tables, 1 and 2). The effect of horticultural treatments alone resulted in 27.45% increased to 35.05% reduction of infestation. However, the majority of the effect was due to winter pruning (21.60% increased to 29.44%), since summer pruning showed (1.38% increased to 3.73%). Mechanical control treatment (worming) was slightly effective resulted in 10.20% increased to 14.95%. Microbiological control with bacteria or fungus showed slight effect, as the results were 4.31 - 4.58% increased to 5.14 – 6.07%. Local painting and local spraying treatments varied much as they resulted in 67.09% increased to 75.23% and 66.12% increased to 72.90%, respectively. Combined applications (Integrated Pest

Control) of winter and summer pruning treatments, together with local chemical treatments magnified the reduction of infestation 80.65 - 77.71% and greatly increased to 89.72 - 87.38% when repeated year after another. The

Table 3. General grouping of different treatments applied to control *chlorophorus varius* larvae on citrus trees during one (1) and two (2) successive years (2002/03 and 03/04).

| Treatment | Corrected mean no. of alive larvae | Corrected % R. I. | Ranked order | L.S.D | | |
|---|---|---|---|---|---|---|
| Pr + W + LP (2) | 2.06 | 89.70 | 1 | A | | |
| Pr + W + LS (2) | 2.52 | 87.40 | 2 | A | | |
| Pr + W + LP (1) | 4.04 | 79.80 | 3 | A | | |
| Pr + W + LS (1) | 4.47 | 77.65 | 4 | A | | |
| Local Painting (2) | 4.95 | 75.25 | 5 | A | | |
| Local Spraying (2) | 5.42 | 72.90 | 6 | A | | |
| Local Painting (1) | 6.58 | 67.10 | 7 | A | | |
| Local Spraying (1) | 6.79 | 66.05 | 8 | A | | |
| Pruning (2) | 13.00 | 35.00 | 9 | | B | |
| Winter Pruning (2) | 14.11 | 29.45 | 10 | | B | C |
| Pruning (1) | 14.50 | 27.50 | 11 | | B | C |
| Winter Pruning (1) | 15.69 | 21.55 | 12 | | B | C |
| Worming (2) | 17.01 | 14.95 | 13 | | B | C |
| Worming (1) | 17.95 | 10.25 | 14 | | B | C |
| Fungal (2) | 18.79 | 6.05 | 15 | | B | C |
| Bacterial (2) | 18.97 | 5.15 | 16 | | | C |
| Fungal (1) | 19.08 | 4.60 | 17 | | | C |
| Bacterial (1) | 19.14 | 4.30 | 18 | | | C |
| Summer Pruning (2) | 19.25 | 3.75 | 19 | | | C |
| Summer Pruning (1) | 19.73 | 1.35 | 20 | | | C |
| Untreated check | 20.00 | 0 | 21 | | | C |

R.I.: Reduction of Infestation
Pr: Pruning (winter and summer)
W: Worming
LP: Local Painting.
LS: Local Spraying.

horticultural treatments (winter and summer pruning) resulted in satisfied control if repeated year after another.

Data indicated that repeating the different treatments year to another was mostly of considerable values, but it was negligible in other cases. Repeating the combined treatments increased the reduction of infestation with 9.1 – 9.7%. Repeating pruning increased the reduction of infestation with 7.6% (the effect was mainly due to winter pruning). Repeating local chemical treatment increased the reduction of infestation with 6.8 – 8.1%. Repeating worming treatment increased the reduction of infestation with 4.8%. Repeating microbiological treatments negligibly increased the reduction of infestation (0.8 - 1.5%).

Corrected percentages reduction of *C. varius* infestation in Table (3) showed significant differences between the 21 treatments. However, there were insignificant differences between the combined treatments of pruning together with local spraying or painting and local spraying or local painting alone when they were applied for one or two successive years. On the other hand, there were insignificant differences between the winter and summer pruning together, winter pruning, worming, when they were applied for one or two successive years and fungal treatment for two successive years. Bacterial and summer pruning for two successive years and fungal treatment for two years were statistically insignificant. Interaction insignificance was between winter pruning, worming, for one or two successive years, winter and summer pruning together for one year, and fungal treatment for two years.

Moreover, the last 11 treatments were also insignificantly different from the untreated check control.

Accordingly, local spraying or painting treatments alone or together with winter (and if possible summer) pruning and worming treatments are sufficiently effective applications in controlling *C. varius* larvae in citrus trees. The effectiveness increases when treatments were repeated year after another.

The previous results are in agreement with Castellanos *et al.* (1990) who recommended pruning treatment to all branches containing larvae of cerambycid as a mean of control. Yuan and Huang (1997) found that the most effective method to control citrus borers was local painting of the trunk base by insecticides.

Promising results on the reduction of cerambycid borer with *Beauveria bassiana* were obtained from Japan by Kashio and Grey (1996).

Traditionally, El-Shrif & Tadros (1985) and El-Minshawy (1976) in Egypt resulted in 76 – 83 % reduction of *C. varius* infestation with 4 sprays with insecticides at 3 weeks interval. Yuan & Huang (1997) and Machado & Raga (1999) applied 3 - 4 sprays during oviposition period that were effective method against some cerambycids.

In Egypt, Helwa & Tadros (2000) found that the respective percentages reduction of *C. varius* infestation on peach trees were 18 - 24% due to dormant and summer pruning. About 8% was due to worming but 64 and 67% due to local painting or local spraying. In addition, 78 – 82 and 80 – 87% was due to pruning, worming and local painting or local spraying treatments together when applied for only one year. Applying the previous treatments for two successive years resulted in 36 - 37, 12 - 14, 45 - 48, 11, 74 - 77, 78, 92 - 93 and 95 - 97%, respectively. The cumulative effect for three successive years was 57, 19, 66, 15, 85, 86, 97 and 99%, respectively.

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# حفارات أشجار الموالح (٢) الطرق البديلة لمكافحة حفار ساق الخوخ ذو القرون الطويلة ***Chlorophorus varius*** باستخدام المعاملات البستانية والميكانيكية والميكروبية والكيماوية الموضعية في مصر

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[٢] *كلية العلوم- جامعة القاهرة- الجيزة*

للحد من التلوث البيئي بالمبيدات، تم تقييم فعالية عشرة طرق للمكافحة غير التقليدية مثل المعاملات البستانية والميكانيكية والكائنات الحيوية الدقيقة والكيماوية الموضعية في حديقة موالح مصابة بشدة بحفار ساق الخوخ ذو القرون الطويلة *Chlorophorus varius* في منطقة طوخ محافظة القليوبية خلال عام واحد وعامين متتاليين (من ديسمبر ٢٠٠٢ إلي نوفمبر ٢٠٠٣، و ٢٠٠٣ / ٢٠٠٤). بلغ معدل تقليل الإصابة عندما أجريت المعاملات التالية خلال عام واحد وعامين متتاليين، على التوالي ما يلي:

- التقليم الشتوي ٢١,٦٠ و ٢٩,٤٤%
- التقليم الصيفي ١,٣٨ و ٣,٧٣%
- التقليم الشتوي والصيفي معا ٢٧,٤٥ و ٣٥,٠٥%
- قتل اليرقات والعذاري بالسلك ١٠,٢٠ و ١٤,٩٥%
- المعاملة بالفطريات الممرضة ٤,٥٨ و ٦,٠٧%
- المعاملة بالبكتيريا الممرضة ٤,٣١ و ٥,١٤%
- الرش الموضعي ٦٦,١٢ و ٧٢,٩٠%
- المعاملة بالدهان الموضعي ٦٧,٠٩ و ٧٥,٢٣%
- التقليم الشتوي والصيفي معا بالإضافة إلي الرش الموضعي ٧٧,٧١ و ٨٧,٣٨%
- التقليم الشتوي والصيفي معا بالإضافة إلي الدهان الموضعي ٨٠,٦٥ و ٨٩,٧٢%.