# STONE FRUIT TREE PESTS: (9) ALTERNATIVE MEANS OF CONTROL OF *MACROTOMA PALMATA* BY HORTICULTURAL, MECHANICAL, MICROBIOLOGICAL, AND LOCAL CHEMICAL TREATMENTS IN APRICOT ORCHARDS IN EGYPT

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***Abstract***

Alternative means of control of *Macrotoma palmata* (Coleoptera: Cerambycidae) in apricot orchards by horticultural, mechanical, microbiological, and local chemical treatments were evaluated at Tokh district, Qalubia governorate during one and two successive years (1999/2000 and 2000/2001). The respective rates reductions of infestation with the following 13 treatments applied for one and two successive years were as follows: dormant pruning (8.15 increased to 10.39%), summer pruning (0.74 increased to 1.30%), dormant and summer pruning (8.89 increased to 11.69%), worming (26.67 increased to 33.77%), bacterial or fungal (2.96 or 4.44 increased to 3.90 or 5.19%), local painting or local spraying (50.37 or 51.11 increased to 62.34 or 61.04%), pruning, worming, together with bacterial or fungal (34.07 or 32.59 increased to 44.16 or 41.56%), and pruning, worming, and local painting or local spraying (71.85 or 70.37 increased to 77.92 or 75.32%) treatments. The integrated control program of *ptosima undecimmacu lata, Chlorophorus varius, Macrotoma palmata,* and *Scolytus amygdali*) was successfully achieved by pruning, worming, and could be promoted by local chemical treatments.

## INTRODUCTION

The sunt macrotoma *Macrotoma palmata* (Coleoptera: Cerambycidae) is a destructive pest in apricot orchards in Egypt. Larvae bore deep and wide tunnels inside the wood of the stem and larger branches, causing weakness, breakage of tree branches, leading to reducing the production, and finally death of the whole trees.

Up until now, recommendations for the control of the fruit tree borers' infestation (including *M. palmata*) in stone fruit (including apricot) orchards are still mainly directed towards the chemical control treatments. Chemical control with complete coverage spray with insecticides, leads to adverse affects on the biological control agents (parasitoides, predators, and pathogens), pollute the fruit production and the environment.

Apricot plantations spread allover the new reclaimed lands in addition to old Delta lands owing to the profitable income. This study is a pioneer attempt to control *M. palmata*, which is the apricot production-limiting factor.

The available literature in Egypt included studies on the biology of *M. palmata* (Mostafa, 1977) and monitored the population fluctuation (Tadros *et al.*, 1993 and Tadros *et al.*, 2006 in press). These studies are essential in determination of the proper timing of the pest control treatments. Previous trials on control included laboratory bioassay on eggs (El-Sebay, 1984) and evaluation of field treatments (Tadros *et al.*, 1996). However, literature on the control of *M. palmata* in fruit orchards abroad is lacking.

The aim of the present investigation is to prevent the yield losses due to this boring pest, 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 production of decontamination of fruits through using non traditional approaches for controlling *M. palmata*. In addition, evaluation of the integration of control program of the four major apricot tree borers as reported in the series of these researches numbers 6 on *P. undecimmaculata,* 7 on *C. varius*, and 8 on *S. amygdali* (Tadros *et al.*, 6, 7, and 8 in press).

## MATERIALS AND METHODS

At Tokh district, Qalubia governorate, experiments were carried out in an apricot orchard (10 feddans and 20 years old) highly infested with *M. palmata.* Trials were extended during 2 successive years from October 1999 to December 2001. The following 13 treatments were evaluated using completely randomized design (50 trees each treatment and each tree was considered a replicate).

**a. Horticultural treatments:**

1. **Dormant pruning treatment:** During December of each year, the regular horticultural winter pruning was carried out including the infested branches and stubs (characterized with exit holes and exudates sawdust).
2. **Summer pruning treatment:** After harvesting, more infested branches were pruned during July for rejuvenating new sound branches.
3. **Dormant and summer pruning treatments:** Treatments numbers 1 and 2 were applied together.

**b. Effect of mechanical treatment:**

4. **Worming treatment:** After pruning, hard flexible wire was used to kill the larvae and pupae inside infested tunnels on the stem and main branches.

**c. Microbiological treatments:**

5. **Bacterial treatment:** Bactospeine F.C. (a.i. *Bacillus thuringiensis* (Berliner), 8500 International Units Ak / mg) at the rate of 200 cc/100 liters of water was locally

sprayed on the stem, main branches and pruning sites 4 times each season (at monthly intervals on May, June, July and August) using knapsack sprayer.

6. **Fungal treatment:** Biofly F.C. (a.i., *Beauveria bassiana*, 3 x $10^7$ spores / mg) at the rate of 400 cc/100 l. w. were locally sprayed on the stem, main branches and pruning sites 4 times each season (at monthly intervals on May, June, July and August) using knapsack sprayer.

**d. Local chemical treatments:**

7. **Local painting treatment:** Stemex insecticide (3% Anthracine + 18% Naphthalene) was used to paint the stem, main branches and infested sites 4 times each season at monthly intervals (May, June, July, and August). Painting was practical using a brush.
8. **Local spraying treatment:** The MOA recommended Basudin (Diazinon) 60% EC and Cidial L (Phenthoate) 50% EC each at the rate of 300 cc/100 l. w. was sprayed alternatively 4 times each season at monthly intervals (May, June, July, and August). Spraying was practiced by a knapsack sprayer and mainly directed towards the stem, branches and infested sites.

**e. Combined treatments:**

9. **Pruning, worming, and bacterial treatment:** Treatment numbers 3, 4, and 5 were conducted together.
10. **Pruning, worming, and fungal treatments:** Treatments numbers 3, 4, and 6 were conducted together.
11. **Pruning, worming, and local painting treatments:** Treatments numbers 3, 4, and 7 were conducted together.
12. **Pruning, worming, and local spraying treatments:** Treatments numbers 3, 4, and 8 were carried out together.

**f. Untreated:**

13. **Check treatment:** Check trees were left untreated as control treatment.

**g. Procedures of treatments:** The previous 13 treatments were conducted during November 1999 to October 2000 season. During the 2nd season (November 2000 to October 2001), the same previous treatments were repeated on other trees in another nearby area of the same orchard with the same technique for confirmation. In the meantime, the same previous 13 treatments were carried out on the same last year trees to evaluate the effect of the treatments when applied for two successive years (from November 1999 to October 2001). Treatments were evaluated by counting the newly emerged beetles indicated by the newly exit

holes on the trees during the following season. New exit holes were continuously counted and canceled by painting after each year treatment.

**h. Evaluation of treatments:** The efficiency of treatments was based on the percentage reduction of the each borer infestation (Henderson and Tilton, 1955), as follow:

$$\% \text{ reduction of infestation} = [(C - T) / C]^{-1} 100$$

Where, C: the mean number of new exit holes in untreated trees.

T: the mean number of new exit holes in treated trees.

Grouping of treatments was based on ANOVA test and "Least Significant Difference" (Snedecor and Cochran, 1990).

## RESULTS AND DISCUSSION

Experiments to evaluate the direct effects of different horticultural, mechanical, microbiological, and local chemical treatments alone or in combination with each other's on the reduction of *M. palmata* infestation were conducted for only one single year (1999–2000 or 2000-2001). The cumulative effects were also evaluated as well for two successive years from late 1999 to late 2001.

**A. Effect of one single year treatments (Direct effect):** (Table, 1)

**a. Effect of horticultural treatments alone:**

1. **Effect of dormant pruning treatment:** Pruning treatment reduced the borer infestation with 7.81–8.45% (mean, 8.15%) each year. This low reduction was due to the mode of larval feeding and habitat inside the stem main branches and stubs which mostly did not included in the dormant pruning. However, pruning of dying branches somewhat reduced the borer infestation.
2. **Effect of summer pruning treatments:** Summer pruning was least effective as the degree of borer reduction of infestation resulted in 0.00-1.56% (mean, 0.74%). Summer pruning was directed only towards the new shoots, some older sites and scarcely towards the fallen main branches due to relatively heavy fruiting coincided with heavy infestation.
3. **Effect of dormant and summer pruning treatments:** The reduction in *M. palmata* infestation slightly increased when applying dormant and summer treatments together than each treatment alone, ranged 8.45-9.38% (mean, 8.89%).

**b. Effect of mechanical treatment:**

4. **Effect of worming treatment:** Worming treatment was noticeably effective showing 23.44–29.58% (mean, 26.67%) reduction of the borer infestation. This

was due to the compactness of the coarse sawdust resulted from the larval feeding and the existence of larger larval, pre-pupae and pupae stages close to the larval tunnel's openings In addition, this treatment facilitates parasites and predators to reach the live larvae and pupae inside the tunnels.

**c. Effect of microbiological treatments:**

5. **Effect of bacterial treatment:** Bacterial treatment was relatively inactive in the field as the bacteria highly affected with the weather factors (especially higher temperature and hot wind) thus, these bacteria were difficult to reach the larvae inside their tunnels. Therefore, this treatment was less effective as the percentage reduction of infestation recorded only 2.82–3.13% (mean, 2.96%).
6. **Effect of fungal treatment:** The percentage reduction in *M. palmata* infestation due to fungal treatment was low but slightly higher than bacteria showing 4.22-4.69% (mean, 4.44%).

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

**Effect of local painting treatment:** Local painting four times a year with "Stemex" insecticide on the stem and larger pruned areas increased the percentage reduction of *M. palmata* infestation reaching 47.89–53.13% (mean, 50.37%). This considerable reduction was due to the unsuccessful trails of the borer to infest these sites.

Table 1. Effect of one single year treatments on the percentage reduction in *M. palmata* infestation in apricot orchards at Qalubia governorate during 1999-2000 and 2000-2001 seasons.

| Treatments | % reduction of infestation | | | | | |
|---|---|---|---|---|---|---|
| | 1st year 1999-2000 | | 2nd year 2000-2001 | | Mean | |
| | No. of exit holes | % | No. of exit holes | % | No. of exit holes | % |
| A: Horticultural Treatments: | | | | | | |
| 1. Dormant pruning | 5.9 | 7.81 | 6.5 | 8.45 | 6.20 | 8.15 |
| 2. Summer pruning | 6.3 | 1.56 | 7.1 | 0.00 | 6.70 | 0.74 |
| 3. Dormant & summer pruning | 5.8 | 9.38 | 6.5 | 8.45 | 6.15 | 8.89 |
| B: Mechanical Treatments: | | | | | | |
| 4. Worming | 4.9 | 23.44 | 5.0 | 29.58 | 4.95 | 26.67 |
| C: Microbiological Treatments: | | | | | | |
| 5. Bacterial | 6.2 | 3.13 | 6.9 | 2.82 | 6.55 | 2.96 |
| 6. Fungal | 6.1 | 4.69 | 6.8 | 4.22 | 6.45 | 4.44 |
| D: Local Chemical Treatments: | | | | | | |
| 7. Local painting | 3.0 | 53.13 | 3.7 | 47.89 | 3.35 | 50.37 |
| 8. Local spraying | 3.1 | 51.56 | 3.5 | 50.70 | 3.30 | 51.11 |
| E: Combined Treatments: | | | | | | |
| 9. Treatments, 3 + 4 + 5 | 4.3 | 32.81 | 4.6 | 35.21 | 4.45 | 34.07 |
| 10. Treatments, 3 + 4 + 6 | 4.4 | 31.25 | 4.7 | 33.80 | 4.55 | 32.59 |
| 11. Treatments, 3 + 4 + 7 | 1.8 | 71.88 | 2.0 | 71.83 | 1.90 | 71.85 |
| 12. Treatments, 3 + 4 + 8 | 1.9 | 70.31 | 2.1 | 70.42 | 2.00 | 70.37 |
| F: Untreated Treatments: | | | | | | |
| 13. Check | 6.4 | -- | 7.1 | -- | 6.75 | -- |

9. **Effect of local spraying treatment:** Local spraying four times a year with insecticides to the stem, bases of main branches and pruned stubs adequately reduced *M. palmata* infestation with 50.70–51.56% (mean, 51.11%). This treatment hindered the beetle settings, the beetle oviposition, hatching and larval entry inside the apricot wood.

**e. Effect of combined treatments:**

10 **Effect of pruning, worming, and bacterial treatments:** Table (1) indicated that bacterial treatment somewhat increased the effectiveness of the combined treatments as the reduction in *M. palmata* infestation reached 32.81–35.21% (mean, 34.07%). The major reduction was mainly due to pruning and worming treatments.

11. **Effect of pruning, worming, and fungal treatments:** In addition, the effectiveness of these three treatments was mainly due to pruning and worming but the fungal treatment did not add noticeable effect. This combined treatment resulted in 31.25–33.80 % (mean, 32.59%).

12. **Effect of pruning, worming, and local painting treatments:** Quite adequate reductions in *M. palmata* infestation was achieved when these combined treatments were applied together showing 71.83–71.88% (mean, 71.85%) reductions of infestation. The effect was due to all the three treatments rather than one main treatment.

13. **Effect of pruning, worming, and local spraying treatments:** Also, applying these treatments together showed almost equal adequate results concluding 70.31–70.42% (mean, 70.37%) reductions in infestation..

**B. Effect of two successive year treatments (Cumulative effect):** Table (2)

**a. Effect of horticultural treatments alone:** Dormant pruning treatment alone in winter slightly reduced *M. palmata* infestation in spite of repeating this treatment for two successive years. This low reduction of infestation (10.39%) was because the larval infestation concentrated in the stem and main branches. However, winter pruning somewhat shared in reducing the borer infestation. Summer pruning had almost no effect (1.30%) on the reduction of infestation although it was repeated for two successive years. Summer pruning did not share in the reduction of infestation and should be excluded in the integrated control program. Applying dormant and summer pruning treatments together for two successive years reduced infestation with 11.69%.

Table 2. Effect of two successive year treatments on the percentage reduction in *M. palmata* infestation in apricot orchards at Qalubia governorate during the two successive seasons (1999-2001) and differences between one and two year's treatments.

| Treatments | Two successive years | | Differences between 1 & 2 years (%) |
|---|---|---|---|
| | No. of exit holes | % reduction of infestation | |
| A: Horticultural Treatments: | | | |
| 1. Dormant pruning | 6.9 | 10.39 | 2 |
| 2. Summer pruning | 7.6 | 1.30 | 1 |
| 3. Dormant & summer pruning | 6.8 | 11.69 | 3 |
| B: Mechanical Treatments: | | | |
| 4. Worming | 5.1 | 33.77 | 7 |
| C: Microbiological Treatments: | | | |
| 5. Bacterial | 7.4 | 3.90 | 1 |
| 6. Fungal | 7.3 | 5.19 | 1 |
| D: Local Chemical Treatments: | | | |
| 7. Local painting | 2.9 | 62.34 | 12 |
| 8. Local spraying | 3.0 | 61.04 | 10 |
| E: Combined Treatments: | | | |
| 9. Treatments, 3 + 4 + 5 | 4.3 | 44.16 | 10 |
| 10. Treatments, 3 + 4 + 6 | 4.5 | 41.56 | 9 |
| 11. Treatments, 3 + 4 + 7 | 1.7 | 77.92 | 6 |
| 12. Treatments, 3 + 4 + 8 | 1.9 | 75.32 | 5 |
| F: Untreated Treatments: | | | |
| 13. Check | 7.7 | -- | |

**b. Effect of mechanical treatment alone:** Worming treatment (killing larvae, pre-pupae, and pupae stages) effectively reduced *M. palmate* infestation (33.77%) when applied for two successive years.

**c. Effect of microbiological treatments:** The pathogenic bacteria or fungus was relatively useless even when applied cumulatively for two successive years (3.90 and 5.19%, respectively).

**d. Effect of local treatments:** Local painting and local spraying 4 times a year with insecticides was quite effective in the reduction of *M. palmata* infestation especially when was applied for two successive years (62.34 and 61.04%, respectively).

**e. Effect of combined treatments:**

Applying dormant pruning, summer pruning, worming, microbiological, and/or local chemical treatments in different combinations resulted in adequate reduction in *M. palmata* infestation especially when carried out year after another.

Winter and summer pruning, worming and bacterial treatments showed 44.16% reduction of infestation when conducted for two successive years. Applying winter and summer pruning, worming and fungal treatments for two successive years resulted in almost similar results (41.56%). Winter and summer pruning, worming with local painting for two successive years almost doubled percentage reduction in the borer infestation (77.92%). Winter and summer pruning, worming with local spraying for

two successive years resulted in almost similar percentage reduction in the borer infestation (75.32%). These combined treatments would resulted in more reduction in *M. palmate* infestation should they applied yearly.

**C. Statistical analysis:** Statistical analysis and grouping of the 13 treatments applied for one and two years concluded that there were significant differences between treatments and classified as:

**a. Superior group (70 – 100%):**

1. Pruning, worming, and local painting for two years (77.92%) A
2. Pruning, worming, and local spraying for two years (75.32%) A
3. Pruning, worming, and local painting for one year (71.85%) A
4. Pruning, worming, and local spraying for one year (70.37%) A

**b. Sufficient group (50 – less than 70%):**

1. Local painting for two years (62.34%) AB
2. Local spraying for two years (61.04%) AB
3. Local spraying for one year (51.11%) AB
4. Local painting for one year (50.37%) AB

**c. Moderate group (30 - less than 50%):**

1. Pruning + Worming + Bacterial for two years (44.16%) B
2. Pruning + Worming + Fungal for two years (41.56%) B
3. Pruning + Worming + Bacterial for one year (34.07%) B
4. Worming for two years (33.77%) BC
5. Pruning + Worming + Fungal for one year (32.59%) B

**d. Less group (15 - less than 30%):**

1. Worming for one year (26.67%) B

**e. Least group (1 - less than 15%):**

1. Dormant and summer pruning for two years (11.69%) BC
2. Dormant pruning for two years (10.39%) BC
3. Dormant and summer pruning for one year (8.89%) C
4. Dormant pruning for one year (8.15%) C
5. Fungal for two years (5.19%) C
6. Fungal for one year (4.44%) C
7. Bacterial for two years (3.90%) CD
8. Bacterial for one year (2.96%) D
9. Summer pruning for two years (1.30%) D
10. Summer pruning for one year (0.74%) D

## DISCUSSION

From the foregoing results in Tables (1) and (2), it could be concluded that the direct effect of one single year treatments on *M. palmate* infestation varied from one treatment to another. The cumulative effect of two successive year treatments concluded that the infestation could be highly reduced if these treatments repeated year after another. The effect of horticultural treatments alone (winter and summer pruning) approximated 9 and 12% reduction of infestation when applied for 1 and 2 years, respectively. However, the majority of the effect was due to dormant winter pruning (8 and 10%, respectively). Summer pruning was negligible (1%).

The direct effect of mechanical treatment alone (worming) was of reasonable value (27%) increased to 34% when applied for two successive years.

Microbiological treatments with bacteria or fungus showed very low effects (3 and 5% for one year, scantly increased to 4 and 5% for two years). This was owing to the phenomenon that the pest hide inside the tree wood under the bark in addition that the bacteria and fungus were highly affected with the weather factors in the field and failed to reach the larvae inside.

Local spraying and local painting were quite effective in the reduction of the borers' infestation (50 and 51%). The cumulative effect for two years increased the reduction of infestation to 62 and 61%, respectively.

Applying dormant pruning in winter with the summer pruning, worming together with pathogenic microbiological or local chemical treatments in different combinations magnified the reduction of infestation and greatly magnified the reduction of infestation when applied for two successive years. Pruning, worming and bacterial or fungal treatments reduced the infestation with about 34 or 33% for one year and 44 or 42% for two years. However, local painting or local spraying with pruning, and worming treatments greatly reduced the infestation with 72 or 70% for one year and 78 or 75% for two years, respectively.

Table (2) concluded that repeating the different treatments from one year to another was of great value in effective treatments, of less value in moderately effective treatments, but of no value in the least effective treatments.

Repeating winter and summer pruning together increased the reduction of infestation with 3%, (winter pruning only increased with 2% while summer pruning only increased with 1%). Repeating worming treatment increased the reduction of infestation with 7%. Repeating bacterial or fungal treatments increased the reduction of infestation with 1%. Repeating local spraying or painting treatments increased the reduction of infestation with 10-12%, respectively. Repeating the different

combinations of pruning and worming with microbiological treatments increased the reduction of infestation with 9-10% but with local chemical treatments increased with 5-6%.

It could be concluded that the low cost and environmentally safe treatments such as winter pruning and worming increased the reduction of infestation and was of great value, and should be repeated each year. Repeating local spraying or painting treatments was also valuable, especially when applied after harvesting. Microbiological and mechanical treatments should be excluded although they are environmentally safe.

The previous treatments on the control of *M. palmate* evaluated the effect of winter and/or summer pruning, worming, bacterial, fungal, local painting and local spraying and combinations of pruning, worming, and microbiological or local chemical treatments. These experiments were applied in advance of the promising results of Tadros *et al.* (1996) who evaluated winter pruning, worming, injection of insecticide in the larval tunnels, and the three treatments together. Data resulted in 7.2-9.6, 21.8-23.1, 33.9-34.6, and 56.9-59.1% reduction of infestation when applied for one year, and 17.3, 35.9, 47.5, and 74.8%, respectively, when applied for two years. Moreover, El-Sebay (1984) carried out laboratory bioassay studies on *M. palmate* eggs. Literature on *M. palmate* abroad is lacking.

## CONCLUSION

From the foregoing results and the previous three current researches Tadros *et al.* series numbers 6, 7 and 8 (2006, in press) it could be concluded that the integrated control of apricot tree borers (*M. palmata*, *C. varius*, *P. undecimmaculata,* and *S. amygdali*) would be as follows:

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

From the foregoing results, it could be concluded that the direct effect of one year treatments varied from one treatment to another and from one boring insect pest to another Table (3). The effect of horticultural treatments (winter and summer pruning) varied from 9, 22, and 35 to 45% reduction in *M. palmata*, *C. varius*, *P. undecimmaculata,* and *S. amygdali*, respectively. The majority of the effect was due to winter pruning (8, 16, 33, and 33%, respectively). Summer pruning was negligible in case of *M. palmata*, *C. varius*, and *P. undecimmaculata* (1, 7 and 1%, respectively), but of some value in case of *S. amygdali* (18%).

The effect of mechanical treatment alone (worming) was noticeable only in case of *M. palmata* (27%) but it was of low values in case of *C. varius* (12%) and *P. undecimmaculata* (6%). It was impractical in case of *S. amygdali* so it was canceled.

Generally, useless effects were obtained with the microbiological treatments

whether with the pathogenic bacteria or fungus. This was because the bacteria and fungus were highly affected with the weather factors in the field and failed to reach the larvae hide deep inside the tree wood or under the bark. The respective bacterial and fungus treatments showed only 3, 4, 7 and 6% and 4, 5, 9 and 8% for the four-target pests, respectively.

Local painting and local spraying were quite effective in the reduction of the four borers' infestation resulting in 50, 75, 61, and 58% and 51, 74, 70, and 67% for the four-target pests, respectively.

Applying pruning (in winter and summer), worming together with microbiological or local chemical treatments in different combinations magnified the reduction of the four pests infestation. The respective reduction of infestation of the four pests reached 34, 32, 35, and 51% due to pruning, worming and bacterial treatments, 33, 30, 35, and 52% due to pruning, worming, and fungal treatments, 72, 87, 81, and 78% due to local painting with pruning, and worming treatments, and 70, 85, 84, and 84% due to local spraying with pruning, and worming treatments.

Table 3. Effect of one year and two successive years treatments on the percentage reduction in stone fruit tree borers' infestation in apricot orchards at, Qalubia governorate during 1999-2000 and 2000-2001 seasons.

| Treatments | % reduction of infestation | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *M. palmata* | | *C. varius* | | *P. undecim-maculata* | | *S. amygdali* | |
| | 1-year | 2-years | 1-year | 2-years | 1-year | 2-years | 1-year | 2-years |
| A: Horticultural Treatments: | | | | | | | | |
| 1. Dormant pruning | 8 | 10 | 16 | 26 | 33 | 47 | 33 | 42 |
| 2. Summer pruning | 1 | 1 | 7 | 9 | 1 | 3 | 18 | 22 |
| 3. Dormant & Summer pruning | 9 | 12 | 22 | 32 | 35 | 50 | 45 | 55 |
| B: Mechanical Treatments: | | | | | | | | |
| 4. Worming | 27 | 34 | 12 | 19 | 6 | 12 | -- | -- |
| C: Microbiological Treatments: | | | | | | | | |
| 5. Bacterial | 3 | 3 | 4 | 5 | 7 | 13 | 6 | 9 |
| 6. Fungal | 4 | 4 | 5 | 6 | 9 | 12 | 8 | 12 |
| D: Local Chemical Treatments: | | | | | | | | |
| 7. Local painting | 50 | 62 | 75 | 80 | 61 | 71 | 58 | 65 |
| 8. Local spraying | 51 | 61 | 74 | 78 | 70 | 76 | 67 | 75 |
| E: Combined Treatments: | | | | | | | | |
| 9. Treatments, 3 + 4 + 5 | 34 | 44 | 32 | 43 | 35 | 52 | 51 | 58 |
| 10. Treatments, 3 + 4 + 6 | 33 | 42 | 30 | 42 | 35 | 52 | 52 | 61 |
| 11. Treatments, 3 + 4 + 7 | 72 | 78 | 87 | 95 | 81 | 89 | 78 | 84 |
| 12. Treatments, 3 + 4 + 8 | 70 | 75 | 85 | 92 | 84 | 90 | 84 | 91 |

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

The cumulative effect of two successive year treatments highly reduced the infestation when repeated year after another. However, the reduction varied from one treatment to another and from one boring insect pest to another Table (3).

The respective effect of horticultural treatments (winter and summer pruning) varied from 12, 32, and 50 to 55% reduction in *M. palmata*, *C. varius*, *P. undecimmaculata,* and *S. amygdali*. The majority of the effect was due to dormant winter pruning (10, 26, 47, and 42%, respectively) rather than summer pruning (1, 9, 3, and 22%, respectively).

The cumulative effect of mechanical treatment (worming) for two successive years was considered only in case of *M. palmata* (34%) but of negligible value in case of *C. varius*, *P. undecimmaculata,* and *S. amygdali* (19, 12, and 0%, respectively).

Although microbiological treatments with the bacteria or fungus were repeated for two successive years, yet they were useless (3-13% only).

The cumulative effect of local painting and local spraying for two successive years were adequate in reducing *M. palmata*, *C. varius*, *P. undecimmaculata,* and *S. amygdali* infestation (62, 80, 71, and 65% and 61, 78, 76, and 75%, respectively).

Combined applications of pruning (winter and summer), worming together with microbiological or local chemical treatments greatly magnified the reduction of the four pests infestation when repeated one year after another. Pruning, worming and bacterial or fungal treatments slightly reduced the infestation reaching 42-44, 42-43, 52, and 58-61%, respectively. Local painting or spraying with pruning, and worming treatments significantly reduced the infestation with 75-78, 92-95, 89-90, and 84-91%, respectively.

**C. The differences in the percentage reduction of infestation:**

Table (4) concluded that repeating the different treatments from one year to another was of great value in effective treatments, of less value in moderately effective treatments, but of no value in the least effective treatments.

Repeating pruning in winter and summer increased the reduction of infestation with 16% in case of *P. undecimmaculata* (14% due to winter pruning only) and 10% in case of *C. varius* and *S. amygdali*. Repeating local painting increased the reduction of infestation 12% in case of *M. palmata* and 10% in case of *P. undecimmaculata*. Repeating local spraying increased the reduction of infestation with 10% in case of *M. palmata*. In case of *M. palmata* and *C. varius*, repeating bacterial treatment with pruning and worming treatments increased the reduction of infestation with 10-11%. In addition, in case of *C. varius* repeating fungal treatment with pruning and worming increased the reduction of infestation with 12%.

Table 4. The differences in the effect of one single and two successive year treatments on the percentage reduction in stone fruit tree borers' infestation in apricot orchards at Qalubia governorate during 1999-2001 seasons.

| Treatments | % reduction of infestation | | | |
|---|---|---|---|---|
| | *M. palmata* | *C. varius* | *P. undecim-maculata* | *S. amygdali* |
| A: Horticultural Treatments: | | | | |
| 1. Dormant pruning | 2 | 10 | 14 | 9 |
| 2. Summer pruning | 0 | 2 | 2 | 4 |
| 3. Dormant & Summer pruning | 3 | 10 | 16 | 10 |
| B: Mechanical Treatments: | | | | |
| 4. Worming | 7 | 7 | 6 | -- |
| C: Microbiological Treatments: | | | | |
| 5. Bacterial | 0 | 1 | 6 | 3 |
| 6. Fungal | 0 | 1 | 3 | 4 |
| D: Local Chemical Treatments: | | | | |
| 7. Local painting | 12 | 5 | 10 | 7 |
| 8. Local spraying | 10 | 4 | 6 | 8 |
| E: Combined Treatments: | | | | |
| 9. Treatments, 3 + 4 + 5 | 10 | 11 | 7 | 7 |
| 10. Treatments, 3 + 4 + 6 | 9 | 12 | 7 | 9 |
| 11. Treatments, 3 + 4 + 7 | 6 | 7 | 8 | 6 |
| 12. Treatments, 3 + 4 + 8 | 5 | 7 | 6 | 7 |

On the other hand, repeating the following treatments: bacterial or fungal treatments and summer pruning alone in all four pests, winter pruning in case of *M. palmata*, local painting or spraying in combination with pruning and worming in case of *M. palmata* and local painting and spraying alone in case of *C. varius* and local spraying alone in case of *P. undecimmaculata* as well as worming treatment in case of *S. amygdali* slightly increased the reduction of infestation with 0 up to 5 or 6%.

Other treatments moderately increased the reduction of infestation with 6-9%.

It could be concluded that repetition of some treatments increased the reduction of infestation and was of great value and should be applied to the promising treatments only. Other treatments should be repeated each two or more years according to their response to application.

Generally speaking, the effect of horticultural treatments varied much between 9 and 45% reduction in the four borers infestation. Mechanical treatment was sometimes effective or mostly useless. Microbiological treatments were ineffective. Local painting and local spraying were quite effective (50–75%). Pruning, worming together with local chemical treatments in different combinations effectively reduced the borers' infestation.

Repeating these combined treatments year after another magnified the effect of these treatments and resulted in satisfied reduction in the four-target pests' infestation. Actually, all these treatments – including the local chemical treatments – are safe to the environment and the man and animal health.

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# آفات أشجار الفاكهة ذات النواة الحجرية:
# (٩) الطرق البديلة لمكافحة حفار ساق السنط *Macrotoma palmata* باستخدام المعاملات البستانية والميكانيكية والميكروبية والكيماوية الموضعية في حدائق المشمش في مصر

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تم تقييم فعالية بعض الطرق البديلة لمكافحة حفار ساق السنط *Macrotoma palmata* في حدائق المشمش باستخدام المعاملات البستانية والميكانيكية والميكروبية والكيماوية الموضعية في منطقة طوخ، محافظة القليوبية لمدة عام واحد وعامين متتاليين (١٩٩٩/٢٠٠٠و ٢٠٠٠/٢٠٠١). بلغت معدلات تقليل الإصابة عند تطبيق المعاملات الأثني عشر الآتية لمدة عام واحد وعامين متتاليين ما يلي، على الترتيب: معاملات التقليم الشتوي (٨,١٥% ازدادت إلي ١٠,٣٩%)، ومعاملات التقليم الصيفي (٠,٧٤% ازدادت إلي ١,٣٠%)، ومعاملات التقليم الشتوي والصيفي معا (٨,٨٩% ازدادت إلي ١١,٦٩%)، ومعاملات قتل اليرقات داخل أنفاقها (٢٦,٦٧% ازدادت إلي ٣٣,٧٧%)، والمعاملات البكتيرية أوالفطرية (٢,٩٦ أو ٤,٤٤% ازدادت إلي ٣,٩٠ أو ٥,١٩%)، ومعاملات الدهان الموضعي أوالرش الموضعي (٥٠,٣٧ أو ٥١,١١% ازدادت إلي ٦٢,٣٤ أو ٦١,٠٤%)، ومعاملات التقليم مع قتل اليرقات مع البكتيرية أوالفطرية (٣٤,٠٧ أو ٣٢,٥٩% ازدادت إلي ٤٤,١٦ أو ٤١,٥٦%)، ومعاملات التقليم، مع قتل اليرقات مع الدهان الموضعي أوالرش الموضعي (٧١,٨٥ أو ٧٠,٣٧% ازدادت إلي ٧٧,٩٢ أو ٧٥,٣٢%). وبالمقارنة مع حفارات أشجار المشمش الهامة (*Ptosima undecimmaculata* و *Chlorophorus varius* و *Macrotoma palmata* و *Scolytus amygdali*) فإن برنامج المكافحة المتكاملة أظهرت فعالية جيدة باستخدام معاملات التقليم وقتل اليرقات داخل أنفاقها (في بعض الأحوال)، كما يمكن تعظيم الفعالية جدا بالمعاملات الكيماوية الموضعية في حالات الإصابة الشديدة.