STONE FRUIT TREE PESTS: (7) ALTERNATIVE MEANS OF CONTROLLING *Chlorophorus varius* IN APRICOT ORCHARDS IN EGYPT

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Abstract

Alternative means of control of *Chlorophorus varius* (Coleoptera: Cerambycidae) in apricot orchards by horticultural, mechanical, microbial, 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 12 treatments applied for one and two successive years were as follows: dormant pruning (16.19 increased to 25.76%), summer pruning (6.73 increased to 8.59%), dormant and summer pruning (22.12 increased to 32.32%), worming (11.65 increased to 18.69%), bacterial or fungal (4.00 or 4.34 increased to 5.05 or 5.56%), local painting or local spraying (75.42 or 73.89 increased to 80.30 or 78.28%), pruning, worming, together with bacterial or fungal (32.10 0r 29.54 increased to 43.43 or 41.92%), pruning, worming, and local painting or local spraying treatments (86.79 or 85.05 increased to 95.45 or 91.92%).

INTRODUCTION

In Egypt, apricot orchards are seriously attacked with *Chlorophorus varius* (Coleoptera: Cerambycidae). Larvae bore deep tunnels inside the wood of the stem and branches, reducing the production, causing weakness and finally death of trees.

In spite of the high cost of chemical control, the adverse affect on the natural enemies (parasites, predators, and pathogens), and pollution of the environment, recommendations for the control of the fruit tree borers' infestation in stone fruit orchards are still mainly directed towards the chemical control treatments.

Apricot is a profitable crop, therefore plantations were progressively spread allover the new reclaimed lands in addition to old Delta lands. This study is a pioneer attempt to control the wasp beetle *C. varius*, which is one of the apricot production-limiting factors.

The available literature in Egypt included studies on the biology of *C. varius* on peach trees (Tadros, 1993), monitored the population fluctuation in fig (Kinawy *et al.*, 1993), peach (Tadros, 1994), and apricot orchards (Tadros, *et al.*, in press). These studies are essential in determination of the proper timing of the pest control treatments. Previous trials to control *C. varius* were applied in grapevine (El-Sherif and

Tadros, 1985), peach (Helwa and Tadros, 2000), and plum (Tadros and Helwa, 2000) orchards. However, studies concerning the control of *C. varius* in apricot orchards in Egypt and abroad are lacking and needs further exclusive work.

The aim of the present investigation was to prevent the yield losses through using non-traditional approaches for controlling *C. varius* to minimize the pesticide residues, reduce the outbreaks of secondary species, decrease the environmental pollution, magnify the role of the biological control agents and obtain better production of fruits.

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 *C. varius.* 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).
2. **Summer pruning treatment:** During July, the newly infested branches were pruned.
3. **Dormant and summer pruning treatments:** Treatments numbers 1 and 2 were applied together.

b. Effect of mechanical treatment:

4. **Worming treatment:** After pruning, a knife and a flexible wire were used to scratch the infested areas on the stem and main branches to kill the larvae and pupae.

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 (20 liters capacity) 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 2000). During the 3rd season (November 2000 to October 2001), the same technique of the 2nd year was repeated for confirmation and to evaluate the effect of the three successive year treatments (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 estimated according to the percentage reduction of the each borer infestation (Henderson and Tilton, 1955), as follow:

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

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

Trials were conducted to evaluate the effect of different horticultural, mechanical, microbial, and local chemical treatments alone or in combination with each other's on the reduction of *C. varius* infestation. The direct effects of treatments were evaluated when applied for only one single year (1999–2000 or 2000-2001). The cumulative effects were also evaluated as well for two successive years (1999-2001).

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

1.1. Effect of horticultural treatments:

1.1.1. Effect of dormant pruning treatment: As shown in (Table, 1), pruning treatment was of little value since the larvae feed and habitat inside the stem main branches and stubs which rarely included in the dormant pruning. Thus, the reduction of infestation reached 14.61–17.77% (mean, 16.19%).

1.1.2. Effect of summer pruning treatments: Due to the undetectable symptoms of new infestation and the borer infestation did not occur in the smaller branches, summer pruning was of some value in reducing the borer infestation, showing 6.61–6.85% (mean, 6.73%) (Table, 1).

1.1.3. Effect of dormant and summer pruning treatments: The reduction in *C. varius* infestation increased when applying dormant and summer treatments together compared with each treatment alone (Table, 1), they ranged 21.92–22.31% (mean, 22.12%).

1.2. Effect of mechanical treatment:

1.2.1. Effect of worming treatment: Worming treatment was not much effective owing to the deep larval habitat inside the apricot wood. However, this treatment exposed the larval tunnels to parasites and predators as well as the weather factors to do their effective role in the borer reduction of infestation. The reduction of the borer infestation reached 10.50-12.81% (mean, 11.65%) (Table, 1).

1.3. Effect of microbial treatments:

1.3.1. 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) and the difficulty of these bacteria to reach the larvae inside their tunnels. Therefore, this treatment was less effective as the percentage reduction of infestation recorded only 2.89-5.02% (mean, 4.00%) (Table, 1).

1.3.2. Effect of fungal treatment: As in bacteria, the percentage reduction in *C. varius* infestation due to fungal treatment was as low as 3.72-4.11 % (mean, 3.92%) (Table, 1).

1.4. Effect of local chemical treatments:

1.4.1. Effect of local painting treatment: Local painting four times / year with "Stemex" insecticide on the stem and larger pruned areas significantly increased the percentage reduction of *C. varius* infestation showing 73.97–76.86% (mean, 75.42%) (Table, 1). This high percent reduction was due to the unsuccessful trails of the borer to infest these sites.

1.4.2. Effect of local spraying treatment: Local spraying four times / year with insecticides to the stem, bases of main branches and pruned stubs adequately reduced *C. varius* infestation with 72.15-75.62% (mean, 73.89%) as shown in Table (1). This treatment hindered the beetle settings, the beetle oviposition, hatching and larval entry inside the apricot wood.

Table 1. Effect of single year treatment on the percentage reduction of *C. varius* 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 larvae	%	No. of larvae	%	No. of larvae	%
Horticultural Treatments:						
Dormant pruning	18.7	14.61	19.9	17.77	19.30	16.19
Summer pruning	20.4	6.85	22.6	6.61	21.50	6.73
Dormant & summer pruning	17.1	21.92	18.8	22.31	17.95	22.12
Mechanical Treatments:						
Worming	19.6	10.50	21.1	12.81	20.35	11.65
Microbial Treatments:						
Bacterial	20.8	5.02	23.5	2.89	22.15	4.00
Fungal	21.0	4.11	23.1	3.72	22.05	4.34
Local Chemical Treatments:						
Local painting	5.7	73.97	5.6	76.86	5.65	75.42
Local spraying	6.1	72.15	5.9	75.62	6.00	73.89
Combined Treatments:						
Treatments, 3 + 4 + 5	14.9	31.96	16.4	32.23	15.65	32.10
Treatments, 3 + 4 + 6	15.3	30.14	17.2	28.93	16.25	29.54
Treatments, 3 + 4 + 7	2.8	87.21	3.3	86.36	3.05	86.79
Treatments, 3 + 4 + 8	3.2	85.39	3.7	84.71	3.45	85.05
Untreated Treatments:						
Check	21.9	--	24.2	--	23.05	--

1.5. Effect of combined treatments:

1.5.1. Effect of pruning, worming, and bacterial treatments: Table (1) indicated that bacterial treatment did not increase the effectiveness of the combined treatments as the percentage reduction in *C. varius* reached 31.96-32.23% (mean,

32.10%). The obtained results are mainly due to pruning and worming treatments.

1.5.2 Effect of pruning, worming, and fungal treatments: As mentioned above, the effectiveness of these treatments was mainly due pruning and worming but the fungal treatment did not add noticeable effect. This combined treatment resulted in 28.93-30.14% (mean, 29.54%) (Table, 1).

1.5.3. Effect of pruning, worming, and local painting treatments: Excellent results were obtained when these combined treatments were applied together showing 86.36-87.21% (mean, 86.79%) reductions of infestation (Table, 1). The effect was due to all combined treatments.

1.5.4. Effect of pruning, worming, and local spraying treatments: As shown in Table (1), almost equal excellent and satisfactory results were achieved when these combined treatments were applied together showing 84.71-85.39% (mean, 85.05%) reductions in infestation.

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

2.1. Effect of horticultural treatments alone: Data in Table (2) indicated that, dormant pruning treatment alone in winter somewhat reduced *C. varius* infestation when applied for two successive years. This relatively low percentage reduction of infestation (25.76%) was due to that, the larval infestation was mainly concentrated in the stem and main branches. However, winter pruning somewhat shared in reducing the borer infestation. Summer pruning had slight effect (8.59%) in this respect, 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. Dormant and summer pruning treatments together for two successive years reduced infestation with 32.32%.

2.2. Effect of mechanical treatment alone: Worming treatment (killing larvae, pre-pupae, and pupae stages) was generally difficult to apply but it had a slight effect in the reduction of infestation (18.69%) (Table, 2).

2.3. Effect of microbial treatments: The pathogenic bacteria or fungus was relatively useless even when applied cumulatively for two successive years (5.05 and 5.56%, respectively) (Table, 2).

2.4. Effect of local treatments: Local painting and local spraying 4 times / year was quite effective in the reduction of *C. varius* infestation especially when was applied for two successive years (80.30 and 78.28%, respectively) (Table, 2).

Table 2. Effect of two successive year treatments on the percentage of reduction in *C. varius* 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 larvae	% reduction of infestation	
Horticultural Treatments:			
Dormant pruning	14.7	25.76	10
Summer pruning	18.1	8.59	2
Dormant & summer pruning	13.4	32.32	10
B: Mechanical Treatments:			
1. Worming	16.1	18.69	7
Microbial Treatments:			
Bacterial	18.8	5.05	1
Fungal	18.7	5.56	1
Local Chemical Treatments:			
Local painting	3.9	80.30	5
Local spraying	4.3	78.28	4
Combined Treatments:			
Treatments, 3 + 4 + 5	11.2	43.43	11
Treatments, 3 + 4 + 6	11.5	41.92	12
Treatments, 3 + 4 + 7	0.9	95.45	7
Treatments, 3 + 4 + 8	1.6	91.92	7
Untreated Treatments:			
Check	19.8	--	

2.5. Effect of combined treatments:

Applying dormant pruning, summer pruning, worming, microbial, and/or local chemical treatments in different combinations resulted in adequate reduction in *C. varius* infestation especially when carried out yearly.

Winter and summer pruning, worming and bacterial treatments showed 43.43% reduction of infestation when conducted for two successive years (Table, 2). Applying winter and summer pruning, worming and fungal treatments for two successive years resulted in almost similar results (41.92%). Winter and summer pruning, worming with local painting for two successive years almost doubled percentage reduction in the borer infestation (95.45%). Winter and summer pruning, worming with local spraying for two successive years resulted in almost similar percentage reduction in the borer infestation (91.92%).

Statistical analysis: Statistical analysis and grouping of the 13 treatments applied for one and two years concluded that there were significant differences between treatments classified as: {insignificant differences between the same letters of grouping}

1. Superior group (80 – 100%):

1. Pruning, worming, and local painting for two years (95.45%) A

2. Pruning, worming, and local spraying for two years (91.92%) A
3. Pruning, worming, and local spraying for one year (86.79%) A
4. Pruning, worming, and local painting for one year (85.05%) A
5. Local painting for two years (80.30%) A

2. Sufficient group (50 – less than 80%):

1. Local spraying for two years (78.28%) A
2. Local painting for one year (75.42%) A
3. Local spraying for one year (73.89%) A

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

1. Pruning + Worming + Bacterial for two years (43.43%) B
2. Pruning + Worming + Fungal for two years (41.92%) B
3. Dormant and summer pruning for two years (32.32%) B
5. Pruning + Worming + Bacterial for one year (32.10%) B

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

1. Pruning + Worming + Fungal for one year (29.54%) B
2. Dormant pruning for two years (25.76%) BC
3. Dormant and summer pruning for one year (22.12%) BC
4. Worming for two years (18.69%) BC
5. Dormant pruning for one year (16.19%) BC

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

1. Worming for one year (11.65%) C
2. Summer pruning for two years (8.59%) CD
3. Summer pruning for one year (6.73%) CD
4. Fungal for two years (5.56%) D
5. Bacterial for two years (5.05%) D
6. Fungal for one year (4.34%) D
7. Bacterial for one year (4.00%) D

From the foregoing results, it could be concluded that the direct effect of one single year treatments on *C. varius* infestation varied from one treatment to another. The cumulative effect of two successive year treatments proved that the infestation could be highly reduced if these treatments repeated yearly. The effect of horticultural treatments alone (winter and summer pruning) reached 22 and 32% reduction of infestation when applied for 1 and 2 years, respectively. However, the majority of the effect was due to dormant winter pruning (16 and 26%, respectively). Summer pruning was negligible (7 and 9%, respectively). The direct effect of mechanical treatment alone (worming) was of low value (12%). The cumulative effect for two successive years was slightly increased to reach 19%.

Microbial treatments with bacteria or fungus showed very low effects (4%) for one year, slightly increased to 5 and 6% for two years. This was owing to the phenomenon that the pest hide inside the tree wood under the bark (Tadros, 1993) 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 (74 - 75%). The cumulative effect for two years increased the reduction of infestation to 78 and 80%, respectively.

Applying dormant pruning in winter with the summer pruning, worming together with pathogenic microbial or local chemical treatments in different combinations magnified the reduction of infestation and greatly increased the reduction of infestation when applied for two successive years. Pruning, worming and bacterial or fungal treatments reduced the infestation with about 32 or 30% for one year and 43 or 42% for two years. However, local painting or local spraying with pruning, and worming treatments greatly reduced the infestation with 87 or 85% for one year and 95 or 92% for two years, respectively.

Repeating winter and summer pruning together increased the reduction of infestation with 10%, (winter pruning only increased with 10% while summer pruning only increased with 2%). 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 4-5%, respectively. Repeating the different combinations of pruning and worming with microbial treatments increased the reduction of infestation with 11-12% but with local chemical treatments it increased with 7%.

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. Microbial and mechanical treatments should be excluded although they are environmentally safe.

The obtained results are somewhat in agreement with Helwa and Tadros (2000) and Tadros and Helwa, (2000) who studied the effect of horticultural, mechanical, and local chemical treatments on *C. varius* infestation and yield production in plum and peach orchards. They recommended dormant pruning in winter (15.6-18.5 increased to 36.4% after 2 years), worming (6.5-7.2 increased to 12.8% after 2 years), local chemical treatments (62.7-66.9 increased to 72.3-78.2% after 2 years), and combined treatments (77.1-84.7 increased to 85.1-95.8% after 2 years) as effective and environmentally safe means of control.

REFERENCES

1. El-Sherif, S.I. and A.W. Tadros. 1985. Screening of certain insecticides for the control of the wasp beetle, *Chlorophorus varius* Mull. (Coleoptera: Cerambycidae) on grapevine. Bull. Fac. Agric., Univ. of Cairo, Egypt, 36 (1): 601-608.
2. Helwa, A.Y.H. and A.W. Tadros. 2000. Effect of horticultural, mechanical and local chemical treatments on *Chlorophorus varius* infestation and yield production in peach orchards. J. Agric. Sci., Mansoura Univ., 25 (8): 374-385.
3. Henderson, C.F. and E.W. Tilton. 1955. Test with acaricides against the brown wheat mite. J. Econ. Entomol., 48: 157-161.
4. Kinawy, M.M., F.F. Abd-Allah and A.W. Tadros. 1993. Emergence of adults of *Chlorophorus varius* and its relation to climatic conditions in fig orchards. Communications in Science & Development Res., Alexandria, Egypt. 42 (644): 55-65.
5. Snedecor, W and A. Cochran. 1990. Statistical Methods. The Iowa State Univ. press, Ames, Iowa, USA.
6. Tadros, A.W. 1993. The life-cycle of the wasp beetle, *Chlorophorus varius* Mull. (Coleoptera: Cerambycidae) on peach in Egypt. Egypt. J. Agric. Res., Cairo, Egypt, 71 (2): 429 - 435. {Presented to the "4th Professional Fruit Worker Conference", Ashville, North Carolina, U. S. America, Oct. 1989, 4 (15)}.
7. Tadros, A.W. 1994. Monitoring the population of the wasp beetle, *Chlorophorus varius* Mull. (Coleoptera: Cerambycidae) on peach and its hosts in Egypt. Egypt. J. Agric. Res., 72 (1): 103-115. {5th Professional Fruit Workers Conf., Ashville, North Carolina, USA, Oct. 17-18, 1990, 5 (16)}.
8. Tadros, A.W., A. M. Abdel-Rahman and I. A. Abdel-Hamid (in press): Stone Fruit Tree Pests: (5) Monitoring the major apricot tree borers (*Ptosima undecimmaculata, Chlorophorus varius, Macrotoma palmata,* and *Scolytus amygdali*) in Egypt. Egypt. J. Agric. Res., Egypt.
9. Tadros, A.W. and A.Y.H. Helwa. 2000. Effect of horticultural, mechanical, and local chemical treatments on *Chlorophorus varius* infestation and yield production in plum orchards. 7th Arab Conf. of Plant Protection, Amman, Jordan, 16-22 Oct., 2000.

آفات أشجار الفاكهة ذات النواة الحجرية:
(٧) الطرق البديلة لمكافحة حفار ساق الخوخ ذو القرون الطويلة *Chlorophorus varius* في حدائق المشمش في مصر

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تم تقييم فعالية بعض الطرق البديلة لمكافحة حفار ساق الخوخ ذو القرون الطويلة *Chlorophorus varius* في حدائق المشمش باستخدام المعاملات البستانية والميكانيكية والميكانيكية والكيماوية الموضعية في منطقة طوخ، محافظة القليوبية لمدة عام واحد وعامين متتاليين (١٩٩٩/٢٠٠٠،و ٢٠٠٠/٢٠٠١). بلغت معدلات خفض الإصابة عند تطبيق المعاملات الإثني عشر الآتية لمدة عام واحد وعامين متتاليين ما يلي، علي الترتيب: معاملات التقليم الشتوي (١٦,١٩% ازدادت إلي ٢٥,٧٦%)، ومعاملات التقليم الصيفي (٦,٧٣% ازدادت إلي ٨,٥٩%)، ومعاملات التقليم الشتوي والصيفي معا (٢٢,١٢% ازدادت إلي ٣٢,٣٢%)، ومعاملات قتل اليرقات داخل أنفاقها (١١,٦٥% ازدادت إلي ١٨,٦٩%)، والمعاملات البكتيرية أوالفطرية (٤,٠٠-٤,٣٤% ازدادت إلي ٥,٠٥-٥,٥٦%)، ومعاملات الدهان الموضعي أوالرش الموضعي (٧٥,٤٢-٧٣,٨٩% ازدادت إلي ٨٠,٣٠-٧٨,٢٨%)، ومعاملات التقليم مع قتل اليرقات مع البكتيرية أوالفطرية (٣٢,١٠-٢٩,٥٤% ازدادت إلي ٤٣,٤٣-٤١,٩٢%)، ومعاملات التقليم، مع قتل اليرقات مع الدهان الموضعي أوالرش الموضعي (٨٦,٧٩-٨٥,٠٥% ازدادت إلي ٩٥,٤٥-٩١,٩٢%).