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## Some results of evaluation of new-introduced apricot cultivars under conditions of Plovdiv region

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(Manuscript received 15 May 2016; accepted for publication 24 August 2016)

**Abstract.** *Apricot is not typical species for South Central Region of Bulgaria, where the Plovdiv region occupies a large part of the territory, but last 5 years the area and production remain stable. In this study, are presented the first results of investigation on seven new introduced apricot cultivars 'Bergecot', 'Flavor cot', 'Jenny cot', 'Lady cot', 'Perle cot', 'Sweet cot' and 'Tom cot', carried out at the Fruit Growing Institute in Plovdiv. The investigation included phenological data, fruit dimensions, chemical composition and sensory evaluation of the fruits. The studied cultivars more often entered the stage of flowering after second part of March and the differences between them were insignificant – one or two days. Among the investigated cultivars four of them ripened in the third decade of June, 'Lady cot' ripened in the beginning of July, 'Bergecot' in the end of July and 'Jenny cot' in the first half of August. The largest fruits had cultivar 'Lady cot' – 57.86 g, and the smallest one 'Flavor cot' – 37.64 g. The total soluble solids (TSS) content in the present study varied from 13.4° Brix in 'Perle cot' to 23.3° Brix in 'Jenny cot' cultivar. The highest vitamin C content was found in 'Bergecot' – 29.40 mg/100 g and it is statistically proved. According to the final evaluation the cultivars 'Bergecot' and 'Sweet cot' have excellent sensory characteristics and the other 5 cultivars are classified in the group of first class. According to the obtained data, all evaluated cultivars in this study are suitable for growing under the conditions of Plovdiv region. The most attractive and quality fruits have cultivars 'Lady cot', 'Perle cot', 'Bergecot' and 'Sweet cot'.*

**Keywords:** *Prunus armeniaca* L., fruit characteristics, chemical composition, sensory evaluation

### Introduction

According to Bulgarian Agrostistics (2014), the South Central Region, where the Plovdiv region takes up a big part of the territory, is the second largest areas in Bulgaria occupied by fruit orchards. Nevertheless, it is considered that Plovdiv is not typical region for apricot growing. The main reasons are unstable winter temperatures and late spring frosts which cause frost damages of wood, flower buds and young fruits (Bozhkova and Todorova, 2012). However there are apricot trees and orchards that remain vital and fruit bearing for many years. This suggests, that defining of suitable micro regions and appropriate cultivars are keys for successful apricot production in Plovdiv region. This study aims to present some results of investigation of new introduced apricot cultivars carried out at the Fruit Growing Institute in Plovdiv. The best one will be recommended to the producers in the region.

### Materials and methods

The study was carried out in the period 2014 – 2015 at the Fruit Growing Institute, Plovdiv. The trees of the studied cultivars 'Bergecot', 'Flavor cot', 'Jenny cot', 'Lady cot', 'Perle cot', 'Sweet cot', and 'Tom cot' were planted in a 2ha collection plantation in 2012 at a planting distance 4 × 3 m. Every cultivar is presented by minimum of 6 trees. The collection plantation is grown under non-irrigation conditions. The area between rows was maintained as fallow and in the rows was treated once with herbicide Goal 2E – 4 l/ha and once with Roundup 4 l/ha. The observed phenological characteristics included flowering and fruit ripening. Biometrical and chemical

analyses of the fruits were performed. IBPGR (International Board for Plant Genetic resources) descriptor was used to allocate the cultivars into groups according to the fruit weight, using the following scale: very small (20 – 30 g), small (31 – 40 g), small / medium (41 – 45 g), medium (46 – 55 g), medium / large (56 – 60 g), large (61 – 70 g) and very large >70 g. Thirty fruits from 4 trees were used as average sample for biometrical, chemical and sensory analyses. The study on the chemical composition and the sensory evaluation of apricot fruits was conducted in the period between 2014 – 2015 at the Fruit Growing Institute in Plovdiv. Fruits in technological maturity were collected for the average samples and they were used for the chemical analysis and the sensory evaluation. Total soluble solids (TSS) content was determined (°Brix), sugars were determined according to the method of Schoorl-Regenbogen, the acid contents were defined titrimetrically, active acidity (pH) was measured potentiometrically and the ascorbic acid (Vitamin C) was determined by the method of Tillmans (1932). Sensory evaluation was carried out individually by members of an authorized tasting panel. A nine-grade scale was used to evaluate the following seven sensory characteristics of the fruit: size, shape, colour, texture, taste, aroma and sweetness. The following scoring was used to define the strength of the sensory characteristic evaluated; 1 – 3 very poor to poor; 3 – 4 fair; 5 – 6 good and 7 – 9 very good to excellent. Every characteristic was multiplied by a specific weight coefficient as following: 0.43 for size, 0.43 for shape, 0.44 for colour, 0.6 for texture, 0.7 for taste, 0.7 for aroma and 0.7 for sweetness. The final score was obtained on the basis of the average grade of the total evaluation. According to the final evaluation, the fruits were divided as excellent or first class and second class. Data of the chemical analysis were statistically analyzed following Duncan's multiple range test.

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## Results and discussion

As it is known, the date of the beginning of flowering is specific to cultivar, but it also depends on the climatic factors. The deviation of this phenophase in two consecutive years is more than 20 days (Table 1). Data showed that the studied cultivars more often entered the stage of flowering after second part of March and the differences between them were insignificant – one or two days. Flowering continued in the frame of 6 to 10 days, that also depends of the climatic factors during the years. The shortest flowering period was established in 'Flavor cot' and 'Lady cot', while in the other cultivars the duration of this period was 9-10 days. Lyubenov (2005) investigated big number of apricot hybrids and indicated that for the Silistra region, early flowering begins after March 20<sup>th</sup> and lasts until mid of April. Similar results are obtained in southwestern Poland (Licznar-Malanczuk and Sosna, 2005), in Malatya, southeastern Turkey (Asma et al., 2007), and for the region of Belgrade, Serbia (Milatovic 2005).

Four of the investigated cultivars ripened in the third decade of June, so it can say that it is the typical apricot season in the Plovdiv region (Table 2). The cultivar 'Lady cot' ripened in the beginning of July, 'Bergecot' in the end of July and 'Jenny cot' in the first half of

August (this property make it a very desirable). The greatest variation in the period of ripening demonstrated 'Jenny cot' and the differences between the earliest and the latest date of maturation is 8 days.

According the fruit dimensions, the largest fruits had 'Lady cot', and the smallest one the cultivar 'Flavor cot'. The differences in the values between them are statistically proved. Fruit weight of 'Lady cot' is around 58g, that according descriptor list for apricot (by Bioversity International organization – formerly IPGRI) they can be classified as medium large, although the Cot International company describes it as large. Comparatively equal in size are fruits of 'Perle cot' and 'Sweet cot'. The fruits of 'Flavor cot' are small, and those of the other four cultivars are with small to medium size. According to Piagnani et al. (2013) data 'Flavor cot' is also classified in the group of small to medium size. Generally investigated cultivars had small to middle size of the fruit stones. The smallest weight of fruit stone was measured on 'Perle cot' -1.8g, and the biggest one on 'Jenny cot', 'Bergecot' and 'Lady cot', which is statistically proved. The relative share of the fruit stone vary between 3.40% in 'Perle cot' to 6.87% in 'Flavor cot'.

Total soluble solids (TSS) is a characteristic that gives the most rapid information about the biological value of a fruit. The TSS

**Table 1.** Phenological data of the investigated apricot cultivars

Cultivar	Year	White bud phase	Beginning of flowering	Beginning of full flowering	End of full flowering	End of flowering	Duration of flowering (days)
Bergecot	2014	11.03.	12.03.	14.03.	19.03.	20.03.	9
	2015	25.03.	27.03.	29.03.	01.04.	02.04.	7
Flavor cot	2014	14.03.	15.03.	16.03.	19.03.	21.03.	7
	2015	25.03.	27.03.	29.03.	01.04.	02.04.	7
Jenny cot	2014	13.03.	14.04.	16.03.	19.03.	21.03.	9
	2015	24.03.	25.03.	27.03.	31.03.	02.04.	9
Lady cot	2014	13.03.	14.03.	15.03.	19.03.	21.03.	8
	2015	25.03.	27.03.	29.03.	31.03.	01.04.	6
Perle cot	2014	13.03.	14.03.	15.03.	19.03.	21.03.	8
	2015	23.03.	25.03.	27.03.	31.03.	02.04.	9
Sweet cot	2014	11.03.	12.03.	14.03.	19.03.	21.03.	10
	2015	25.03.	28.03.	29.03.	01.04.	02.04.	6
Tom cot	2014	13.03.	15.03.	16.03.	19.03.	21.03.	8
	2015	23.03.	25.03.	27.03.	31.03.	02.04.	9

**Table 2.** Investigated apricot cultivars fruit dimensions

Cultivar	Fruit maturity	Fruit				Fruit stone				
		Lenght, mm	Width, mm	Thickness, mm	Fruit wight, g	Lenght, mm	Width, mm	Thickness, mm	Stone wight, g	Relative share, %
Bergecot	29.07.	42.23 <sup>ok*</sup>	41.74 <sup>bc</sup>	42.74 <sup>ab</sup>	42.93 <sup>cd</sup>	26.11 <sup>ab</sup>	12.03 <sup>ab</sup>	18.87 <sup>cd</sup>	2.76 <sup>a</sup>	6.43
Flavor cot	30.06.	43.87 <sup>bc</sup>	37.08 <sup>d</sup>	39.43 <sup>b</sup>	37.64 <sup>d</sup>	27.67 <sup>a</sup>	11.27 <sup>b</sup>	19.55 <sup>bc</sup>	2.59 <sup>ab</sup>	6.87
Jenny cot	09.08.	42.71 <sup>bc</sup>	40.44 <sup>c</sup>	43.21 <sup>ab</sup>	43.96 <sup>bcd</sup>	27.30 <sup>a</sup>	12.10 <sup>ab</sup>	20.59 <sup>ab</sup>	2.98 <sup>a</sup>	6.79
Lady cot	01.07.	48.32 <sup>a</sup>	44.90 <sup>a</sup>	46.96 <sup>a</sup>	57.86 <sup>a</sup>	26.08 <sup>ab</sup>	13.10 <sup>a</sup>	20.45 <sup>ab</sup>	2.84 <sup>a</sup>	4.91
Perle cot	21.06.	45.78 <sup>ab</sup>	44.59 <sup>ab</sup>	45.79 <sup>a</sup>	53.13 <sup>ab</sup>	24.35 <sup>b</sup>	12.11 <sup>ab</sup>	17.71 <sup>d</sup>	1.80 <sup>c</sup>	3.40
Sweet cot	21.06.	45.89 <sup>ab</sup>	40.31 <sup>c</sup>	43.79 <sup>ab</sup>	48.98 <sup>abc</sup>	26.01 <sup>ab</sup>	11.88 <sup>b</sup>	20.78 <sup>a</sup>	2.57 <sup>ab</sup>	5.28
Tom cot	18.06.	44.38 <sup>bc</sup>	39.76 <sup>cd</sup>	42.17 <sup>ab</sup>	42.62 <sup>cd</sup>	25.08 <sup>ab</sup>	11.67 <sup>b</sup>	18.59 <sup>cd</sup>	2.04 <sup>bc</sup>	5.02

\*Different letters in the same row/column indicated significant difference (  $p < 0.05$  )

content in the present study varied from 13.4°Brix in 'Perle cot' to 23.3°Brix in 'Jenny cot' cultivar (Table 3). It was observed that early ripened cultivars as 'Perle cot', 'Sweet cot' and 'Tom cot' collected low TSS and sugars. According to Pangelova (1969) the climatic conditions in summer influence on TTS values: when the weather is humid in summer, the values are lower and vice versa, but she also found that the chemical composition of fruits of some cultivars is relatively more stable. Piagnani et al. (2013) reported 14.6 % about the TSS content for 'Flavor cot' which is lower than our data but the data concerning pH are similar. Organic acids of fruits have a good effect on digestion and the intestine tract and they also determine the taste qualities of fruits. As a whole, the studied cultivars have a middle acid contents varying from 1.31% 2.81%. The highest statistically significant acid content was found for the cultivars 'Sweet cot', 'Perle cot' and 'Lady cot'. In this study, the cultivars having a

higher TSS had a lower percentage of titratable acids. This is conversely of other our observation on plum. The pH value of the consumed fruits and juices could also affect the total pH balance in the human body. The cultivars included in the present study had pH values fruits ranging within 3.24 and 4.35. Although the pH value of apricot cultivars is low, apricots are known as alkalinizing fruits, which makes them useful for fresh consumption. The analyses about vitamin C content in the investigated apricot cultivars showed that the lowest vitamin C content was found in 'Flavor cot' – 4.62 mg/100 g and the highest value was detected in 'Bergecot' – 29.40 mg/100 g respectively and it is statistically proved.

The fruit quality is a complex of many different characteristics describing both external appearance and taste qualities. That is why the sensory evaluation is as important as the chemical analysis. The results of the sensory analysis are presented in the Table 4. The

**Table 3.** Chemical composition of the investigated apricot cultivars fruits

Cultivar	Total soluble solid (Brix <sup>o</sup> )	Sugar, %	Acids (TA)%	Ascorbic acid, mg/100g	pH
Bergecot	17.7 <sup>c*</sup>	10.44 <sup>b</sup>	1.60 <sup>b</sup>	29.40 <sup>a</sup>	3.56
Flavor cot	19.1 <sup>b</sup>	12.66 <sup>a</sup>	1.53 <sup>b</sup>	4.62 <sup>d</sup>	3.93
Jenny cot	23.3 <sup>a</sup>	11.90 <sup>ab</sup>	1.31 <sup>b</sup>	5.69 <sup>d</sup>	4.35
Lady cot	16.6 <sup>c</sup>	11.00 <sup>b</sup>	2.13 <sup>a</sup>	5.01 <sup>d</sup>	3.50
Perle cot	13.4 <sup>e</sup>	8.34 <sup>c</sup>	2.21 <sup>a</sup>	11.88 <sup>b</sup>	3.24
Sweet cot	13.9 <sup>e</sup>	9.60 <sup>bc</sup>	2.81 <sup>a</sup>	8.58 <sup>c</sup>	3.76
Tom cot	15.9 <sup>cd</sup>	10.16 <sup>b</sup>	1.38 <sup>b</sup>	6.20 <sup>d</sup>	3.70

\*Different letters in the same row/column indicated significant difference ( p<0.05)

**Table 4.** Sensory evaluation of the investigated apricot cultivars fruits

Cultivar	Appearance				Taste quality			Total score	Final evaluation
	Fruit size	Fruit shape	Fruit colour	Texture	Taste	Aroma	Sweetness		
Bergecot	6.1	8.1	7.6	8.3	6.8	7.0	7.0	51.1	excellent
Flavor cot	5.5	6.0	5.8	5.4	7.2	6.7	6.8	43.7	first class
Jenny cot	6.0	6.5	6.0	6.5	7.0	7.0	6.8	45.8	first class
Lady cot	8.5	8.0	7.5	7.2	5.7	6.2	6.2	49.7	first class
Perle cot	7.0	7.6	7.9	7.5	5.5	5.6	6.3	47.4	first class
Sweet cot	7.3	6.8	6.7	6.8	7.5	7.7	7.8	50.7	excellent
Tom cot	5.7	6.8	7.8	7.2	7.0	6.8	7.5	48.8	first class

sensory evaluation is a combination of the external appearance and taste qualities, the latter having a greater importance for the final score. The larger fruit size is always preferred for apricot, but generally for all fruits. The difference in the score of this property between the studied cultivars was 3.0 points. Compared to fruit size, the score for fruit shape varied less and the biggest difference was 2.1 points. Fruit colour together with fruit size contributes to fruit attractiveness. Judging by the scores given for fruit coloration, it is obvious that the dark orange coloured fruits with red blush are preferred. Taste qualities combine the scores given for the texture, taste, aroma and sweetness. Usually the well-informed buyers pay great attention to taste qualities along with the external appearance of fruits. Out of the 7 studied cultivars, the highest score was given for the fruit texture of the cultivar 'Bergecot' and the lowest one – for the fruit texture of 'Flavor cot'. The rest of the cultivars received more closed scores. The taste is of greatest importance for grading the cultivars in result of the sensory evaluation. The best taste was found

in 'Sweet cot', and 'Flavor cot', although none was scored the maximum 9 points, i.e. the cultivars occupied the lower part of the excellent category. According to the final evaluation the cultivars 'Bergecot' and 'Sweet cot' are with excellent sensory characteristics and other 5 cultivars are classified as first class. Looking at the values of the chemical analysis we could not find a correlation between the chemical properties and the result of the sensory evaluation. Caliskan et al. (2012) investigated a big number of apricot cultivars and found that in their case the taste correlated with the TSS.

## Conclusion

The studied cultivars more often entered the stage of flowering after second part of March and the differences between them were insignificant – one or two days. The cultivars 'Flavor cot', 'Perle cot',

'Sweet cot', and 'Tom cot' ripened in the third decade of June, 'Lady cot' ripened in the beginning of July, 'Bergecot' in the end of July and 'Jenny cot' in the first half of August. According to the fruit dimensions, the largest fruits had cultivar 'Lady cot' – 57.86 g, and the smallest one 'Flavor cot' – 37.64 g. The lowest content of total soluble solids (TSS) was found in 'Perle cot' - 13.4° Brix and the highest in 'Jeny cot' - 23.3° Brix. The highest vitamin C content was found in 'Bergecot' – 29.40 mg/100 g and it is statistically proved. Excellent sensory evaluation obtained cultivars 'Bergecot' and 'Sweet cot' and the other 5 cultivars are classified in the group of first class. All evaluated cultivars in this study are suitable for growing under the conditions of Plovdiv region. The most attractive and quality fruits have cultivars 'Lady cot', 'Perle cot', 'Bergecot' and 'Sweet cot'.

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**Review**

- Honey bees and their products as indicators of environmental pollution: A review** 175  
D. Salkova, M. Panayotova-Pencheva

**Genetics and Breeding**

- Characterization of the Bulgarian sunflower hybrid Valin** 183  
G. Georgiev
- Evaluation of the combining ability of mutant maize lines** 189  
V. Valkova, N. Petrovska
- Evaluation of small size fruit peppers *Capsicum annum* spp. *microcarpum* with cluster and factor analysis** 193  
V. Kuneva, M. Nikolova
- Sensitivity of promising cherry hybrids and new cultivars to economically important fungal diseases** 197  
K. Vasileva, S. Malchev, A. Zhivondov

**Nutrition and Physiology**

- Lysozyme levels in haemolymph of worker bees (*Apis mellifera* L.) from bee colonies with different degree of expression of hygienic behaviour** 201  
S. Lazarov, I. Zhelyazkova, D. Salkova, R. Shumkova, S. Takova

**Production Systems**

- Study on energy flows of renewable sources for producing hot water on dairy farms** 205  
R. Georgiev, K. Peychev, D. Georgiev, R. Slavov, S. Apostolov, J. Ellingsen, J. Tønnesen
- Loose smut of barley grown in three types of farming** 209  
T. Nedelcheva, V. Maneva
- Efficacy and timing of some new products against pear psylla (*Cacopsylla pyri* L.) (Hemiptera: Psyllidae): I. Spirotetramat** 213  
V. Arnaudov
- Influence of year's characteristics and the different fertilization levels on the structural elements of wheat yield** 217  
V. Kuneva, R. Bazitov, A. Stoyanova

<b>Grain combines productivity according to various unloading methods – in the field and at the edge of the field</b>	<b>221</b>
N. Delchev, K. Trendafilov, G. Tihanov, Y. Stoyanov	
 <b>Agriculture and Environment</b>	
<b>Effect of some herbicides on weeds and vines in mother plantation of Cabernet sauvignon</b>	<b>227</b>
N. Prodanova – Marinova	
<b>Influence of foliar herbicides treatment on malting barley (<i>Hordeum vulgare</i> L.) productivity of Emon, Vanessa and Vicky varieties</b>	<b>232</b>
D. Atanasova, V. Maneva	
<b>Selectivity and stability of herbicides and herbicide combinations for the grain yield of maize (<i>Zea Mays</i> L.)</b>	<b>237</b>
G. Delchev, T. Barakova	
<b>Effect of some soil herbicides on vegetative habits of almond trees of 'Nonpareil' cultivar grown in a second-year nursery field</b>	<b>242</b>
Z. Rankova, M. Tityanov	
<b>Phytosanitary conditions of the organic field and boundary</b>	<b>245</b>
D. Atanasova, V. Maneva, N. Grozeva	
 <b>Product Quality and Safety</b>	
<b>Quality traits of eggs from autosexing Easter eggers</b>	<b>249</b>
H. Lukanov, A. Genchev, A. Pavlov, I. Penchev	
<b>Amino acid composition of lamb meat from the North East Bulgarian fine fleece breed and its crossbreds from internal breeding</b>	<b>256</b>
R. Slavov, G. Mihaylova, St. Ribarski, D. Panayotov, D. Pamukova, D. Dragnev	
<b>Some results of evaluation of new-introduced apricot cultivars under conditions of Plovdiv region</b>	<b>262</b>
V. Bozhkova, M. Nesheva	

## 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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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. IX<sup>th</sup> 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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