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USE OF PREPARATIONS WITH DIFFERENT BIOLOGICAL EFFECT IN SPRING VETCH AND THEIR INFLUENCE ON THE PRODUCTIVITY AND INSECT PEST DENSITY

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Summary. The study was conducted during the 2007-2009 period in IFC, Pleven by the split plot method. The effects of Atonic– 0.06 l/da (growth regulator), Masterblend – 160 g/da (combined leaf fertilizer) and Confidor 70 WG (700 g/kg imidacloprid) – 15 g/da (an insecticide) on the dry mass productivity and density of the important insect pests in spring vetch were studied. Treatment was performed once (at the stages of budding and flowering) and twice (at budding and flowering). Measurements of the population density of sucking insect pests (*Homoptera* (suborder *Aphidodea* and *Auchenorrhyncha*) and *Thysanoptera* order) were conducted from the stage of budding to harvesting of aboveground mass. The use of Atonic, Masterblend and Confidor alone and in combination increased the dry mass productivity of spring vetch by 6.1 % to 32.4 %. The application of the combinations of Confidor with Atonic and Confidor with Masterblend had the highest efficiency, for which the lowest abundance of the pests was also found irrespective of their order belonging (the decrease was by 40.7 – 45.5% to 35.7 – 39.8% for *Homoptera* and *Thysanoptera*, respectively, compared to control). It was found that under two-fold treatment of the spring vetch with Confidor and Masterblend (alone and in combinations) at the stages of budding and flowering, the members of the different orders had the lowest abundance, as compared to their single application. That provided higher productivity by 10.6 % and 19.0 %, respectively as compared to their single treatment.

Key words: Atonic, Confidor, forage, Masterblend, sucking insect pests, vetch.

Abbreviations: b – stage of budding, f – stage of flowering, b+f – stage of budding and flowering.

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INTRODUCTION

Searching for new active factors having effect on plant productivity is a major trend in world agriculture (Zhelyazkova, 2007). Promising direction to increase the plant production is the use of growth regulators (Zhelyazkova and Pavlov, 2004; Zhelyazkova et al., 2004; Guluoglu et al., 2006), leaf fertilizers (Petkova and Poryazov, 2007; Stoyanova, 2009) and biostimulants (Palazova, 2005; Pet et al., 2005). Often under simultaneous application of growth regulators with nutrient elements and pesticides the positive effect on the yield is higher (Tsibulko et al., 2000; Stoeva and Shaban, 2001). The studies of Tsibulko et al. (2000) showed that the best technological method for treatment was their joint application with insecticides. Studies of similar nature in spring vetch are not known. The objective of this study was to determine the effect of the growth stimulant Atonic, combined leaf fertilizer Masterblend and insecticide Confidor (alone and in combinations) on the dry mass productivity and density of some sucking insect pests in spring vetch.

MATERIAL AND METHODS

The trial was carried out during 2007–2009 in IFC – Pleven. It was laid out by the split plot method with four replications of the variants and a natural background of soil supply with the major nutrients. The soil type is leached chernozem with $pH_{(KCl)}$ – 5.49 and content of total N – 34.30 mg/1000 g soil, P_2O_5 – 3.72 mg/100 g soil and K_2O – 37.50 mg/100 g soil. Spring vetch variety Obrazets 666 sown at a rate of 220 germinable seeds/m^2 was used. The effects of the growth stimulant Atonic applied at a dose of 0.06 l/da, the combined leaf fertilizer Masterblend at a dose of 160 g/da and the insecticide Confidor 70 WG at a dose of 15 g/da were studied when used alone or in combinations. The preparations were carried out with Matabi style 1.5 by hand. The ratio of the preparations in combination was 1:1, or 1:1:1 in the triple combination. Atonic (Azahy Chemical, Japan) contains 0.2% sodium orthonitro-phenolate, 0.3% sodium-paranitro-phenolate and 0.1% sodium-5-nitroguaicol. Phenol compounds that are active constituents of the growth stimulant are natural substances being naturally present in plant cells. It is mainly used to stimulate the growth and to increase the quantity and quality of the obtained products. It is recommended to mix it with different kinds of leaf fertilizers and pesticides, which results in positive synergism. Masterblend (Masterblend Fertilizer, USA) contains 20% nitrogen (6.22% nitrate + 3.88% ammonia + 9.90% urea), 20% soluble phosphorus (P_2O_5), 20% soluble potassium (K_2O) and minor elements (B, Cu, Fe, Mn, Mo, Zn, Mg). Confidor 70 WG (700 g/kg imidacloprid, Bayer, Germany) belongs to the group of chloronicotinyl insecticides and is active in a great number of sucking and stinging insects. Thielert (2006) found that foliar applications accelerated plant development, increased aboveground and root biomass and the number of formed generative organs and yield was 60 % higher even in the absence of attack by insects. Variants of the trial were as follows: control (treated with distilled water); Atonic; Masterblend; Atonic with Masterblend; Confidor; Confidor with Atonic; Confidor with Atonic with Masterblend; Confidor with Masterblend.

The treatment was conducted once (at the stages of budding and flowering) and twice (at budding and flowering).

Measurements of the population density of sucking insect pests were conducted two times per week by mowing with an entomological net from the stage of budding to harvesting of aboveground mass (25–30 days after flowering). The Confidor efficiancy was calculated by the formula of Henderson and Tillton (1955):

$$E = 100\ (1 - \frac{Ta\ .\ Cb}{Tb\ .\ Ca})$$

where:

E – efficiency of the preparation [%];

Ta – number of the live individuals after treatment (spraying) of the experimental area;

Cb – number of the live individuals in the control before the treatment of the experimental area;

Tb – number of live individuals before treatment of the experimental area;

Ca – number of live individuals in the control after treatment of the experimental area.

The obtained data were processed by the method of variance analysis with programmed product MS/STDTA.

RESULTS AND DISCUSSION

The period of study covered years differing in meteorological conditions (Fig. 1). With the sum of vegetation rainfall of 176.3 mm and the average daily air temperature of 15.1°C, the year 2008 was the most favorable for spring vetch growth and development. The experimental years 2007 and 2009 were characterized by considerably lower sums of vegetation rainfall as compared to 2008 (44.2% and 30.6%, respectively). The average daily air temperatures in 2007 were by 0.7 and 0.6°C higher in average as compared to those in 2008 and 2009, respectively. The unfavorable meteorological conditions in

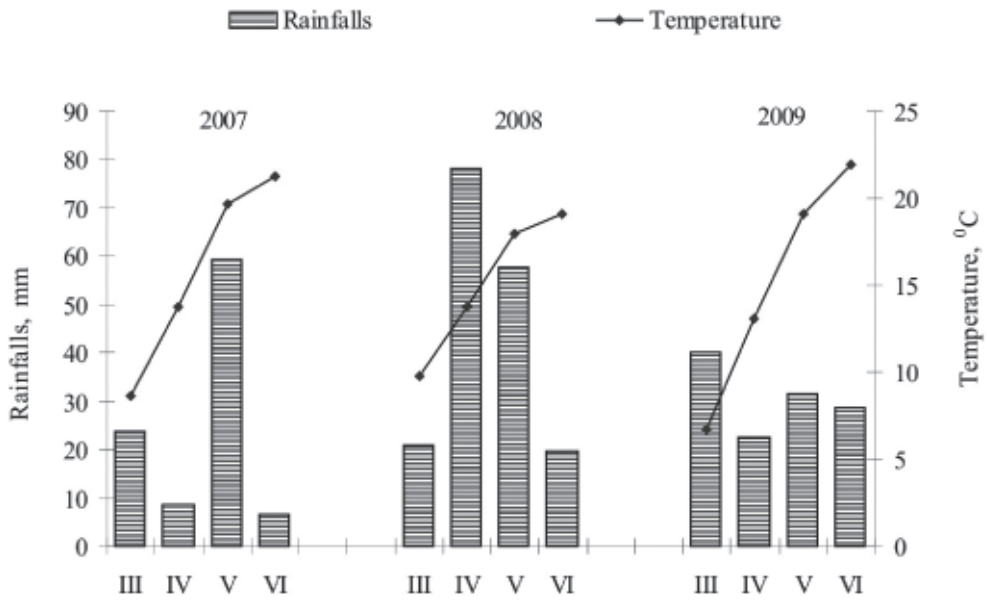

Fig. 1. Meteorological characteristics for Pleven region

2007 were complemented by the uneven distribution of rainfall by months and severe spring drought in April (the rainfall amount was only 8.5 mm), exerting an exceptionally negative impact on yield formation.

The obtained yields of dry mass from spring vetch were influenced by the meteorological conditions in the different years as well as by the kind of applied preparations and treatment stages (Table 1). During the three-year study the average increase in dry mass accumulation varied from 6.1 % to 32.4 %. The data in Table 1 show that the control had the lowest yields (conditions of a natural nutritive regime) – an average of 2730.6 kg/ha with variation during the years from 2088.9 to 3450.7 kg/ha. The use of the growth stimulant Atonic increased the vetch productivity by approximately 8.8%, its two-fold application at the stages of budding and flowering being the most efficient. The trend was more considerably pronounced in the other variants – the two-fold treatment at the stages of budding and flowering provided 10.5% and 18.6% higher productivity as compared to the single treatment at the same stages. The combined use of preparations had a stronger positive effect on the yields as compared to their use alone, statistically significant differences being found only in the variants with Atonic. The combination of Confidor with Atonic was distinguished for the highest productivity, followed by Confidor with Masterblend and Confidor with Atonic and Masterblend.

The greatest effect of the preparations was obtained during 2008 which was favorable from a meteorological point of view, reported also in the studies of other authors (Nenova and Atanasov, 2009). The data from the variance analysis showed significance of the differences between treatments at the stages of budding, budding and flowering and only flowering (there was no significance for the application of Confidor at budding and flowering). During the more unfavorable years 2007 and 2009, the result from the treatment with Atonic, Masterblend and Confidor was less pronounced, the differences in the productivity between the single treatments at budding and flowering being unsignificant. A similar trend was also found for the three-year period of study. During the period of study the following species of the injurious entomofauna of order *Homoptera* (suborder *Aphidodea* and *Auchenorrhyncha*) and *Thysanoptera* prevailed: *Acyrthosiphon pisum* Harris, *Empoasca pteridis* Dhlb., *Psammotettix striatus* L., *Thrips tabaci* Lind. and *Taeniothrips atratus*. The other injurious species had low percentage participation from the stage of budding to harvesting of the aboveground mass. The average population density of the members of orders *Homoptera* and *Thysanoptera* for the period was 16.5 and 8.1 insects/m^2, respectively. The harmful activity of the sucking pests consisted in sucking of plant sap and it was associated with disturbance of the physiological processes in plants, anatomical-morphological changes in leaves, severe roll, deformation, in many cases drying and fall of leaves. The observed damage was associated with decreased yields. The use of preparations having different biological effects creates favorable conditions for plant growth and development, giving an opportunity to decrease the injurious species abundance and as a final result, to obtain higher yield. Treatment with Masterblend alone or in

Table 1. Effect of treatment with Atonic, Masterblend and Confidor 70 WG on the dry mass productivity of spring vetch [kg/ha].

Variants	Stage of treatment	2007		2008		2009		Average	
		[kg/ha]	[%]	[kg/ha]	[%]	[kg/ha]	[%]	[kg/ha]	[%]
Control	b	2078.3		3442.0		2595.1		2705.2	
	b+f	2142.2		3597.3		2858.6		2866.0	
	f	2046.3		3312.6		2502.9		2620.6	
	average	2088.9		3450.7		2652.2		2730.6	
Atonic	b	2174.2	4.6	3804.4	10.5	2779.6	7.1	2919.4	7.9
	b+f	2270.1	6.0	4166.7	15.8	3214.3	12.4	3217.0	12.2
	f	2110.2	3.1	3571.4	7.8	2661.0	6.3	2780.9	6.1
	average	2184.8	4.6	3847.5	11.4	2885.0	8.6	2972.4	8.8
Masterblend	b	2430.0	16.9	4218.4	22.6	3082.6	18.8	3243.7	19.9
	b+f	2621.8	22.4	4580.8	27.3	3609.5	26.3	3604.0	25.7
	f	2270.1	10.9	3856.1	16.4	2885.0	15.3	3003.7	14.6
	average	2440.6	16.7	4218.4	22.1	3192.3	20.1	3283.8	20.1
Atonic + Masterblend	b	2461.9	18.5	4270.2	24.1	3161.6	21.8	3297.9	21.9
	b+f	2653.8	23.9	4684.3	30.2	3635.8	27.2	3658.0	27.6
	f	2334.1	14.1	3882.0	17.2	2871.8	14.7	3029.3	15.6
	average	2483.3	18.8	4278.8	23.8	3223.1	21.3	3328.4	21.7
Confidor	b	2493.9	20.0	4166.7	21.1	3161.6	21.8	3274.1	21.0
	b+f	2653.8	23.9	4710.2	30.9	3635.8	27.2	3666.6	27.9
	f	2398.0	17.2	3933.8	18.8	3016.7	20.5	3116.2	18.9
	average	2515.2	20.4	4270.2	23.6	3271.4	23.2	3352.3	22.6
Confidor + Atonic	b	2557.9	23.1	4503.1	30.8	3293.3	26.9	3451.4	27.6
	b+f	2749.7	28.4	4839.6	34.5	3793.9	32.7	3794.4	32.4
	f	2398.0	17.2	4114.9	24.2	3016.7	20.5	3176.5	21.2
	average	2568.5	22.9	4485.9	29.9	3368.0	26.7	3474.1	27.1
Confidor + Atonic + Masterblend	b	2493.9	20.0	4373.7	27.1	3214.3	23.9	3360.6	24.2
	b+f	2653.8	23.9	4658.4	29.5	3675.4	28.6	3662.5	27.8
	f	2366.0	15.6	4063.2	22.7	3003.5	20.0	3144.2	20.0
	average	2504.6	19.8	4365.1	26.4	3297.7	24.1	3389.1	24.0
Confidor + Masterblend	b	2525.9	21.5	4425.5	28.6	3253.8	25.4	3401.7	25.8
	b+f	2717.7	26.9	4787.8	33.1	3767.6	31.8	3757.7	31.1
	f	2366.0	15.6	4063.2	22.7	2990.3	19.5	3139.8	19.8
	average	2536.6	21.3	4425.5	28.1	3337.2	25.6	3433.1	25.6
$LSD_{0.05\%}$		272.6		279.2		300.9		290.1	

Legend: b – stage of budding; f – stage of flowering; b+f – stage of budding and flowering.

combination with Atonic was related to a decrease of population density of aphids and cycads by 3.3% to 25.8%, respectively and that of thrips by 2.4 to 14.2% (Table 2). Comparing the density of the members of order *Homoptera* and *Thysanoptera* to the control it was found that the decrease in abundance of sucking insects was more pronounced for the cycads and aphids. The average abundance of species of order *Homoptera* decreased by 16.6% for plants treated with Masterblend, followed by plants treated with Masterblend and Atonic (decrease by 10.8%). A similar trend was also observed for the members of order *Thysanoptera*, where lower density (by 10.3%) compared to control was found after application of Masterblend. Depending on the stage of application of Masterblend (alone or in combination with Atonic), the most pronounced decrease in abundance of sucking insect pests was found for the two-fold treatment at the stages of budding and flowering, where the decrease reached 25.8%. The combined leaf fertilization determined not only the higher plant productivity, but also gave an opportunity for regulation of the abundance and damage caused by sucking insect pests. Similar results concerning the influence of mineral fertilization on the pest density were also reported by other authors (Abdulmazhid, 1973; Vladimirovich, 2008). When applying Atonic alone, the injurious species abundance increased by 14.0-28.9%, but their effect on the plants was probably compensated by the growth stimulant that enhanced growth and increased the quantity of the obtained yield. The increased productivity of the plants treated with Confidor (alone or in combinations) was determined not only by the influence of the active ingredient imidacloprid as a growth regulator (Thielert (2006), but also by its insecticidal effect. The results in Table 3 show that Confidor had high efficacy against the sucking insects of order *Homoptera* (suborder *Aphidodea* and *Auchenorrhyncha*) and *Thysanoptera* (the efficacy varied from 83.3 to 96.1%). The highest efficacy was found for the combined application with Atonic, that increased the initial effect of the insecticide as compared to its application alone. The trend was particularly well expressed in dry years with high temperatures and insufficient precipitation amount (year 2007). Treatment of plants with Confidor (alone or in combinations) considerably decreased the abundance of sucking insects in the different years, as well as on average for the period by 25.9% to 45.5%, which was more pronounced for the species of order *Homoptera* (the decrease varied from 29.8% to 45.5%) (Table 2). The trend in thrips density was similar, where the decrease compared to control varied from 25.9% to 39.8%. It was observed that under the combined application of Confidor with Atonic the pest abundance was the lowest, irrespective of their order belonging, that was due to the positive synergism between the preparations. Very good results associated with low density of the studied orders were also found for treatment with Confidor in combination with Masterblend. This determined also the highest productivity of plants, exactly in these variants, for which the decrease in abundance of insects was by 40.7-45.5% to 35.7-39.8% for *Homoptera* and *Thysanoptera*, respectively.

With regard to the stages of Confidor and Masterblend application (alone or in combinations), it was found that the

Table 2. Effect of treatment with Atonic, Masterblend and Confidor on insect pests abundance during the growing season.

Variants	Stage of treatment	Number of insects/100 sweeps									
		Homoptera					Thysanoptera				
		2007	2008	2009	Average	-,+ %	2007	2008	2009	Average	-,+ %
Control	b	227.2	603.4	159.1	329.9		147.0	125.0	232.5	168.2	
	b+f	237.7	618.3	145.5	333.8		156.1	104.5	220.3	160.3	
	f	209.5	612.3	152.2	324.7		141.3	117.4	216.7	158.5	
	average	224.8	611.3	152.3	329.5		148.1	115.6	223.2	162.3	
Atonic	b	231.2	769.1	165.2	388.5	17.8	169.3	134.0	271.3	191.5	13.9
	b+f	256.4	924.3	208.4	463.0	38.7	190.5	119.8	293.0	201.1	31.1
	f	235.3	854.0	179.0	422.8	30.2	184.0	150.2	245.6	193.3	21.9
	average	241.0	849.1	184.2	424.8	28.9	181.3	134.7	270.0	195.3	22.1
Masterblend	b	211.2	509.1	136.2	285.5	-13.5	127.1	117.8	200.5	148.5	-11.7
	b+f	176.4	461.7	104.6	247.6	-25.8	126.2	85.6	183.2	131.7	-14.2
	f	191.3	541.3	140.6	291.1	-10.4	134.0	106.2	211.5	150.6	-5.0
	average	193.0	504.0	127.1	274.7	-16.6	129.1	103.2	198.4	143.6	-10.3
Atonic + Masterblend	b	205.3	551.9	147.5	301.6	-8.6	144.0	123.7	211.6	159.8	-5.0
	b+f	186.2	492.5	120.7	266.5	-20.2	130.5	92.7	195.5	139.6	-9.0
	f	204.7	600.6	136.9	314.1	-3.3	150.8	113.0	200.3	154.7	-2.4
	average	198.7	548.3	135.0	294.0	-10.8	141.8	109.8	202.5	151.3	-5.4
Confidor	b	161.6	425.2	116.5	234.4	-28.9	103.4	95.3	158.8	119.2	-29.2
	b+f	116.3	363.5	84.7	188.2	-43.6	92.9	70.1	140.0	101.0	-34.2
	f	145.4	446.1	107.2	232.9	-28.3	112.0	94.0	173.8	126.6	-20.1
	average	141.1	411.6	102.8	218.5	-33.7	102.8	86.5	157.5	115.6	-27.8
Confidor + Atonic	b	138.3	375.8	90.4	201.5	-38.9	86.8	84.3	146.2	105.8	-37.1
	b+f	84.6	274.9	63.7	141.1	-57.7	66.8	52.9	100.0	73.2	-52.3
	f	123.2	365.4	101.0	196.5	-39.5	108.1	69.0	152.7	109.9	-30.6
	average	115.4	338.7	85.0	179.7	-45.5	87.2	68.7	133.0	96.3	-39.8
Confidor + Atonic + Masterblend	b	176.7	465.6	130.1	257.5	-22.0	115.0	100.4	178.7	131.4	-21.9
	b+f	139.1	381.2	96.7	205.7	-38.4	85.5	81.7	136.5	101.2	-34.0
	f	158.4	430.9	102.0	230.4	-29.0	122.1	92.3	154.2	122.9	-22.5
	average	158.1	425.9	109.6	231.2	-29.8	107.5	91.5	156.5	118.5	-25.9
Confidor + Masterblend	b	124.5	410.7	107.1	214.1	-35.1	94.7	90.6	155.1	113.5	-32.5
	b+f	109.7	319.7	85.2	171.5	-48.6	72.9	64.0	113.4	83.4	-45.6
	f	140.4	362.1	98.1	200.2	-38.3	95.6	82.1	157.9	111.9	-29.4
	average	124.9	364.2	96.8	195.3	40.7	87.7	78.9	142.1	102.9	-35.7

Legend: b – stage of budding; f – stage of flowering; b+f – stage of budding and flowering.

Table 3. Effect of Confidor 70 WG (alone or in combinations) against harmful species of order *Homoptera* (suborder *Aphidodea* and *Auchenorrhyncha*) and *Thysanoptera* [%].

Variants	2007	2008	2009
Confido 70 WG - 15 g/da	83.3	95.6	90.8
Confido 70 WG - 15 g/da + Atonic - 0.06 l/da	91.7	96.1	94.5
Confido 70 WG - 15 g/da + Atonic - 0.06 l/da + Masterblend - 160 g/da	80.4	91.2	89.2
Confido 70 WG - 15 g/da + Masterblend - 160 g/da	82.0	93.4	93.3

members of the different orders had the lowest significant abundance under the two-fold treatment of spring vetch at the stages of budding and flowering as compared to their single application. The decrease was 19.5% and 18.5% as compared to the single treatment at budding and at flowering respectively, which provided 10.6% and 19.0% higher productivity.

Treatment with Masterblend and Confidor (alone and in combinations) favored plant development, provided protection from the sucking insect pests and created conditions for high productivity.

CONCLUSIONS

The use of Atonic – 0.06 l/da, Masterblend – 160 g/da and Confidor 70 WG – 15 g/da (alone and in combinations) increased the dry mass productivity of spring vetch by 6.1–32.4%. Their combined application had a stronger positive effect on the yields as compared to their use alone. The application of the combination of Confidor with Atonic and Confidor with Masterblend had the highest efficiency. The plant treatment with Masterblend alone or in combination with Atonic was related to a decrease of population density of aphids and cycads by 3.3–25.8% and that of thrips by 2.4–14.2%. The most pronounced decrease in abundance of sucking insect pests was found for the treatment with Confidor (alone or in combinations). The decrease varied from 20.1% to 57.7%, which was more pronounced for the species of order *Homoptera*. It was observed that under the combined application of Confidor with Atonic and Confidor with Masterblend the pest abundance was the lowest during the growing season (the decrease was by 40.7–45.5% to 35.7–39.8% for *Homoptera* and *Thysanoptera*, respectively). It was found that under two-fold treatment of the spring vetch with Confidor and Masterblend (alone and in combinations) at the stages of budding and flowering the members of the different orders had the lowest abundance as compared to their single application. That provided 10.6 and 19.0% higher productivity as compared to their single treatment. The treatment of Masterblend and Confidor (alone and in combinations) favored plant development, provided protection from the sucking insect pests and created conditions for high productivity.

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