

COMPARISON OF INTEGRATED AND CONVENTIONAL PLANT PROTECTION OF CHERRY ORCHARDS

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Abstract. The investigations were carried out in four fruit bearing sweet cherry orchards (60 ha) of the Institute of Agriculture in Kyustendil during 1990-2006 (with intermission). Two plant protection technologies for control of cherry leaf spot and cherry fruit fly were applied: T1 - conventional with protective application for controlling of cherry leaf spot and pest control by treatments independently of its density. T2 – integrated protection with post infection (curative) treatments against cherry leaf spot according to the method of Eisensmith and Jones (1981a, 1981b) and control of cherry fruit fly and other pests according to the threshold. During the period of investigation seven fungi, one bacteria and nine pests were permanent species which caused damage of cherry in Kyustendil region (South – western Bulgaria). The key disease and pest were cherry leaf spot (*B. jaapii*) and cherry fruit fly (*R. cerasi*). The number of treatments in the integrated plant protection treatment of cherry was reduced by application of post infection (curative) treatments against cherry leaf spot and threshold for *R. cerasi* established in the Institute of agriculture in Kyustendil.

Key words: cherry leaf spot, cherry fruit fly, conventional, integrated plant protection

INTRODUCTION

The soil, climatic and topographical conditions in some regions of Bulgaria are favourable for sweet cherry growing and production of high quality fruits. The Kyustendil region is the most ancient cherry-growing region where are 1/3 of the cherry orchards of Bulgaria (there are about 1600 ha).

A lot of fungi, bacteria and pests attack cherry but *Blumeriella jaapii*, *Monilinia laxa*, *Monilinia fructigena*, *Pseudomonas syringae* pv. *syringae*, *Ragoletis cerasi*, *Myzus cerasi* some species from fam. *Lipidoptera* cause serious damage in some years (Boller et al., 1980; Jaastad, 1999; Eisensmith and Jones, 1981a; Velichkova-Sotirova, 1983; Borovinova, 1998; Sredkov, 1995a; 1995b; Casagrande et al., 1995; Rüll, 1999; Holb, 2003; 2004; Holb and Schnabel, 2005; Van Leewwen et al., 2000, 2002).

Cherry leaf spot (*B. jaapii*) and cherry fruit fly (*R. cerasi*) are the economically important disease and pest in cherry orchards in Bulgaria against which pesticides are applied every year (Velichkova-Sotirova, 1983; Sreskov, 1995a; 1995b; Borovinova, 1998).

In Europe and USA cherry leaf spot is controlled by 2-5 fungicides applications (Velichkova-Sotirova, 1983; Eisensmith and Jones, 1981a; 1981b; Cardei, 1988; Bielenin et al., 1981). The Model of Eisensmith and Jones (Eisensmith and Jones, 1981a; 1981b) with post infection treatments allows reducing of treatments. This model has been investigated in Bulgaria and the results were very good (Borovinova, 1998; 2003).

In Bulgaria cherry fruit fly is controlled by 1-2 insecticide treatments regardless of the density of cherry fruit fly because Bulgarian standard is very strict. It does not permit wormy

fruits. Sredkov, 1995a; 1995b established biological-threshold for cherry fruit fly which allows the reduction of treatments against this pest.

The number of applications of pesticides in cherry orchards is smaller than in apple orchards. Nevertheless the problem with plant protection of cherry trees with a decrease of the pesticides is serious problem for cherry-growing, because cherry fruits ripen for a short time and it is very difficult to protect cherry fruits from pesticide residues.

The aim of this study was to investigate the possibilities for reducing pesticide treatments and to compare integrated and conventional plant protection of cherry orchards.

MATERIALS AND METHODS

The investigations were carried out in four fruit bearing sweet cherry orchards (60 ha) of the Institute of Agriculture in Kyustendil during 1995-2006 (with intermission). The basic investigations were performed in a cherry orchard established in 1991. Cultivars Bing and Van were grafted on *Prunus mahaleb* rootstock and planted at a distance of 5.7 x 4.5 m. The trees were shaped in the freely growing crown. The floor management in the inter-row was fallow, which included one autumn cultivation (plough or disking), and during the vegetation period - superficial soil cultivations (Tasseva, 2005).

Additional investigations were conducted in three other experimental orchards which were sweet cherry cultivar collections.

Two plant protection technologies for control of cherry leaf spot and cherry fruit fly were applied: T1 - conventional with protective application for controlling of cherry leaf spot and pest control by treatments independently of its density. T2 – integrated protection with post infection (curative) treatments against cherry leaf spot according to the method of Eisensmith and Jones (1981a, 1981b) and control of cherry fruit fly and other pests according to their threshold. Untreated trees were used as control in some years.

Cherry leaf spot was controlled with ergo sterol biosynthesis inhibitors and do din. Bacterial canker, brown rot, shot-hole were controlled by protective treatments with copper containing fungicides during late autumn and early spring.

Yellow sticky traps (REBELL) were used for determination start of emergency and density of *Rhagoletis cerasi*. The insecticides – formation, dymethoat and heptenophos were used for cherry fruit fly control.

Pests of *Lepidoptera*, *Hymenoptera*, *Coccidae* were controlled on based on economic thresholds with Cipermetrin + Chlorpirophos.

Five to ten trees in five replications of each cultivar were evaluated, taking an average sample of 100 leaves from the four sides of each tree at the end of august for *Blumeriella jaapii* using the method of Townsend at Heuberger (Kremer and Unterstenhofer, 1967). 500 - 600 fruits were selected randomly from each tree and were assessed for rot.

During the harvest 300 fruits of each cultivar were assessed for larvae of *Rhagoletis cerasi*.

RESULTS AND DISCUSSION

Permanent fungal and bacterial diseases during the period of investigation on cherry were cherry leaf spot (*Blumeriella jaapii*), brown rot (*Monilinia laxa* and *Monilinia fructigena*), shot-hole (*Stigmia carpophila*) and bacterial cancer (*Pseudomonas syringae* pv *syringae*). Cherry leaf spot (*B. jaapii*) was the key disease against which treatments are applied every year.

For the period of the investigation a minimum of 17 infection periods in 1997 and a maximum of 36 infection periods in 2005 were registered (Table 1). The number of periods with heavy infection was the largest in 2006 (17). Cherry leaf spot was controlled by 3 (1995, 1997 and 2006) and by 2 treatments (1996 and 2005) in the orchard with protective treatments which were effective during the period. The rate of attack of the leaves of cultivars Van and Kozerska was very low. The rate of attack of the leaves of very susceptible cultivar Bing was higher than this of Van and Kozerska. During the same period the disease was controlled by 1 (1996), 2 (1995, 1997 and 2005) and 3 (2006) post infection treatments which were also effective. The rate of attack of the leaves was low (Table 1).

The obtained results demonstrated that *Blumeriella jaapii* can be controlled successfully by preventive and post infection treatments. Preventive schedule gave effective control of cherry leaf spot and confirmed the results from previous studies conducted by Velitschkova (1983) when it was established that cherry leaf spot can be controlled successfully with 4 or 5 preventive treatments. Despite decreasing the number of treatments the infection by cherry leaf spot was low at orchards with curative application. This result confirms results of Borovinova (1998) and was similar to those obtained by Eisensmith and Jones (1981a, 1981b) with sour cherry in USA – Michigan. The present study was conducted in years with a lot of periods with heavy infection and supported by the heavy rate of attack of the Control (untreated trees) clearly demonstrated that post infection treatments imposed good cherry leaf spot control with 1 or 3 treatments. By comparison, the number of treatments and its effectiveness in the integrated and conventional technology it was obvious that the applications of treatments against cherry leaf spot only when it is strictly necessary, reduced the number of treatments in some years and good control was achieved. This model seems to be the best strategy in cherry protection in integrated cherry production.

The number of treatments against cherry leaf spot can be reduced only during moderately wet or dry spring and summer but not in very wet years such as 2005 and 2006. Our results are similar to these of Eisensmith and Jones (1981a) obtained for sour cherry.

The good protection against cherry leaf spot in 2006 was the result not only from special treatments but the protective treatments against *Monilinia sp.* which coincided with some periods of infection for cherry leaf spot and was done with appropriate fungicide – Bravo (hlortalonil). The rainy periods occurred during the ripening period in 2006 were favourable for fruit cracking and rot. The special pre-harvest treatment with Bravo (hlortalonil) was applied, damage by rot were 2.2% of cultivar Mizia, 33.14% of Van and 43.7% of cultivar Rainier. The additional spray against fruit rot of very susceptible cultivars to cracking and rot was not enough for the control of *Monilinia sp.* and other fungi causing fruit rot as *Botrytis cinerea* and *Alternaria alternata*. These results are in agreement with those of Van Leeuwen et al., 2000, 2002; Holb, 2004 and Borovinova, 2004, who stated that a more serious brown fruit infection of stone and pome fruits occurred in rainy periods due to fruit cracking and lower effectiveness of fungicides.

Weather conditions for fruit rot were the less suitable for all other years and special pre-harvest treatments were not applied and nevertheless yield loss was significantly lower (0.60 – 4%) than in 2006. The treatments against cherry leaf spot with Folicur 25 WG (tebuconazol) were sufficient and effective at this weather conditions.

The main bacterial disease bacterial cancer (*Pseudomonas syringae* pv *syringae*) causing cancers on trunks and branches some years was controlled by 2 preventive treatments with copper containing fungicides.

Special treatments against shot-hole syndrome caused by *Stigmia carpophila*, *Xanthomonas campestris* pv. *Pruni* and *Bacillus pumilus* were not applied. The treatments for

controlling bacterial cancer and cherry leaf spot were effective against shot-hole syndrome too. The infection of these pathogens was negligible.

The pests of cherry can be classified in three groups - permanent, changeable and accidental. During the period of investigation 20 permanent pests were found but only *Rhagoletis cerasi*, *Mizus cerasi*, *Quadraspidiotus perniciosus*, some species of *Tortricida* and *Operophtera brumata* caused real damages in cherry orchards in the Kyustendil region.

Cherry fruit fly was the key pest against which pesticides are applied every year during the period of investigation (Table 2). The density of *R. cerasi* was high from 16 (2001) to 106 (1998) females caught per trap. The damage by this pest in untreated orchards reaches to 26%. Cherry fruit fly was controlled by 2 treatments in T1 (conventional plant protection) and by 1 in T2 (integrated plant protection) were not applied second treatment because the density of females cherry fruit flies caught in traps were less than their threshold. Regardless of the reduced treatments cherry fruits were protected and fruits with larvae were not found (except for 1997- 0.2%).

Leafrollers (*Archips rosana*, *Archips crataegana* and *Archips xylosteana*) were the most dangerous species from fam. *Tortricidae*. The damages by these species and *Operophtera brumata* were economically important during 1998, 2000 and they were controlled by one treatment at two technologies. An insecticide spray was made after the bloom and it protected the cherry trees from *Phyllobius oblongus*, *Epicometis hirta*, *Neurotoma nemoralis* and *Caliroa cerasi* pests which do injure during this period.

The number of treatments against *Quadraspidiotus perniciosus* was depends on the density climatic condition in years and susceptibility of varieties. One treatment in two technologies was made with Mineral oil – 3% in the end of the winter in 1998, 2000 and 2001. *Mizus cerasi* is one of the most dangerous species for the young trees. In the orchards, where cherry fruit fly was controlled, the density of *M. cerasi* was lower than the economic threshold and special treatment was not applied.

CONCLUSIONS

During the period of investigation seven fungi, one bacterium and nine pests were permanent species which caused damage of cherry in Kyustendil region. The key disease and pest were cherry leaf spot (*B. jaapii*) and cherry fruit fly (*R. cerasi*). The number of treatments in the integrated plant protection treatment of cherry was reduced by application of post infection (curative) treatments against cherry leaf spot and threshold for *R. cerasi* established in the Institute of agriculture in Kyustendil.

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REZUMAT

STUDIUL COMPARATIV PRIVIND PROTECȚIA INTEGRATĂ ȘI CEA CONVENȚIONALĂ A LIVEZILOR DE CIREȘ

Cercetările au avut loc în patru livezi de cireș (60 ha) ale Institutului de Agricultură din Kyustendil, între 1990-2006 (cu unele întreruperi). S-au aplicat două tehnologii de protecție a plantelor, pentru atacul antracnozei frunzelor de cireș și musca cireșelor: T1 – convențională, cu protecție pentru controlul antracnozei frunzelor și controlul dăunătorilor prin tratamente independente de densitatea lor; T2 – protecție integrată cu tratamente post-infecție (curative) împotriva antracnozei frunzelor, în conformitate cu metoda Eisensmith și Jones, și controlul pentru musca cireșelor și al altor dăunători corespunzător pragului de dăunare. Pe parcursul cercetării, pagube constante la cireș, caracteristice zonei Kyustendil (sud-vestul Bulgariei), au fost cauzate de șapte ciuperci, o bacterie și nouă dăunători. Boala și dăunătorii cheie au fost antracnoza frunzelor (*B. jaapii*) și musca cireșelor (*R. cerasi*). Numărul de tratamente din complexul de protecție integrată a cireșului a fost redus prin aplicarea tratamentelor post-infecție (curative), împotriva antracnozei frunzelor și atacului de *R. cerasi*, corespunzător pragului de dăunare.

Table 1

Number of infection periods by *B. jaapii*, treatments and rate of attack (%)

Years	Periods of infections of <i>B. jaapii</i> (May-August)			Number of treatments against <i>B. jaapii</i>		Fungicides and Active ingredient	<i>B. jaapii</i> rate of attack (%)								
	Light infection	Moderate infection	Heavy infection	T1	T2		Bing			Kozerska			Van		
							T1	T2	C	T1	T2	C	T1	T2	C
1995	13	4	7	3	2	Baycor (Bitertanol) - 0,15%	-	3.77	78.11	4.53	1.53	52.56	-	1.44	44.00
1996	8	2	9	2	1	Baycor (Bitertanol) - 0,15%		5.30	15.80	-	-	-	-	1.33	21.40
1997	5	3	9	3	2	V1- Silit 40 (Dodine) 0,1%, Systane 12E (Micobutani)- 0.06% V2 - Scor (Difenconazol) - 0.02%	13.22	8.22	54.0	-	-	-	1.45	0.25	-
2005	16	9	11	2	2	Folicur25WG (Tebuconazol)-0.075%	0	0	-	-	-	-	0	0	12.8
2006	1	4	17	3	3	Folicur25WG (Tebuconazol)-0.075% Silit40 (Dodine) 0.1%	4.2	0.88	-	-	-	-	-	0.16	-

T1 – Conventional technology (with protective treatments)

T2 – Technology with postinfection (curative) treatments

C – Control – untreated

Table 2

Mean number of cherry fruit flies (female) caught per trap, number of treatments and percent of fruits with larvae

Years	Mean number of cherry fruit flies caught per trap		T1 – Conventional plant protection			T2 – Integrated plant protection			Control untreated (in private orchards)	Control untreated (in experimental orchards)
	Before the first treatment	Two weeks ago second treatment	Number of treatments	Insecticides	Per cent of fruits with larvae	Number of treatments	Insecticides	Per cent of fruits with larvae		
1997	25	11	2	Antio 33 (Formothion) -0.2% Hostakvik 50EC (Heptenofos) -0.05%	0.3	1	Antio33 (Formothion) - 0.2%	0.2	15.0	-
1998	106	5	2	Antio 33 (Formothion) - 0.2% Hostakvik 50EC (Heptenofos) -0.05%	0.7	1	Bi 58 (Dimethoat)- 0.15%	0	22.0	-
1999	29	7	2	Hostakvik 50EC (Heptenofos) -0.05%	0.3	1	Bi 58 (Dimethoat)- 0.15%	0	1.0	-
2000	28	2	2	Sumition 50EC(Fenitrothion) - 0.2% Hostakvik 50EC (Heptenofos)-0.05%	0.7	1	Bi 58 (Dimethoat)- 0.15%	0	1.0	26.0
2001	16	11	1	Bi 58(Dimethoat) -0.15%	0	1	Bi 58 (Dimethoat)- 0.15%	0	-	-