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The Effect of Pre Spring Spray to Reduce of Citrus Important Pests

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Abstract: The importance of pre spring spray against citrus aphids, *Pulvinaria aurantii* Cockerell and *Panonychus citri* McGregor that are the most important pest of citrus during spring was tested. In this research, 150 trees ten years old sweet orange (Thomson navel on *Citrus aurantium* (root stocks)) in a citrus orchard approximately three hectares sampled. The experiment was laid out in a totally randomized (one-way) design replicated five times. According to the results, the pre spring spray do not effect on population density of citrus aphids and *P. aurantii* during March, April, May and June. However, the *P. citri* population decreased. Therefore, it seems the pre spring spray in citrus orchards is not necessary, but if *P. citri* is observed, the pre spring spray should be recommended.

Key words: Pre spring spray, citrus aphids, *Pulvinaria aurantii, Panonychus citri*

INTRODUCTION

Mazandaran by possessing vast citrus orchards, has provided employment conditions for many residents of the region which the obtained income of its sale is of a particular importance in province economy. Of threatening cases in citrus cultivation is a relatively long history of pesticides application against citrus pests (Damavandian and Tavakoli, 2004), the phenomenon of pests resistance to pesticides (Damavandian, 2007a) and environmental destructive effects as damaged equilibrium position and outbreak of new pests (Damavandian, 1993) which finally causes to increase production costs. One way to stand in front of this problem in northern country's citrus orchards is to eliminate the unnecessary spray. In view of Dent (1991), pesticides should not be used against pests which have become resistant. On one hand, most citrus pests which have spent autumn and winter, have reached to old nymphs which are much more resistant in comparison to crawlers and the early ages of nymph period (Hallaji and Sanadi, 2004; Rajabpour, 2006). In addition to the mentioned cases, Metcalf and Luckmann (1994) believe that spray period should be accommodated (consistent) with pests population density or on the other hand, it should be reached to economic threshold limit. Unfortunately, except *Pulvinaria aurantii* Cockerell (Rajabpour, 2006) the economic threshold of other important pests of citrus in northern region of the country has not been calculated but some thing which is obvious is that all mentioned pests population of citrus has decreased to a very low population due to early autumn spray and winter cold (Hallaji and Sanadi, 2004). On the other hand, old nymphs ages resistance of the remaining pests after winter in comparison with early ages, weakens the efficiency logic of pre spring spray to decrease citrus pests. Although, for controlling citrus red mite and citrus red scale in southern California area, the citrus orchards should be treated during April and May (Davidson *et al*., 1991). According to Plant Protection Organization (PPO), each year the farmers of citrus orchards should spray their orchards at the end of winter or early spring by mineral oil plus one acaricide in northern Iran (Mazandaran Province) (Hashemi, 2006). The main goal of this research has been to determine the importance amount for pre spring spray in order to control predominant pests of citrus.

MATERIALS AND METHODS

A citrus orchard of approximately three hectares (Thomson navel on *Citrus aurantium* (rootstocks)) ten year old trees were selected from Baharestan orchards (Sari). The orchards had 15 rows which there was approximately 75 trees in each row. The pests which were studied in this research include: citrus aphids which the predominant species was *Aphis gossypii* Glover, *Pulvinaria aurantii* Cockerell and *Panonychus citri* McGregor. Initially, we divided 15 rows into 5 three-rows groups, then treated randomly two rows in each group with mineral oil and we selected one row as control group (no pre spring spray was conducted). In this way, each row in each group was devoted to one of two mineral oil

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and control treatments. Then in each group, 10 trees were selected for sampling. There were 5 trees between each two sampled trees so that 50 trees were studied for each treatment in each sampling period. Ten rows which were devoted to mineral oil treatment, were divided into two 5-row group for separation which from this on, first group will be called treatment A and second group will be called treatment B. Specifications of mineral oil used are as follows: carbon number 23; unsulphonated mineral residue 94%; mean molecular density at 15°C, 0.859 and kinematic viscosity at 20°C, 35.89. Spray in first year was performed on 24 March 2003 due to cold air and in second year was performed on 4 March 2004.

It should be mentioned that according to PPO recommendation in order to pre spring spray, the treatment was applied include: 75 mL of hexythiazox EC 10 (Nissorun) per 100 L of water plus 1500 mL mineral oil and water only as control. For the provided combination spray, 1800 L pesticide sprayer was used.

Citrus aphids: A set of aphids on terminal buds was considered as a colony and in each visit, all existing colonies were enumerated in western half of each tree. For each treatment, 50 trees were visited and for three treatments in each sampling turn, 150 trees were visited. Colonies enumeration was performed from beginning of March before sudden increase in colonies. Then, it was repeated once per two weeks and until next spray (mid of Jun), it was continued.

***Pulvinaria aurantii*:** Eight leaves were separated randomly from 4 directions of tree from each tree and were placed into plastic bag and after transferring to laboratory, leaves, rear and front were visited and all developmental stages of *P. aurantii* were counted. In this way, 1200 leaves were studied in each sampling period. Trees selection was for similar sampling of citrus aphids. Sampling time was also repeated once two week.

***Panonychus citri*:** During studies of leaf samples in *P. aurantii*, different developmental stages of *P. citri*, if it is observed, it was counted. The experiments was laid out in a totally randomized (one-way) design replicated five times for each treatment. Means were compared using Fisher's pairwise comparisons.

RESULTS

Citrus aphids: Data collected during years 2003 and 2004 claim that inefficiency of pre spring spray to decrease aphids colony. In first sampling in date 4/03/2003, the No. of observed colonies was very slight and pre-spring spray was performed in date 24/03/2003 due to cold

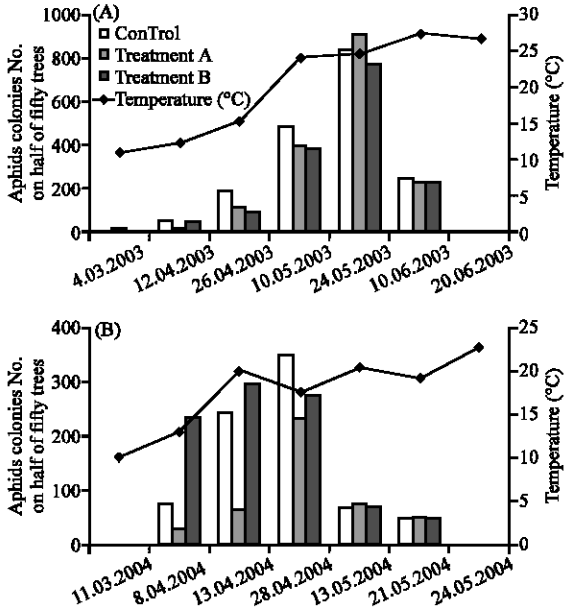

Fig. 1: Aphids colonies No. on half of citrus trees in three treatments: control, treatment A and treatment B, along with environment temperature as centigrade (°C)

air (climate). As it is shown in Fig. 1, despite of spray, the No. of aphids colony increased gradually by increasing air heat so that in date 24/05/2003, the most No. of colonies was related to trees which were treated by mineral oil in pre spring spray. When the temperature was reached to 27.2°C in date 10/06/2003 from 24.6°C in date 24/05/2003, we had decrease in colonies and in date 20/06/2003, no colony was observed in the visited trees. In 2004, the results were also approximately similar to that of 2003. In this way that the No. of colonies in different treatments had approximately (relatively) similar falling and rising. Regarding to this that pre spring spray was conducted in date 4/03/2004 according to PPO recommendation and, the No. of colonies was again increased by increasing heat. Since during April of 2004, air temperature was higher than that of April in 2003; therefore, peak point of colonies No. was observed one month sooner which at the same attribute and the population decreased faster during May 2004 (Fig. 1). In spite of lower temperature during May of 2004 in comparison with May 2003. Statistical analysis of the obtained data from 7 sampling dates, they show that the differences between aphids colony No. after pre spring spray in three treatments (Table 1), except for date 26/04/2003 (between treatment B and control group) were not significant. Although colony No. in treatment B had become approximately twice to the earlier date. The

Table 1: Aphids colony No. on half of fifty trees per each treatment in seven sampling dates

Date	Control	Treatment A	Treatment B
4/3/2003	0a*	7a	1a
12/4/2003	44a	9a	43a
26/4/2003	188b	116b	96a
10/5/2003	476b	403b	383b
24/5/2003	837b	907b	772b
10/6/2003	242a	231a	227b
20/6/2003	0		

*Aphids colonies No. in each treatment followed by the same letter(s) were not significant different (>0.05) for a given date

Table 2: Aphids colonies No. on half of fifty trees per each treatment in eight sampling dates

Date	Control	Mineral oil A	Mineral oil B
11/3/2004	0a*	0a	0a
8/4/2004	76a	33a	239a
13/4/2004	245b	68a	300b
28/4/2004	352b	236b	277b
13/5/2004	70a	74a	73a
21/5/2004	51a	52a	51a
24/5/2004	0a	0a	0a
28/5/2004	0	0	0

*Aphids colonies No. in each treatment followed by the same letter(s) were not significant different (>0.05) for a given date

Table 3: Average number of different developmental stages of *P. aurantii* for three teeatments and per each leaf in seven sampling dates

Date	Control	Mineral oil A	Mineral oil B
28/02/2003	0a*	0a	0a
12/4/2003	8a	2a	0a
26/04/2003	0a	0a	0a
10/5/2003	0a	0a	0a
24/05/2003	0a	0a	0a
10/6/2003	0a	0a	0a
20/06/2003	90b	103b	225b

**P. aurantii* numbers in each treatment followed by the same letter(s) were not significant different (>0.05) for a given date

Table 4: Average No. of different Developmental stages of *p. aurantii* for three treatments and for each leaf in seven sampling dates

Date	Control	Treatment A	Treatment B
28/2/04	10a*	15a	49a
18/3/04	28a	4a	0a
6/4/2004	0a	4a	0a
15/4/04	5a	0a	0a
21/4/04	0a	0a	0a
13/5/04	2a	0a	0a
27/6/04	23ab	2a	0a
15/6/04	824	0a	293b

* *P. aurantii* No. in each treatment followed by the same letter(s) were not significant different (>0.05) for a given date

results obtained from Table 1 represents that aphids colony falling and rising in each three treatments have been approximately similar so that out of 21 statistical comparison, a significant different was just observed in one case and in the other 20 comparisons, the differences were not significant.

Second year's pre spring spray was performed in date 4/03/2004 due to heat air, but there was observed no significant different between colonies No. in three treatments until second sampling stage which was conducted 40 days later (Table 2). In date 13/04/2004, there was no significant different just between control group and treatment B but in next sampling date at 28/04/2004, colonies increase was to some extent which there was observed no significant different between all three treatments, again and in date 13/05/2004, we observed decreasing in colonies No. so that by the earlier date, all three treatments had a significant different but had no significant different with each other (Table 2). Results obtained from the recorded data and statistical analysis of data determined that pre spring spray has had no significant effect in decreasing aphids colonies numbers during spring and until next spray period.

***P. aurantii*:** The data obtained during years 2003 and 2004 represents that the *P. aurantii* population is very low during March, April, May and mid of June when is usually next spray turn (Table 3). In addition, the data were analyzed in a totally randomized (one-way) design and compared using Fisher's pairwise comparisons. The results didn't show a significant different between *P. aurantii* No. after pre spring spray between two oil and control treatments, except for 20/06/2003 when there was no significant different between treatments but by earlier sampling date in 10/6/03 due to sudden uprising of new generation, a significant different was observed (Table 3). An approximately similar result was also observed in next year and regarding to pre spring spray was conducted in date 4/03/2004, there was no significant different between treatments about to three months later and only in date 15/06/2004 due to new generation of *P. aurantii*, a significant different was observed in treatment B and Control treatment by earlier dates (Table 4).

***P. citri*:** During first year experiment (end of Feb through mid of Jun 2003) *P. citri* was not observed in the studied samples, but in first date of next year sampling at 28/02/2004, *P. citri* was observed.

As it was mentioned, spray date was 4/03/2004 which the above- mentioned spray caused to decrease *P. citri* population and in control rows where no spray was conducted, *P. citri* population increased to some extent in date 19/05/2004 when we forced to spray (Fig. 2). According to statistical studies 4 days before first oil spraying, there was no significant different between oils and control treatments but 17 days later in 18/05/2004, there was a significant different between oil and control treatment and this significant different was observed in all sampling dates except for date 6/04/2004 which of course, in the above mentioned date, *P. citri* No. was greater

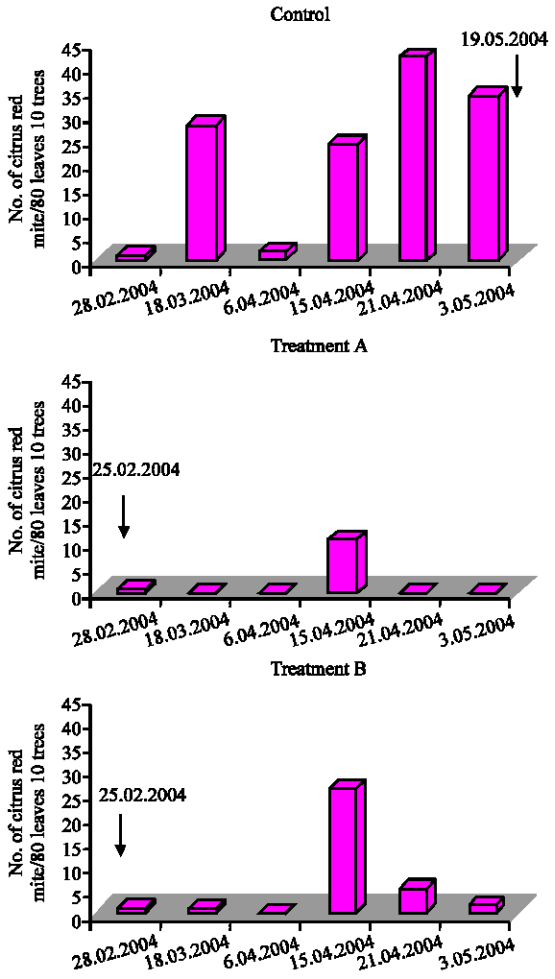

Fig. 2: No. of different developmental stages of *Panonychus citri* per 80 leaves of 10 trees in three control, A mineral oil and B mineral oil treatments

Table 5: Average number of different developmental stages of *P. citri* for three treatments and for eighty leaves from ten trees in seven sampling dates

Date	Control	Treatment A	Treatment B
28/02/2004	1a*	1a	1a
18/03/2004	28a	0a	1a
6/4/2004	2a	0a	0a
15/04/2004	24b	11a	26a
21/04/2004	42b	0a	5a
13/05/2004	34b	0a	2a
27/05/2004	0a	0a	0a

**P. aurantii* No. in each treatment followed by the same letter(s) were not significant different (>0.05) for a given date

(more) in control rows but the difference was not to some extent which is significant (Table 5). Spray in control rows due to high density of pest population was conducted in date 19/05/2004 and in next sampling date in 27/05/2004 there were no significant different between treatments (Table 5).

DISCUSSION

Regarding to results obtained from aphids colony, it can be concluded that pre spring spray has no effect in decreasing aphids colony population during months of March, April, May and Jun. In addition, Karner (1999) and Cisneros and Godfrey (2001) reported that *A. gossypii* is one of the most important pest because long time of pesticide application caused to eliminate natural enemies and resist to pesticides as well (O'Brien *et al*., 1992; Kerns and Gaylor, 1992; Mioannidis, 1998; Hollingsworth *et al*., 1994), therefore, pre spring spray can also cause disorder in natural enemies' activities which exact mention of this point requires study and investigation.

P. aurantii population has severely decreased during winter so that during the studied years to the mid of Jun, a high population was not observed. As it is determined by data, in date 20/6/03 in first year and also in date 15/6/04, a sudden and bursting increase was observed (Table 3, 4) which this population increase can be attributed to new generation emergence, which has also agreement with Hallaji and Sanadi (2004) reports.

The earlier mentioned researchers believe that female insects density (at the end of May) and first instar of first generation is observed in sampling from beginning of Jun to end of July and its population peak is at the end of Jun when is the best time for chemical spray for pests. It should be mentioned that next spray date which is declared by PPO, is always based on new generation pest emergence; therefore, pre spring spray regarding to very low population of *P. aurantii* and not having any effect in determining next spray time, is not anything except energy waste and increase in production cost.

In first year experiment, no statistics was registered about *P. citri* presence and naturally, no damage was also observed, but in second year, *P. citri* had an uprising state and pre spring spray was very effective in decreasing the earlier mentioned pest population so that in control rows which no spray was conducted, after 2 months, we forced to spray. Therefore, it can be concluded that in citrus orchards, it *P. citri* is observed, it should be recommended pre spring spray; if not, there is no need to spray. This results confirm by Bedford *et al*. (1998) recommendation for spring spray to avoid outbreak of *P. citri*. Data related to this study and investigation represents that in order to control *P. citri*, only mineral oils are sufficient and there is no need to combine acaricide and mineral oil (Damavandian, 2007b). In addition, hexythiazox resistance in the *P. citri* would be highly heritable (Yamamoto *et al*., 1996); it was suggested to be completely recessive and controlled by a single major gene (Yamamoto *et al*., 1995). Bedford *et al*. (1998)

also reported that *P. citri* can build up resistance to such pesticides after they have been used continuously for three to five seasons. There is also evidence that citrus red mite can develop cross-resistance to certain organophosphorus compounds and carbamate-type acaricides (French and Hutchinson, 1980). In conclusion, pre spring treatment in citrus orchard to control citrus aphids and *P. aurantii* is not necessary, however, if *P. citri* will observe the use of mineral oil to prevent the build up of *P. citri* population could be useful alternative to acaricide in northern Iran.

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