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Chemical Control of *Thrips tabaci*, *Epitrix hirtipennis* and *Myzus persicae* in Tobacco Fields in Northern Greece

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Abstract: The present study was conducted in Voion county in the region of Kozani, in tobacco fields, involving population monitoring for two years (2004 and 2005), for three insects: *Thrips tabaci*, *Epitrix hirtipennis* and *Myzus persicae*. Two combined insecticides were applied: Tamaron 600SL (methamidophos) and Confidor 200SL (imidachloprid) and a check field (without application) was used. Sampling was conducted at seven periods, with 85 main samples consisted of three plants. Insecticide application reduced insect population about 70-74% and especially thrips population (up to 78%), resulting in double field yield performance of tobacco in comparison to check fields (no application). In the second year, there was a reduction of initial insect population, maybe due to previous effective application of insecticides and environmental conditions. There was a considerable interaction between insecticide application, insect species and sampling period, indicating different effectiveness of insecticides on insect species and differences in seasonal population fluctuation (due to different biological cycles of the insects during the cultivation period). Differences between years were found, indicating different environmental conditions. In general, there were greater populations of thrips or green aphids than flea beetles (about 30%). Second insecticide application was not only indispensable, but also lead to increased efficiency of insecticides. Finally, different environmental conditions, including transplanting period, may affect uniformity of insecticide application in the tobacco fields.

Key words: Tobacco, onion thrips, tobacco flea beetle, peach aphid, insecticide effectiveness

INTRODUCTION

Tobacco (*Nicotiana tabacum* L.) is cultivated in many countries and among them Greece and other Balkan countries. In Northern Greece, in Voion county in the region of Kozani, tobacco is a traditional cultivation and an important economic activity. Many injurious insect species prefer tobacco as a host plant, resulting in great damages. Three of the most important pests are: Onion thrips, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae), tobacco flea beetle, *Epitrix hirtipennis* (Melsheimer) (Coleoptera: Chrysomelidae) and the green peach aphid, *Myzus persicae* (Sulzer) (Homoptera: Aphididae). Thrips species and sometimes aphids can harm indirectly host-plants, because they are vectors of many viruses (Sakimura, 1962, 1963; Iwaki *et al*., 1984; Cho *et al*., 1987; Sdoodee and Teakle, 1993). The seasonal fluctuation and distribution of thrips species in Greece were studied by Deligeorgidis *et al*. (2005a). Onion thrips and green peach aphid were found in Greek tobacco fields many years ago, but tobacco flea beetle is a newfound pest, discovered in Agrinion region at 1988 and later in Central and Northern Greece (Lykouressis, 1991).

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Many growers of tobacco crop apply combination of insecticides every season to reduce the populations of these pests. Population control is important to keep damage below economic level because their reproductive potential is high, resulting in considerable economic damages and sometimes complete elimination of the crop production (Dominick, 1964; Deligeorgidis *et al*., 2005b). Relative studies for pest control in tobacco were reported by Dominick (1964 and 1967) and Mistric Jr. and Smith (1973) for soil applied insecticides or foliage applied insecticides (Nauen *et al*., 1996). Especially for tobacco flea beetle *E. hirtipennis,* there are many references in comparison to tobacco plant nutrition (Semtner, 1980; Semtner *et al*., 1980) or combination of systemic insecticides (Dominick, 1967). For green aphid *M. persicae*, references consider insecticide effectiveness in relation to resistance (Thurston, 1965; Devonshire and Moores, 1982; Devine *et al*., 1996; Nauen *et al*., 1996). The purpose of this study was to evaluate the effectiveness of the applied insecticides for controlling *Thrips tabaci*, *Epitrix hirtipennis* and *Myzus persicae* populations in tobacco fields. Additionally, to evaluate systemic insecticides for the management of multiple pests, in order to avoid economic loses.

MATERIALS AND METHODS

The present study was conducted in Northern Greece, in Voion county in the region of Kozani, in tobacco (*Nicotiana tabacum* L., cv. Mpasmas) fields, during years 2004 and 2005. In year 2004, transplanting was made at 30 of April and cultivation period lasted until 20 of August. In year 2005, transplanting was made at 2 of May and cultivation period lasted until 25 of August. The distance between rows was 50 cm and plant distance on the rows was 15 cm. Fertilisers and irrigation were supplied as suggested by Greek Tobacco Institute for medium clay-loamy soils (to avoid stress conditions).

Seasonal population fluctuation was studied for three tobacco insects: *Thrips tabaci*, *Epitrix hirtipennis* and *Myzus persicae*, under the application or the absence of two combined insecticides: Tamaron 600SL (methamidophos) and Confidor 200SL (imidachlorpid). For this purpose, each year, two adjacent (50 m distant) tobacco fields of 1 hectare each, were used: In the first field there were applied the two insecticides at a combined dosage of 1000 mL Tamaron 1000 L^{-1} water and 300 mL Confidor 1000 L^{-1} water for 1 ha and at the second field no insecticide application was made to use as a check (control) field. The insecticide applications were conducted in two periods: for year 2004, at 16 of May and 15 of June and for year 2005, at 17 of May and 15 of June (with the same combination of insecticides). Tobacco field yield was also measured in both fields for each year (2004 and 2005).

Seven sampling periods (about every 15 days) were selected to monitor insect population. In year 2004, samplings were made at 15/5, 30/5, 14/6, 29/6, 14/7, 29/7 and 13/8 (15, 30, 44, 59, 74, 89 and 104 days respectively, from transplanting). In year 2005, samplings were made at the same dates (13, 28, 43, 58, 73, 88 and 103 days respectively, from transplanting). Plant samplings (main replications) were 85 and each sampling consisted of three plants (sub replications in nested hierarchal design) the central on the row and two from both sides of the central row (neighbour rows). During the first two sampling periods samples consisted of whole plants, but each sample of the five last periods consisted of two leaves (of commercial dimensions) from each plant (from upper and lower part of the tobacco plants). This kind of sampling was used because the total leaf area of small young plants equals, more or less, the size of two commercial leaves from older (and bigger) plants, resulting in equal sampling size. Replications were designed as a fixed factor, since sampling was made in equal distance spacings. Only adult insects (from the three species) were recorded on the leaves under the stereoscope. Total recordings were about 40,000 and factor markers about 150,000.

Combined factorial analysis in SPPS software, involving two years of experimentation, insecticide application (yes or no), the three insect species, the seven periods of sampling, the main samplings (replications) and the subreplications (3×85). Factorial analysis was based on Snedecor and Cochran (1980). Factor interactions were studied and relation between insect population and field yield was calculated.

RESULTS

Analysis of all factors and their interactions and insect population recordings in both years (2004 and 2005) are summarized in Table 1. The results on tobacco field yield are also included in Table 1. Insecticide application reduced insect population about 70-74% and especially thrips population (up to 78%), resulting in double field yield performance of tobacco in comparison to check fields (no application). In 2004, field yields were found 1458 kg ha^{-1} (insecticide application) and 793 kg ha^{-1} (no application). In 2005, field yields were found 1427 kg ha^{-1} (insecticide application) and 781 kg ha^{-1} (no application). Onion thrips were found in greater populations, followed by green peach aphids and tobacco flea beetles in even lower populations. In the second year, there was a reduction of initial insect population. In general, there were greater populations of thrips or green aphids than flea beetles (about 30%).

There was a considerable interaction between insecticide application, insect species and sampling period, indicating different effectiveness of insecticides on insect species and differences in seasonal population fluctuation. Differences between years were found, indicating different environmental conditions. Additionally, there was found interaction between subreplications and the rest of the factors, especially in year 2004. Different environmental conditions, including transplanting period, may affect uniformity of insecticide application in the tobacco fields.

Insecticide applications and effectiveness on insect population are summarized in Table 2. First insecticide application reduced insect populations, but second application reduced considerably populations leading to increased efficiency of insecticides. The final insect population was even lower at maturity of tobacco plants.

Table 1: Insect populations recorded in years 2004 and 2005 in tobacco fields, after application of combined insecticides and for check field (no application) for: *Thrips tabaci*, *Epitrix hirtipennis* and *Myzus persicae*. Significant factors from combined factorial analysis and Tobacco field yield in kg ha^{-1}

	2004		2005		
Insect species	Insect. appl	Check	Insect. appl	Check	Average of insects
Epitrix hirtipennis	0.4448	1.5630	0.3994	1.3625	0.9424
Myzus persicae	0.5535	1.9165	0.5793	1.7204	1.1924
Thrips tabaci	0.4958	2.2369	0.5076	1.9294	1.2924
Average	0.4980	1.9055	0.4954	1.6707	1.1424
Field yield	1458	793	1427	781	

A) Significant (at $p<0.01$) interactions: insecticide application* insect species *sampling period

B) Additional interaction: All factors* subreplications (due to significant effects in year 2004)

C) Single significant factors: years, insect species (all insects differed significantly), insecticide application, sampling period

Table 2: Data from insect populations recorded in years 2004 and 2005 in tobacco fields, across the seven sampling periods, indicating insecticide effectiveness after the 2 applications

Period	2004	2005	Application
1	1.688e	1.669e	
2	1.414d	1.238d	After 1st
3	1.365d	1.231d	
4	1.325d	1.139c	After 2nd
5	1.221c	1.118c	
6	0.835b	0.699b	
7	0.584a	0.447a	Crop maturity

Values followed by different letter (s) (a, b, c, d and e: Five groups) exhibit statistically significant differences at $p<0.05$

DISCUSSION

Satisfying economic results of tobacco crop production depend mainly on effective insecticide application and sometimes environmental conditions. Effective insecticide application is based on a considerable reduction of the population of injurious insects. In the present study, insecticide application reduced insect population about 70-74% and especially thrips population, resulting in double field yield performance of tobacco in comparison to check fields (no application). Virus infestation that can eliminate tobacco crop was not a problem, and thus, tobacco field production even under no insecticide application was satisfactory. The principal vegetable disease transmitted by thrips and sometimes aphids, is tomato spotted wilt virus (TSWV). This disease has been known for many years and occurs worldwide on over 200 host plants (Iwaki *et al*., 1984). *Frankliniella occidentalis* (Pergande) and *T. tabaci* are the main vectors of TSWV (Sakimura, 1962, 1963; Cho *et al*., 1987; Allen and Broadbent, 1986; Allen and Matteoni, 1988; Broadbent *et al*., 1990; Chamberlin *et al*., 1993). Symptoms are often dramatic: They include ringspotting and necrosis on fruits, foliage and in growing points. Fortunatelly, no such dramatic symptoms were recorded. In general, the initial number of insects was low resulting in low infection pressure. The absence of great insect populations and virus infections, allowed satisfactory tobacco production even in the check fields (due to proper environmental conditions and insecticide application in the total area). In 2005, there was a reduction of initial insect population, maybe due to previous effective application of insecticides in the whole region and environmental conditions. After all transplanting was made in different dates for the two year of experimentation and year to year effects were found significant. Statistical differences between years (2004 and 2005) were revealed from factorial analysis, indicating different (but in general favorable) environmental conditions (GNSA, 2006). Consequently, different environmental conditions (rainfall, air temperature, irrigation, nutrition and transplanting period) may affect uniformity of insecticide application and insect population fluctuation in the tobacco fields, as it was found in the present study, especially for year 2004. Semtner *et al*. (1980) reported that nitrogen had significant effects on tobacco flea beetle abundance during some sampling periods, although the effect over the entire season was not significant.

There was a considerable interaction between insecticide application, insect species and sampling period, indicating different effectiveness of insecticides on insect species and differences in seasonal population fluctuation. This was expected due to differences in the biological cycles of the insects during the cultivation period and the seven sampling periods selected (Blackman, 1988; Lykouressis, 1991; Deligeorgidis *et al*., 2005b). In general, there were greater populations of thrips or green aphids than tobacco flea beetles.

First insecticide application reduced the population of the three insects, but second insecticide application was not only indispensable, but also lead to increased efficiency of insecticides. Aphids are known for insecticide-resistance mechanisms especially for organophosphorus insecticides and carbamates (Devonshire and Moores, 1982; Nauen *et al*., 1996) but some insecticides proved efficient in the past (Thurston, 1965) and especially imidacloprid in recent years (Elbert and Overbeck, 1990; Bai *et al*., 1991) since aphids showed low levels of resistance to this compound (Devine *et al*., 1996). These data are in agreement with the findings of the present study. At the end of the cultivation period, mature tobacco plants are dry and harder and thus insect population reamained low. The combination of the two insecticides was considered effective for the reduction of the population of the three insect species studied.

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