

*Bulgarian Journal of Agricultural Science, 22 (Supplement 1) 2016, 19–24*  
*Anniversary scientific conference „Animal Science - Challenges and Innovations”, November 4-6, 2015, Sofia*  
*Agricultural Academy, Institute of Animal Science – Kostinbrod*

## CHANGES IN PRODUCTIVITY AND QUALITY OF FORAGE FROM PEA AND VETCH UNDER IMPACT OF PRODUCTS WITH DIFFERENT BIOLOGICAL EFFECT

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**Georgieva, N. and I. Nikolova**, 2016. Changes in productivity and quality of forage from pea and vetch under impact of products with different biological effect. *Bulg. J. Agric. Sci.*, 22 (Suppl. 1): 19–24

### Abstract

Production of good quality fodder is of great importance for economical animal production. Both quality and quantity of fodders are influenced by the used plant species, their stage of growth and the applied agronomic practices. The object of this study is to make an assessment of the feeds from main annual legume species – pea and vetch – in quantitative and qualitative terms. Experimental work was conducted in Institute of Forage Crops, Pleven, during the period 2007-2009. The changes in green mass productivity and nitrogen content of fodder under impact of separate and combined use of different products (Atonic, growth regulator; Masterblend, leaf fertilizer; Confidor, insecticide) and phenological stages of application (budding, flowering, budding and flowering) were observed.

*Key words:* green mass, nitrogen content, pea, vetch

### Introduction

One of the major problems hindering expansion of ruminant production is the un-availability of good quality fodder in sufficient quantity. Livestock received nutrients mainly from green fodder, followed by crop residues, grazing, cereal by-products and oil meals (Sarwar et al., 2002). Production of good quality fodder is of great importance for economical animal production. Both quality and quantity of fodders are influenced by the plant species (Kaiser and Piltz, 2002), stage of growth (Kim et al., 2001) and applied agronomic practices (Rehman and Khan, 2003).

Leguminous plants supply the major portion of protein consumed by man either directly or indirectly through animals (Bose and Balakarishnon, 2001). Increasing leguminous share in animal diet not only increases protein content but also enhances voluntary intake and digestibility of entire diet (Parveen et al., 2001). In this regard, special attention should be given to the species *Pisum sativum* (L.) and *Vicia sativa* (L.) which distinguished by high palatability (Kirilov, 1990a, 1990b; Kirilov, 2009), feeding value (Caballero et al., 1996;

Ilieva and Kosev, 2013; Kosev and Ilieva, 2015; Naidenova and Kosev, 2015), mineral content and vitamins (Parveen et al., 2001).

Possibilities for increasing the quantity and quality in these crops ensure the application of growth regulators (Zhelyazkova and Pavlov, 2004; Zhelyazkova et al., 2004), fertilizers (Pachev et al., 2011; Pachev, 2012; Pachev et al., 2012) and plant protection products (Tsibulko et al., 2000).

Considering the aforementioned, the present study was conducted to assess the feed of pea and vetch in quantitative and qualitative terms under impact of different preparations and phenological stages of application.

### Materials and Methods

The experimental work was carried out in the Institute of Forage Crops, Pleven. The field trial was laid out by the split plot method, at natural background of soil supply with the major nutrients. Spring forage pea (variety Pleven 4) and spring vetch (variety Obrazets 666) were sown at a rate of 120

and 220 seeds per m<sup>2</sup> respectively. The effects of the growth stimulant Atonic applied at a dose of 0.06 l.da<sup>-1</sup>, the combined leaf fertilizer Masterblend at a dose of 160 g.da<sup>-1</sup> and the insecticide Confidor 70 WG at a dose of 15 g.da<sup>-1</sup> were studied when used separate or in combinations.

Atonic contains 0.2% sodium orthonitro-phenolate, 0.3% sodium-paranitro-phenolate and 0.1% sodium-5-nitroguaiacol.

Masterblend contains 20% nitrogen (6.22% nitrate + 3.88% ammonia + 9.90% urea), 20% soluble phosphorus (P<sub>2</sub>O<sub>5</sub>), 20% soluble potassium (K<sub>2</sub>O) and minor elements (B, Cu, Fe, Mn, Mo, Zn, Mg).

Confidor 70 WG (700 g.kg<sup>-1</sup> imidacloprid) 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 yield was 60 % higher even in the absence of attack by insects.

Variants of the trial were: control (untreated); Atonic; Masterblend; Atonic with Masterblend; Confidor; Confidor with Atonic; Confidor with Atonic with Masterblend; Confidor with Masterblend. The treatments were conducted as follows: at budding stage (once), at flowering (once), at budding and flowering (twice).

The population density of insect pests was reported once per week by mowing with an entomological net. The green mass was harvested at milk ripeness of lowest pods. The nitrogen content was determined by Kjeldahl method (OMA, 1990).

The obtained data were processed by the method of variance analysis with programmed product Statgraphics Plus for Windows Vers. 2. 1.

## Results and Discussion

Average for the three-year experimental period in terms of the control variant, the spring pea and vetch formed respectively 22035.56 and 12408.89 kg.ha<sup>-1</sup> green mass (Table 1). The separate use of Atonic, Masterblend and Confidor had a positive influence on the productivity of both crops with differences (average for the different stages of application) from 6.6, 17.5 and 21.0% in pea and respectively 9.0, 20.3 and 22.7% in vetch in comparison with the control. It is obvious the more favourable impact of the combined leaf fertilizer on the vegetative development of plants compared to that of the growth stimulator, which is determined by the rich content of macro and micronutrients. The increment of yield after treatment with the insecticide Confidor was essential. It is result of its protective effect in respect to pest insects and stimulating action on development of above

ground mass, observed by other authors regarding to Confidor (Thielert, 2006).

Combined application of Atonic, Masterblend and Confidor in different combinations was related to increased effectiveness of the products and synergistic action. The increment in the amount of formed biomass after combined treatment in spring pea was in limits from 20.2 to 25.3% and from 21.9 to 27.3% in vetch. Differences to the control were statistically significant at the combined applications as well as at separate applications (with exception of separate applications of Atonic at budding and at flowering). Vetch showed a greater responsiveness to application of the products, which are objects of the present study. Probably one of the reasons for that is the greater leaf (assimilating) surface in spring vetch, variety Obrazets 666, at the moment of treatment, compared to that of spring pea, variety Pleven 4 (Ivanov and Kirilov, 2010). The combination with the most favourable effect on green mass productiveness in pea was Masterblend + Confidor, while in vetch was Atonic + Confidor.

The changes in forage productiveness were determined not only by used products but also by the phenological stage of application. The treatment at flowering stage provided 13660.00 and 24451.11 kg.ha<sup>-1</sup> green mass respectively in spring vetch and pea as these amounts were by 6.9 and 4.5% lower than the ones obtained at budding stage. The differences between two stages were significant only at combined treatment of spring vetch. Logically, the twice treatment at budding and flowering had the highest positive effect on plant productivity as the difference in comparison to the single treatment was 11% on average.

As a whole, irrespective of the kind of product and the phase of its application, the changes in the green mass productivity after use of Atonic, Masterblend and Confidor were stronger pronounced in spring vetch (VC=10.3) and weaker pronounced in spring pea (VC=8.5).

The nitrogen content is determinant for the quality of forage crops. Its varying in the conditions of experiment was substantial and it was in the limits of 22.1–30.3 g.kg<sup>-1</sup> in pea and 23.6–30.5 g.kg<sup>-1</sup> forage mass in spring vetch (Table 2). The treatment with products with different biological effect in spring vetch in all stages of application (with exception of the treatment with Atonic at budding stage) led to lowering in the nitrogen content of forage mass with a value of 7.4% averagely. The differences compared to the control were with lower values under the separate use of the products and higher when they are applied as mixtures. Regarding the phases of product's application, it was established that there was more significant lowering in two-time treatment at budding and flowering, which is in a correspondence with the larger quantities of biomass received at these variants. The data is a confirmation of the negative cor-

**Table 1**  
**Productivity in spring pea and vetch after treatment with Atonic, Masterblend and Confidor 70 WG**

Variants	Stages of treatment	Pea green mass, kg.ha <sup>-1</sup>		Vetch green mass, kg.ha <sup>-1</sup>	
Control	b	21964.44	a	12302.22	a
	b+f	22506.67	a	13013.33	a
	f	21635.56	a	11911.11	a
	average	22035.56		12408.89	
Atonic	b	23155.56	a	13306.67	a
	b+f	24666.67	b	14648.89	b
	f	22666.67	ab	12657.78	a
	average	23496.30		13537.78	
Masterblend	b	25688.89	b	14782.22	b
	b+f	27573.33	c	16382.22	c
	f	24480.00	bc	13671.11	bc
	average	25914.07		14945.19	
Atonic+Masterblend	b	26328.89	b	15022.22	b
	b+f	28346.67	de	16640.00	cd
	f	24817.78	c	13786.67	cd
	average	26497.78		15149.63	
Confidor	b	26497.78	bc	14888.89	b
	b+f	28275.56	de	16684.44	cde
	f	25226.67	c	14160.00	cde
	average	26666.67		15244.44	
Atonic+Confidor	b	27262.22	c	15733.33	b
	b+f	28862.22	de	17253.33	e
	f	25813.33	c	14471.11	c
	average	27312.59		15819.26	
Atonic+ Masterblend+Confidor	b	25617.78	b	15315.56	b
	b+f	27413.33	c	16648.89	cd
	f	24986.67	c	14320.00	de
	average	26005.93		15428.15	
Masterblend+Confidor	b	27573.33	c	15502.22	b
	b+f	29288.89	e	17084.44	de
	f	25982.22	c	14302.22	de
	average	27614.81		15629.63	
LSD <sub>0.05%</sub>		1463.63		1142.06	

Legend: b – stage of budding, f – stage of flowering, b+f – stage of budding and flowering

relation dependency between the quantity and quality of crop production pointed by Stancheva (2000).

In spring pea, the tendency of change in nitrogen content under the influence of the used products was not one-way. The separate use of Atonic, Masterblend and Confidor as well

as the combination of Atonic + Masterblend at budding stage was related to increase in the quantity of nitrogen from 2.6 to 10.6%. For all other variants the change in nitrogen content was in the direction of decrease with 9.4% averagely. For both crops decrease in the quality of the forage in relation to the

**Table 2**  
**Nitrogen content in forage mass of spring pea and vetch**  
**after treatment with Atonic, Masterblend and Confidor**  
**70 WG, g.kg<sup>-1</sup> forage mass**

Variants	Stages of treatment	Pea	Vetch
Control	b	27.4	27.6
	b+f	27.6	30.5
	f	27.1	29.5
	average	<b>27.4</b>	29.2
Atonic	b	29.2	27.7
	b+f	27.0	27.5
	f	27.1	29.5
	average	<b>27.8</b>	<b>28.2</b>
Masterblend	b	28.1	27.9
	b+f	24.6	28.0
	f	25.2	28.0
	average	<b>26.0</b>	<b>27.9</b>
Atonic+Masterblend	b	30.3	26.3
	b+f	25.0	28.2
	f	24.5	27.0
	average	<b>26.6</b>	<b>27.1</b>
Confidor	b	29.0	27.2
	b+f	22.1	26.6
	f	24.3	27.1
	average	<b>25.2</b>	<b>27.0</b>
Atonic+Confidor	b	27.4	26.7
	b+f	25.1	25.9
	f	23.7	28.0
	average	<b>25.4</b>	26.9
Atonic+ Masterblend+Confidor	b	27.1	24.3
	b+f	24.7	25.8
	f	23.2	29.0
	average	<b>25.0</b>	<b>26.4</b>
Masterblend+Confidor	b	22.8	24.4
	b+f	24.2	23.6
	f	22.8	28.4
	average	<b>23.3</b>	<b>25.5</b>

Legend: b – stage of budding, f – stage of flowering, b+f – stage of budding and flowering

nitrogen content was the most expressed after treatment with combination Mastblend + Confidor.

Atonic created better conditions for growth and development of plants compared to control, despite the high popula-

tion density of pea aphid when applied separately (Table 3). The combination of the stimulator with leaf fertilizer Masterblend, resulted in a reduction the aphid number averagely of 15.1% in forage peas and 17.1% - in vetch. That determined the realization of higher productivity. The treatment of plants with Masterblend favored the regulation of *Acyrtosiphon pisum* density and also created conditions for increasing the green mass production. Similar results related to the reduction of the aphid density from 10.6 to 12.8% in terms of balanced fertilization in peas, reported Vladimirovich (2008).

Pronounced reduction in the number of *A. pisum* was established after treatment with Confidor (separate or in combination) - from 34.9 to 55.4% in pea and from 35.4 to 56.8% - in vetch, which was associated with the high efficacy of the insecticide. Best results and providing complete control of the population density of the pea aphid were established by the combined application of Confidor with Masterblend (55.4 and 56.8% reduction of numbers).

In regard to the stages of application of Confidor, Masterblend and Atonik regardless separate or in combination, the lowest aphid density was established by simultaneous treatment of pea and vetch in budding and flowering stages as compared to the separate use of the products. The two-time treatment of plants was associated with a reduction in numbers of aphids on average by 24.6 and 32.0% in comparison with the single application in the budding stage and in the flowering stage, respectively in vetch, and in pea - by 22.0 and 35.4%. The most pronounced reduction in numbers was detected after use of the combination Confidor and Masterblend in budding and flowering stages with 65.7 and 69.8%, respectively in pea and vetch.

The insecticide product Confidor had high efficacy against the pea aphid during the three years of study (Table 4). The highest toxicity was found in his combination with Masterblend - from 75.6 to 85.2% in forage pea, and from 82.1 to 90.6% - in vetch. The absence of the wax coating and the presence of a soft leaf structure in vetch favored retention and penetration of products in plant cells, which led to a higher efficacy of the insecticide.

## Conclusions

The changes in the green mass productivity after use of growth stimulant Atonic, leaf fertilizer Masterblend and insecticide Confidor were stronger pronounced in spring vetch (VC=10.3) and weaker pronounced in spring pea (VC=8.5). The positive effect on the productivity in result of the separate and combined use of products was in limits from 6.6 to 25.3% in pea and respectively from 9.0 to 27.3% in vetch in comparison with control, as the combinations with the most

**Table 3**  
**Effect of treatment with Atonic, Masterblend and Confidor on *Acyrtosiphon pisum* Harris abundance during the growing season**

Variants	Stage of treatment	Number of insects / 100 sweeps									
		Pea					Vetch				
		2007	2008	2009	Average	-,+,%	2007	2008	2009	Average	-,+,%
Control	b	769.0	1130.1	895.3	931.5		170.5	557.5	90.0	272.7	
	b+f	782.2	1143.2	922.5	949.3		214.5	607.1	112.5	311.4	
	f	726.1	1071.7	887.8	895.2		194.5	540.0	103.7	279.4	
	average	<b>759.1</b>	<b>1115.0</b>	<b>901.9</b>	<b>925.3</b>	-	<b>193.2</b>	<b>568.2</b>	<b>102.1</b>	<b>287.8</b>	-
Atonic	b	835.3	1452.6	1283.3	1190.4	26.8	195.7	621.0	101.6	306.1	12.2
	b+f	1240.3	1894.7	1540.2	1558.4	63.8	237.4	753.6	130.3	373.8	20.0
	f	713.4	1209.4	947.5	956.8	5.9	205.8	644.0	111.7	320.5	14.7
	average	<b>929.7</b>	<b>1518.9</b>	<b>1257.0</b>	<b>1235.2</b>	<b>32.2</b>	<b>213.0</b>	<b>672.9</b>	<b>114.5</b>	<b>333.5</b>	15.9
Masterblend	b	746.0	1035.3	860.9	880.7	-5.1	157.3	500.4	95.0	250.9	-8.0
	b+f	688.4	944.5	821.7	818.2	-13.4	167.4	458.0	86.5	237.3	-23.8
	f	707.4	1097.0	871.7	892.0	-0.7	171.6	480.5	93.3	248.5	-11.1
	average	713.9	1025.6	851.4	863.7	-6.4	165.4	479.6	91.6	245.6	-14.7
Atonic + Masterblend	b	703.8	959.4	773.3	812.2	-12.4	148.5	501.0	88.5	246.0	-9.8
	b+f	619.1	884.3	688.4	730.6	-23.0	153.0	428.6	84.2	221.9	-28.7
	f	656.6	1004.3	767.8	809.6	-9.8	177.3	474.0	93.3	248.2	-11.2
	average	<b>659.8</b>	<b>949.3</b>	<b>743.2</b>	<b>784.1</b>	<b>-15.1</b>	<b>159.6</b>	<b>467.9</b>	<b>88.7</b>	<b>238.7</b>	<b>-17.1</b>
Confidor	b	468.5	678.3	550.0	565.6	-39.2	120.6	357.1	79.4	185.7	-31.9
	b+f	350.2	533.4	410.4	431.3	-54.7	119.7	213.5	70.1	134.4	-56.8
	f	584.3	687.5	612.5	628.1	-28.8	134.3	348.4	86.0	189.6	-32.2
	average	<b>467.7</b>	<b>633.1</b>	524.3	541.7	-40.9	124.9	306.3	78.5	169.9	-41.0
Atonic + Confidor	b	385.9	567.4	426.7	460.0	-50.6	130.1	348.5	67.3	182.0	-33.3
	b+f	293.4	465.7	342.7	367.3	-61.5	81.5	180.5	50.0	104.0	-66.6
	f	456.4	623.6	542.5	540.8	-39.3	120.0	257.3	80.6	152.6	-45.4
	average	<b>378.6</b>	<b>552.2</b>	<b>437.3</b>	<b>456.0</b>	<b>-50.5</b>	<b>110.5</b>	<b>262.1</b>	<b>66.0</b>	<b>146.2</b>	<b>-49.2</b>
Atonic + Masterblend+ Confidor	b	517.6	749.1	563.3	610.0	-34.5	138.8	403.8	80.4	207.7	-23.8
	b+f	417.1	611.0	490.0	506.0	-46.7	120.9	315.2	61.1	165.7	-46.8
	f	608.7	757.4	665.0	677.0	-23.5	144.8	336.7	70.7	184.1	-34.1
	average	<b>514.5</b>	<b>705.8</b>	<b>572.8</b>	<b>597.7</b>	-34.9	134.8	351.9	70.7	185.8	-35.4
Masterblend + Confidor	b	312.8	514.6	406.7	411.4	-56.1	92.5	284.6	72.5	149.9	-45.0
	b+f	234.3	450.5	310.5	331.8	-65.7	67.3	161.3	53.3	94.0	-69.8
	f	400.5	586.9	507.5	498.3	-44.3	114.2	207.8	66.7	129.6	-53.6
	average	<b>315.9</b>	<b>517.3</b>	<b>408.2</b>	<b>413.8</b>	<b>-55.4</b>	<b>91.3</b>	<b>217.9</b>	<b>64.2</b>	<b>124.5</b>	<b>-56.8</b>

Legend: b – stage of budding, f – stage of flowering, b+f – stage of budding and flowering

**Table 4**  
**Efficacy of Confidor 70 WG against *Acyrtosiphon pisum*, %**

Variants	Pea			Vetch		
	2007	2008	2009	2007	2008	2009
Confidor 70 WG	75.1	66.0	70.1	80.9	94.3	80.4
Confidor 70 WG + Atonic	74.3	70.5	80.6	90.4	100.0	85.2
Confidor 70 WG + Atonic + Masterblend	71.2	69.6	78.4	87.8	86.7	79.8
Confidor 70 WG + Masterblend	80.8	75.6	85.2	90.0	90.6	82.1



favorable influence on green mass formation were Masterblend + Confidor (for pea) and Atonic + Confidor (for vetch). Best results and providing complete control of the population density of the *Acyrtosiphon pisum* were established by the combined application of Confidor with Masterblend.

Phenological stage of budding was more proper for application of the products with different biological effect than flowering stage. The twice treatment at flowering and budding stages had the highest effect on plant productivity as the difference in comparison to the single treatment was 11% on average.

The changes in forage quality of spring vetch after treatment with all products and their combinations and in all phases led to lowering in the nitrogen content of forage mass with a value of 7.4% averagely. In spring pea, the separate use of Atonic, Masterblend and Confidor as well as the combination of Atonic + Masterblend at budding stage was related to increase in the quantity of nitrogen from 2.6 to 10.6%. For all other variants, the change in nitrogen content was in the direction of decrease with 9.4% average.

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