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Production Systems

Selectivity and stability of vegetation-applied herbicides in cotton (*Gossypium hirsutum* L.)

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Abstract. *An experiment was carried out during 2013 – 2015 in the experimental field of the Field Crops Institute, Chirpan, with two cotton cultivars − Helius and Darmi (Gossypium hirsutum L.). Herbicides: Goal 2 E, oxyfluorfen (80 ml/da); Linuron 45 SC, linuron (200 ml/da); Wing-P, pendimethalin + dimethenamid (400 ml/da); Merlin 750 WG, isoxaflutol (5 g/da); Bazagran 480 SL, bentazone (150 ml/da) were investigated. They were treated separately or combined with growth regulator Amalgerol (500 ml/da) or foliar fertilizer Lactofol O (500 ml/da) in the budding stage of the cotton. It was established that selectivity is the lowest in the two cotton cultivars with herbicides Linuron 45 CK and Merlin 750 WG. The purpose of this investigation was to establish the selectivity and stability of some herbicides and their tank mixtures on the cotton by influence of different meteorological conditions. It has been found that the highest phytotoxicity on cotton is given the vegetation-applied herbicides Merlin and Linuron. Foliar fertilizer Laktofol O reduces phytotoxicity of herbicides Goal, Wing, Merlin and Bazagran in two cotton cultivars. Herbicides Wing and Bazagran have excellent selectivity for the two cotton cultivars – Helius and Darmi. The highest yield was obtained by vegetation treatment with herbicide Bazagran, followed by herbicides Wing and Goal. Tank mixtures of Goal, Bazagran and Wing with Laktofol, followed by those with Amalgerol are technologically the most valuable. They combine high yield with high stability over the years. Alone application of herbicides Linuron and Merlin and their tank mixtures with Amalgerol and Laktofol have low estimate.*

Keywords: cotton, weeds, herbicides, selectivity, stability

Introduction

Cotton is an economically important crop for Bulgaria. Weed control in it is crucial for yield and production quality. The influence of economically important weeds was investigated (Dimitrova, 1995; Boz, 2000; Dimitrova and Laleva, 2003; Bukun, 2004 and 2005; Gozgu and Uludag, 2005; Salimi et al., 2006). A problem with modern farming is secondary weed infestation of the cotton crop. Manual weed control is one of the most labor-intensive activities and makes culture economically ineffective. In the application of herbicides during the vegetation a manifestation of phytotoxicity occurs frequently (Economou, 2005; Ashok et al., 2006; Chachalis and Galanis, 2007; Montazeri, 2009; Kahramanoglu and Uygur, 2010; Stoychev et al., 2010 and 2011; Jiang et al., 2012). The fight against secondary weeding is extremely difficult and must seek new approaches and herbicides exhibiting excellent selectivity in technology for cotton growing.

The purpose of this investigation was to establish the selectivity and stability of some herbicides and their tank mixtures on cotton by influence of different meteorological conditions.

Material and methods

During the period 2013 – 2015 a field experiment was carried out in the experimental field of the Field Crops Institute, Chirpan, under rainfed conditions on leached vertisol soil type with two cotton cultivars – Helius and Darmi (*Gossypium hirsutum* L.). A three-factor experiment was conducted under the block method, in 4 repetitions. The size of the crop plot was 15 m^2.

A total of 5 herbicides were investigated applied alone and their tank mixtures with growth regulator and foliar fertilizer. They are applied in budding stage of the cotton (Table 1). These herbicides are applied against the background of the herbicide combination Dual Gold 960 EC (1.2 l/ha) + Goal 2 E (1.2 l/ha), which are applied after sowing before germination. All herbicides and tank mixtures were applied in a work solution of 300 l/ha. The mixing of foliar-applied herbicides was done in the tank on the sprayer. Weeds in the manual weed control were removed by hoeing – 3 times during the cotton vegetation.

Selectivity EWRS was established (1 ball will damage the crop, dance 9 – total destruction of crop), respectively 20 and 40 days after treatment. The selectivity of herbicides has been established through their influence on raw cotton yield. The mathematical processing of the data was done according to the method of analyses of variance (Shanin, 1977; Barov, 1982; Lidanski, 1988). The stability of herbicides and herbicide combinations for raw cotton yield in relation to years was estimated using the stability variances σ_i^2 and S_i^2 of Shukla (1972), the ecovalence W_i of Wricke (1962) and the stability criterion YS_i of Kang (1993).

Results and discussion

The weeds which formed secondary weed infestation in cotton were established. These include the following species: *Convolvulus*

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Table 1. Investigated variants

Variants	Active substance	Doses
Zero control	-	-
Manual weed control	-	-
Goal 2 E	oxyfluorfen	800 ml/ha
Linuron 45 CK	linuron	2 l/ha
Wing-P	pendimethalin + dimethenamid	4 l/ha
Merlin 750 WG	isoxaflutol	50 g/ha
Bazagran 480 SL	bentazone	1.5 l/ha
Amalgerol	growth regulator	5 l/ha
Goal 2 E+Amalgerol	oxyfluorfen + growth regulator	800 ml/ha + 5 l/ha
Linuron 45 CK+Amalgerol	linuron + growth regulator	2 l/ha + 500ml/da
Wing-P+Amalgerol	pendimethalin + dimethenamid+growth regulator	4 l/ha + 5 l/ha
Merlin 750 WG+Amalgerol	isoxaflutol + growth regulator	50 g/ha + 5 l/ha
Bazagran 480 SL+Amalgerol	bentazone + growth regulator	1.5 l/ha + 5 l/ha
Laktofol O	foliar fertilizer	8 l/ha
Goal 2 E+Laktofol O	oxyfluorfen + foliar fertilizer	800 ml/ha + 8 l/ha
Linuron 45 CK+Laktofol O	linuron+foliar fertilizer	2 l/ha + 8 l/ha
Wing-P+Laktofol O	pendimethalin + dimethenamid+foliar fertilizer	4 l/ha + 8 l/ha
Merlin 750 WG+Laktofol O	isoxaflutol+foliar fertilizer	50 g/ha + 8 l/haa
Bazagran 480SL+Laktofol O	bentazone+foliar fertilizer	1.5 l/ha + 8 l/ha

arvensis L., *Solanum nigrum* L., *Xanthium strumarium* L., *Datura stramonium* L., *Amaranthus albus* L., *Amaranthus retroflexus* L., *Amaranthus blitoides* L., *Portulaca oleracea* L., *Euphorbia helioscopia* L., *Chenopodium album* L., *Hibiscus trionum* L., *Cirsium arvense* Scop., *Cynodon dactylon* Pers. and *Sorghum halepense* Pers. All kinds of weeds were met in various stages of development – from second leaf to flowering stage.

The average three-year period of 20 days after treatment in variants treated with Goal and Goal + Amalgerol in both cotton cultivars – Helius and Darmi, there is phytotoxicity – rate 2 by EWRS scale. It's expressed in necrotic spots on the leaves (Table 2). On the 40th day after treatment this phytotoxicity was not observed. With the variant Goal + Laktofol O phytotoxicity was not established – rate 1 by EWRS scale. In the variants treated with Wing and their combinations with Amalgerol in two varieties of cotton phytotoxicity was established – rate 2 by EWRS scale on the 20th day. Phytotoxicity was overcome on the 40th day after spraying. In combinations Wing + Laktofol O and Bazagran + Laktofol O phytotoxicity was not established – rate 1 by EWRS scale. The highest phytotoxicity, which is associated with necrosis and leaf

Table 2. Selectivity of herbicides and their combinations on cotton plants by EWRS scale

Variants	Cultivar Helius		Cultivar Darmi	
	20th day	40th day	20th day	40th day
Zero control	-	-	-	-
Manual weed control	-	-	-	-
Goal 2 E	2	1	2	1
Linuron 45 CK	4	3	4	3
Wing-P	1	1	1	1
Merlin 750 WG	4	3	4	3
Bazagran 480 SL	1	1	1	1
Amalgerol	-	-	-	-
Goal 2 E+Amalgerol	2	1	2	1
Linuron 45 CK+Amalgerol	4	3	4	3
Wing-P+Amalgerol	1	1	1	1
Merlin 750 WG+Amalgerol	4	3	4	3
Bazagran 480 SL+Amalgerol	1	1	1	1
Laktofol O	-	-	-	-
Goal 2 E+Laktofol O	1	1	1	1
Linuron 45 CK+Laktofol O	4	3	4	3
Wing-P+Laktofol O	1	1	1	1
Merlin 750 WG+Laktofol O	3	2	3	2
Bazagran 480SL+Laktofol O	1	1	1	1

drop, was established in Merlin and Linuron – rate 4, but the shedding of flowers or flower buttons was not observed. Lower phytotoxicity was reported in versions with Merlin + Laktofol O – rate 3 by EWRS scale, expressed in necrotic spots on the leaves without dropping.

Period 2013 – 2015 includes the years with varying temperatures and rainfalls. 2013 was the most favourable for cotton. The highest yield was obtained by vegetation treatment of the two cotton cultivars with herbicide Bazagran, followed by herbicides Wing and Goal (Table 3). In these three herbicides yields do not differ mathematically from manual weed control. Vegetation treatment with herbicides Linuron and Merlin leads to a significant reduction in yield. It is most pronounced in 2014. The addition of growth stimulator Amalgerol or foliar fertilizer Laktofol O does not reduce

Table 3. Influence of some herbicide combinations on raw cotton yields (2013 – 2014)

Cultivars	Variants	2013		2014		2015	
		kg/ha	%	kg/ha	%	kg/ha	%
Helius	Zero control	1110	100	1028	100	393	100
	Manual weed control	1967	177.2	2343	227.9	1330	338.4
	Goal 2 E	2180	196.4	2003	194.9	1320	335.9
	Linuron 45 CK	900	81.1	800	77.8	710	180.7
	Wing-P	2463	221.9	1840	179.0	1308	332.8
	Merlin 750 WG	1691	152.4	965	93.9	1005	255.7
	Bazagran 480 SL	2284	205.8	2025	197.0	1205	306.6
	Amalgerol	1141	102.8	1040	101.2	430	107.8
	Goal +Amalgerol	2028	182.7	2080	202.3	1443	367.2
	Linuron + Amalgerol	810	72.9	430	41.8	830	311.2
	Wing-P + Amalgerol	1828	164.7	1600	155.7	1265	321.9
	Merlin + Amalgerol	1474	132.8	1153	112.2	1065	271.0
	Bazagran + Amalgerol	1800	162.2	1990	193.6	1373	349.4
	Laktofol O	1513	136.3	1100	107.0	400	101.8
	Goal + Laktofol O	2268	204.3	2198	213.8	1513	385.0
	Linuron + Laktofol O	880	79.3	780	75.9	983	250.1
	Wing-P + Laktofol O	2244	202.2	2220	216.0	1273	323.9
	Merlin + Laktofol O	1758	142.2	1240	120.6	1005	255.7
	Bazagran + Laktofol O	2449	220.6	2163	210.4	1350	343.5
Darmi	Zero control	1050	100	1003	100	313	100
	Manual weed control	1808	172.2	2003	199.7	1110	354.6
	Goal 2 E	2227	212.1	1970	196.4	963	307.7
	Linuron 45 CK	970	92.4	1050	104.7	210	67.1
	Wing-P	2170	206.7	2130	212.4	1233	393.9
	Merlin 750 WG	1380	131.4	1350	134.6	758	242.2
	Bazagran 480 SL	2250	214.3	2020	201.4	1165	372.2
	Amalgerol	1083	103.2	1100	109.7	420	134.2
	Goal + Amalgerol	1860	177.2	1850	184.5	1050	335.5
	Linuron + Amalgerol	800	76.2	733	73.1	225	71.9
	Wing-P+Amalgerol	1860	177.2	1330	132.6	12,0	389.8
	Merlin + Amalgerol	1215	115.7	1150	114.7	1120	357.8
	Bazagran + Amalgerol	1832	174.5	1775	177.0	1290	412.1
	Laktofol O	1248	118.9	1065	106.2	300	95.9
	Goal + Laktofol O	2327	221.6	2030	202.4	1123	358.8
	Linuron + Laktofol O	850	81.0	625	62.3	693	221.4
	Wing-P + Laktofol O	2264	215.6	2093	208.7	1403	448.3
	Merlin + Laktofol O	1520	144.8	1230	122.6	570	182.1
	Bazagran + Laktofol O	2162	205.9	2130	212.4	1300	415.3

LSD, kg/ha:

F.A	p≤5%=26	p≤1%=34	p≤0.1%=43
F.B	p≤5%=21	p≤1%=27	p≤0.1%=35
F.C	p≤5%=64	p≤1%=85	p≤0.1%=108
AxB	p≤5%=36	p≤1%=48	p≤0.1%=61
AxC	p≤5%=111	p≤1%=147	p≤0.1%=188
BxC	p≤5%=91	p≤1%=120	p≤0.1%=153
AxBxC	p≤5%=157	p≤1%=207	p≤0.1%=266

Table 4. Analysis of variance for cotton yield

Source of variation	Degrees of freedom	Sum of squares	Influence of factor, %	Mean squares
Total	455	1574915	100	-
Tract of land	3	1070	0.1	356.7*
Variants	113	1530385	97.1	13543.2***
Factor A – Years	2	422839	26.8	211419.5***
Factor B – Cultivars	1	12644	0.8	12644.0***
Factor C – Preparations	18	944647	59.9	52480.4***
AxB	2	6024	0.4	3012.0***
AxC	36	107380	6.8	2962.8***
BxC	18	6615	0.5	367.5***
AxBxC	36	30236	1.9	839.9***
Pooled error	339	43460	2.8	128.2

*p≤5% **p≤1% ***p≤0.1%

Table 5. Stability parameters for the variants for raw cotton yield with relation to years

Cultivars	Variants	$\overline{x}$	σ_i^2	S_i^2	W_i	WS_i
Helius	Zero control	844	36.2	122.6	170.8	4
	Manual weed control	1880	3491.1**	6824.5**	6716.9	29+
	Goal 2 E	1834	226.6	-27.2	531.6	31+
	Linuron 45 CK	803	3378.2**	51.8	6503.0	-5
	Wing-P	1870	2857.0**	3373.5**	5515.5	28+
	Merlin 750 WG	1220	4681.5**	8349.1**	8972.5	5
	Bazagran 480 SL	1838	1478.3**	-24.4	2903.2	24+
	Amalgerol	870	-6.9	52.1	89.2	6
	Goal +Amalgerol	1850	419.9*	818.3*	897.8	30+
	Linuron + Amalgerol	690	10422.9**	3742.1**	19850.8	-9
	Wing-P + Amalgerol	1564	464.2*	234.6	981.7	19+
	Merlin + Amalgerol	1231	2285.9**	1314.8**	4433.4	6
	Bazagran + Amalgerol	1721	1396.5**	2045.9**	2748.2	20+
	Laktofol O	1004	1695.9**	658.9*	3315.5	1
	Goal + Laktofol O	1993	139.8	215.0	367.2	41+
	Linuron + Laktofol O	881	8637.6**	353.4	16468.3	0
	Wing-P + Laktofol O	1912	1649.4**	915.7**	3227.5	30+
	Merlin + Laktofol O	1334	1574.6**	3094.5**	3085.7	9
	Bazagran + Laktofol O	1987	1602.1**	9.5	3137.7	32+
Darmi	Zero control	789	172.8	319.7	429.6	2
	Manual weed control	1640	1645.6**	3109.8**	3220.1	18+
	Goal 2 E	1720	3636.6**	-17.7	6992.7	19+
	Linuron 45 CK	743	947.8**	1558.6**	1898.1	-7
	Wing-P	1844	1244.0**	697.7*	2459.2	25+
	Merlin 750 WG	1164	141.0	298.0	369.4	12
	Bazagran 480 SL	1812	1615.3**	-29.1	3162.8	21+
	Amalgerol	868	294.3	662.2*	659.8	5
	Goal + Amalgerol	1587	604.2**	712.1*	1246.9	16+
	Linuron + Amalgerol	586	147.9	63.2	382.3	-2
	Wing-P+Amalgerol	1470	2326.1**	3795.2**	4509.6	13
	Merlin + Amalgerol	1162	4350.5**	16.1	8800.0	3
	Bazagran + Amalgerol	1632	249.9	71.6	575.9	25+
	Laktofol O	871	670.4**	-13.1	1372.4	-1
	Goal + Laktofol O	1827	2681.9**	-12.5	5183.8	22+
	Linuron + Laktofol O	723	4837.3**	888.8**	9267.7	-8
	Wing-P + Laktofol O	1920	240.7	-21.4	558.3	39+
	Merlin + Laktofol O	1107	553.4*	122.4	1150.8	6
	Bazagran + Laktofol O	1864	764.5**	624.1*	1550.7	27+

phytotoxicity of these two herbicides and does not increase yields in both cotton cultivars.

Analysis of variance for cotton yield (Table 4) shows that the preparations have the biggest influence on yield – 59.9% on the variants. The reason is the high phytotoxicity of some herbicides. The years also have big influence on yield – 26.8%. This is due to the large differences in the meteorological conditions during the three years of investigation. The strength of influence of cultivars is 0.8%. This shows that the two cotton cultivars do not differ in their reaction to the investigated herbicides. The influence of years, cultivars and preparations is very well proven at $p \leq 0.01$. There is a proven interaction between cultivars and meteorological conditions of years (AxB) – 0.4%, between preparations and meteorological conditions of years (AxC) – 6.6% and between cultivars and preparations (BxC) – 0.5%. They are very well proven at $p \leq 0.01$. There is also interaction between the three experiment factors (AxBxC) – 1.9%. It is proven at $p \leq 0.01$.

Based on proven preparation x year interaction and cultivar x year interaction, stability parameters for each variant for cotton yield was evaluated with relation to years (Table 5). The stability variances σ_i^2 and S_i^2 of Shukla, the ecovalence W_i of Wricke and the stability criterion YS_i of Kang were calculated. Stability variances (σ_i^2 и S_i^2) of Shukla, which recorded respectively linear and nonlinear interactions, unidirectionally evaluate the stability of the variants. These variants which showed lower values are considered to be more stable because they interact less with the environmental conditions. Negative values of the indicators σ_i^2 and S_i^2 are considered 0. At high values of either of the two parameters - σ_i^2 and S_i^2, the variants are regarded as unstable. At the ecovalence W_i of Wricke, the higher the values of the index, the more unstable the variant.

On this basis, using the first three parameters of stability, it is found that in cultivar Helius stable are herbicide Goal, stimulator Amalgerol and combination Goal + Laktofol O. In cultivar Darmi stable are herbicide Merlin and combinations Linuron + Amalgerol, Bazagran + Amalgerol and Wing + Laktofol O. Other variants have high instability. In these variants values of stability variance σ_i^2 and S_i^2 of Shukla and ecovalence W_i of Wricke are high and mathematically proven. The reason for this high instability is greater variation in seed yields during years of experience as weather conditions affect those most. In part of the variants instability is linear and non-linear type – proven values of σ_i^2 and S_i^2. In other parts of the variants instability is linear type – proven values σ_i^2, the values of S_i^2 are not proven.

To evaluate the complete efficacy of each combination the reaction of cotton to this variant throughout the years should be considered as its effect on cotton yield and its stability. Valuable information about the value of technological value of the variant gives the stability criterion YS_i of Kang for simultaneous assessment of yield and stability, based on the reliability of the differences in yield and variance of interaction with the environment. The value of this criterion is experienced that using nonparametric methods and warranted statistical differences we get a summary assessment aligning variants in descending order according to their economic value.

Generalized stability criterion YS_i of Kang, taking into accounts both the stability and value of yields gives negative assessments of herbicide Linuron and its combinations with Amalgerol and Laktofol, characterizing them as the most unstable or as the lowest yields. According to this criterion, the most valuable technology appears herbicide tank mixtures Goal + Laktofol, Bazgran + Laktofol and Wing + Laktofol, followed by Goal + Amalgerol, Bazgran + Amalgerol and Wing + Amalgerol. These variants combine high levels of yield and high stability of this index during the years. From the viewpoint of technology for cotton growing, high rating also have alone application of herbicides Goal, Bazgran and Wing. They combine relatively good yields with lower stability during the years of the investigation. Alone application of herbicides Linuron and Merlin, as well as their tank mixtures with Amalgerol and Laktofol, get low ratings and are to be avoided. This is due to high phytotoxicity of these two herbicides, despite their very good control against the weeds, forming secondary weed infestation in cotton fields.

Conclusion

It has been found that the highest phytotoxicity on cotton is given by the vegetation-applied herbicides Merlin and Linuron. Foliar fertilizer Laktofol O reduces phytotoxicity of herbicides Goal, Wing, Merlin Bazagran in both cotton cultivars. Herbicides Wing and Bazagran have excellent selectivity for the two cotton cultivars – Helius and Darmi. The highest yield was obtained by vegetation treatment with herbicide Bazagran, followed by herbicides Wing and Goal. Tank mixtures of Goal, Bazagran and Wing with Laktofol, followed by those with Amalgerol are technologically the most valuable. They combine high yield with high stability over the years. Alone application of herbicides Linuron and Merlin and their tank mixtures with Amalgerol and Laktofol have low estimate.

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Instruction for authors

Preparation of papers

Papers shall be submitted at the editorial office typed on standard typing pages (A4, 30 lines per page, 62 characters per line). The editors recommend up to 15 pages for full research paper (including abstract references, tables, figures and other appendices)

The manuscript should be structured as follows: Title, Names of authors and affiliation address, Abstract, List of keywords, Introduction, Material and methods,Results, Discussion, Conclusion, Acknowledgements (if any), References, Tables, Figures.

The title needs to be as concise and informative about the nature of research. It should be written with small letter /bold, 14/ without any abbreviations.

Names and affiliation of authors The names of the authors should be presented from the initials of first names followed by the family names. The complete address and name of the institution should be stated next. The affiliation of authors are designated by different signs. For the author who is going to be corresponding by the editorial board and readers, an E-mail address and telephone number should be presented as footnote on the first page. Corresponding author is indicated with *.

Abstract should be not more than 350 words. It should be clearly stated what new findings have been made in the course of research. Abbreviations and references to authors are inadmissible in the summary. It should be understandable without having read the paper and should be in one paragraph.

Keywords: Up to maximum of 5 keywords should be selected not repeating the title but giving the essence of study.

The introduction must answer the following questions: What is known and what is new on the studied issue? What necessitated the research problem, described in the paper? What is your hypothesis and goal ?

Material and methods: The objects of research, organization of experiments, chemical analyses, statistical and other methods and conditions applied for the experiments should be described in detail. A criterion of sufficient information is to be possible for others to repeat the experiment in order to verify results.

Results are presented in understandable tables and figures, accompanied by the statistical parameters needed for the evaluation. Data from tables and figures should not be repeated in the text. **Tables** should be as simple and as few as possible. Each table should have its own explanatory title and to be typed on a separate page. They should be outside the main body of the text and an indication should be given where it should be inserted.

Figures should be sharp with good contrast and rendition. Graphic materials should be preferred. Photographs to be appropriate for printing. Illustrations are supplied in colour as an exception after special agreement with the editorial board and possible payment of extra costs. The figures are to be each in a single file and their location should be given within the text.

Discussion: The objective of this section is to indicate the scientific significance of the study. By comparing the results and conclusions of other scientists the contribution of the study for expanding or modifying existing knowledge is pointed out clearly and convincingly to the reader.

Conclusion: The most important consequences for the science and practice resulting from the conducted research should be summarized in a few sentences. The conclusions shouldn't be numbered and no new paragraphs be used. Contributions are the core of conclusions.

References:

In the text, references should be cited as follows: single author: Sandberg (2002); two authors: Andersson and Georges (2004); more than two authors: Andersson et al.(2003). When several references are cited simultaneously, they should be ranked by chronological order e.g.: (Sandberg, 2002; Andersson et al., 2003; Andersson and Georges, 2004).

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Books: Author(s) surname and initials, year. Title. Edition, name of publisher, place of publication. Example:

Oldenbroek JK, 1999. Genebanks and the conservation of farm animal genetic resources, Second edition. DLO Institute for Animal Science and Health, Netherlands.

Book chapter or conference proceedings: Author(s) surname and initials, year. Title. In: Title of the book or of the proceedings followed by the editor(s), volume, pages. Name of publisher, place of publication. Example:

Mauff G, Pulverer G, Operkuch W, Hummel K and Hidden C, 1995. C3-variants and diverse phenotypes of unconverted and converted C3. In: Provides of the Biological Fluids (ed. H. Peters), vol. 22, 143-165, Pergamon Press. Oxford, UK.

Todorov N and Mitev J, 1995. Effect of level of feeding during dry period, and body condition score on reproductive performance in dairy cows,IXth International Conference on Production Diseases in Farm Animals, September 11–14, Berlin, Germany.

Thesis:

Hristova D, 2013. Investigation on genetic diversity in local sheep breeds using DNA markers. Thesis for PhD, Trakia University, Stara Zagora, Bulgaria, (Bg).

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Animal welfare

Studies performed on experimental animals should be carried out according to internationally recognized guidelines for animal welfare. That should be clearly described in the respective section “Material and methods”.

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