УДК 636.082.2

Research article

Open access

DOI: 10.32634/0869-8155-2023-369-4-75-79

Zoya S. Sanova, ✉
Vladimir N. Mazurov

Kaluga Research Agriculture Institute Branch of Russian Potato Research Center Center named after A.G. Lorch, Kaluga, Russia

✉ *sanova.zoya@yandex.ru*

Received by the editorial office:
10.02.2023

Accepted in revised:
01.03.2023

Accepted for publication:
15.03.2023

Application of sexed semen of sires in breeding farms of Kaluga region

ABSTRACT

Relevance. The main direction in the improvement of dairy cattle breeds is the search for ways and methods of creating highly productive herds. However, the successful solution of these issues is impossible without the use of modern methods and technologies. Among them, sexed sperm is a sperm divided into X- and Y-containing spermatozoa. When using sexed sperm in dairy cattle breeding, it is possible to regulate the receipt of the desired sex (heifers). The effective use of sexed semen will provide farms with a complete set of their own breeding stock and will allow the sale of heifers.

Methods. The object of research was cows inseminated with sexed sperm of stud bulls of different breeds in a breeding unit. The fertilization of the breeding stock, the duration of pregnancy, the effect of the season on fertilization, analytic investigation of calf crop percent were investigated. For analysis the data were used from the database for zootechnical and pedigree data registration «SELEKS».

Results It was found that the fertilization of heifers from the first insemination with sexed sperm was 38,8%, subsequently it decreased and amounted to 27,7% at the second insemination, 5,5% at the third. 28% remained infertile, 72% of heifers from the total remained pregnant. 85% of live heifers and 15% of bulls were obtained. During the initial insemination of cows of the first calving with sexed sperm, 27,7% of cows became pregnant, with repeated insemination — 27,7%. Fertilization decreased, 39,1% of the animals remained infertile. The best results of fertilization of breeding stock using sexed semen were obtained during the primary insemination of heifers

Key words: animals, sexed sperm, bulls, calves, fertilizing ability, pregnancy

For citation: Sanova Z.S., Mazurov B.N. Application of sexed semen of sires in breeding farms of Kaluga region. *Agrarian science*. 2023; 369(4): 75–79. https://doi.org/10.32634/0869-8155-2023-369-4-75-79.

Научная статья

Открытый доступ

DOI: 10.32634/0869-8155-2023-369-4-75-79

З.С. Санова, ✉
В.Н. Мазуров

Калужский научно-исследовательский институт сельского хозяйства — филиал федерального государственного бюджетного научного учреждения «Федеральный исследовательский центр картофеля им. А.Г. Лорха», Калуга, Россия

✉ *sanova.zoya@yandex.ru*

Поступила в редакцию:
10.02.2023

Одобрена после рецензирования:
01.03.2023

Принята к публикации:
15.03.2023

Применение сексированного семени быков-производителей в племенных хозяйствах Калужской области

РЕЗЮМЕ

Актуальность. Главным направлением в совершенствовании молочных пород скота является изыскание путей и методов создания высокопродуктивных стад. Однако успешное решение невозможно без использования современных методов и технологий. Среди них — сексированная сперма (разделенная на X- и Y-содержащие сперматозоиды). При использовании сексированной спермы в молочном скотоводстве можно регулировать получение желаемого пола (телочек). Эффективное применение сексированного семени обеспечит хозяйствам комплектацию собственным маточным поголовьем и позволит проводить продажу телок.

Методы. Объект исследований — коровы, осемененные сексированной спермой быков-производителей разных пород (джерсейской, Swedish Red, красной датской) в племенном репродукторе. Изучены оплодотворяемость маточного поголовья, продолжительность стельности, влияние сезона на оплодотворяемость, анализ выхода телочек в приплоде. Для анализа использовались данные из базы для регистрации зоотехнических и племенных данных «СЕЛЭКС».

Результаты. Установлено что оплодотворяемость телок от первого осеменения сексированной спермой была 38,8%, в последующем она снижалась и составила при втором осеменении 27,7%, при третьем — 5,5%. Бесплодными остались 28%, стельными — 72% телок от общего количества. Получено 85% живых телочек и 15% бычков. При первичном осеменении коров первого отела сексированной спермой стали стельными 27,7%, при повторном — 27,7%, бесплодными остались 39,1%. Лучшие результаты оплодотворяемости маточного поголовья с использованием сексированного семени получены при первичном осеменении телок.

Ключевые слова: животные, сексированная сперма, быки, телята, оплодотворяющая способность, стельность

Для цитирования: Санова З.С., Мазуров В.Н. Применение сексированного семени быков-производителей в племенных хозяйствах Калужской области. *Аграрная наука*. 2023; 369(4): 75–79. https://doi.org/10.32634/0869-8155-2023-369-4-75-79 (In English).

Введение/Introduction

In modern highly productive dairy cattle breeding, there is a significant decrease in the reproductive ability of cows. At the same time, only 50% of the resulting offspring are heifers, which are necessary for annual entry into the herd, in order to maintain reproduction in each farm [1, 2]. With this state of affairs in many gardens, the issue of getting more heifers is acute. The effective use of sexed semen provides farms with a complete set of their own breeding stock and allows for the sale of heifers [3, 4].

In recent years, serious efforts have been made in the Kaluga Region (Russia) aimed at stabilizing and developing the cattle breeding industry. New farms are being actively built, old ones are being reconstructed. The average dairy productivity of cows in the region in 2020 was 8070 kg. Many farms buy cattle abroad. Also in the region, much attention is paid to the issues of herd reproduction and improvement of breeding qualities of animals, work is actively carried out on the qualitative transformation of domestic dairy breeds with the involvement of the best global gene pool (Collection, Breeding work in animal husbandry of the Kaluga region (2020).

In the future, the main direction in improving dairy cattle breeds is to find ways and methods of creating highly productive herds. However, the successful solution of these issues is impossible without the use of modern methods and technologies [5–7]. Among them the sexed sperm — is a sperm divided into X- and Y-containing spermatozoa. Of course, it should be noted that this is a very subtle biotechnological method and before using it, you need to clearly understand its prospects and problems [8, 9]. For our region, sexed sperm is an opportunity to overcome the trend of reducing the breeding stock of cattle in the shortest possible time, and for breeding farms — to update the livestock and increase breeding sales. However, while the industry is not ready for the large-scale use of sexed sperm, it is necessary to study this method, based on the generalization of the experience of farms where this biotechnological method brings good results. This issue is relevant not only for agricultural enterprises of the Russian Federation, but also for foreign ones too, as a difficult problem of extended reproduction of the herd has appeared [10, 11]. In such conditions, it is difficult to count on a significant increase in the breeding stock at the expense of own resources [12, 13]. It is expensive to purchase herd replacements (especially in foreign countries). That is why it is necessary to use your own reserves to increase the number of repair young.

In this regard, the purpose of our researches work was to study the fertilization of the breeding stock as a result of the use of sperm of bulls divided by sex (biological method of reproduction) on the example of farms in the Kaluga region.

Материал и методы исследования /
Materials and methods

The sources of information were the data of zootechnical and breeding records, on the basis of which a database was created in the MS Excel program. Experimental data were processed by the method of variational using the Microsoft Excel 2000 program. All calculations of indicators of reproductive function of live cows and heifers are given on 01.01.2020. The analysis was carried out on three breeds (red Danish, Swedish red and Jersey) in LLC «Moloko Group». Insemination of heifers with sexed sperm of these breeds started in 2018. All used bulls are selected with the best heredity in terms of milk productivity, reproductive abilities, ease of calving and exterior.

Data collection was carried out on the basis of three farms of the Kaluga region of the breeding producers of LLC «Moloko Group» (breeds: Jersey, Danish Red and Swedish ed) Sukhinichi region, farm of LLC «Swiss milk» (black-and-white breed, holstinized) of the Dzerzhinsky district and the breeding plant of JSC «Krivskoye» (Kholmogorskaya breed, holstinized) of the Borovski region.

The main direction in the development of farms is breeding breeding animals in order to meet the needs of agricultural producers, milk production and processing. The research material was the indicators of fertilization of heifers when using the semen of the presented stud bulls and the characteristics of stud bulls of different breeds in the breeding producers of the region. The system of keeping animals in the farm is year-round stable, the method of keeping cows is loose. Animals are placed in sections depending on their physiological state and productivity. From the maternity ward, newborn calves are transferred to individual houses in a day, where they are kept for three weeks, then up to 6–8 months in boxes of 8 heads. The company practices only artificial insemination of cows and heifers.

Sexed sperm for LLC «Moloko Group» was purchased from International LLC Geneticist Rus (Moscow, Russia.)

The research material was the indicators of fertilization of heifers when using the semen of the presented stud bulls and the characteristics of stud bulls of different breeds in the breeding farm LLC «Moloko Group» in Sukhinichi region. The system of keeping animals in the farm is year-round stable, the method of keeping cows is loose. Animals are placed in sections depending on their physiological state and productivity. From the maternity ward, newborn calves are transferred to individual houses in a day, where they are kept for three weeks, then up to 6–8 months in boxes of 8 heads. The company practices only artificial insemination of cows and heifers. Sexed sperm for LLC «Moloko Group» was purchased from International LLC Geneticist Rus.

Результаты и обсуждения /
Results and discussion

All purebred breeding bulls with sexed sperm have excellent indicators of origin, ancestral productivity, and are evaluated by the quality of offspring. They were used on heifers of the corresponding breeds of the same quality, in the same conditions of maintenance and feeding, so the data obtained reflect a reliable picture.

The experience of using sexed sperm in other regions shows that the fertilization rate at the first insemination ranges from 35 to 60%. Table 1 shows the data on insemination of heifers of different breeds with sexed sperm from 2018 to 2020 in LLC «Moloko Group».

Photo 1. **Bull James breed Jersey (author's photo)**

Photo 2. **Jersey breed cow in LLC «Moloko Group», (author's photo)**

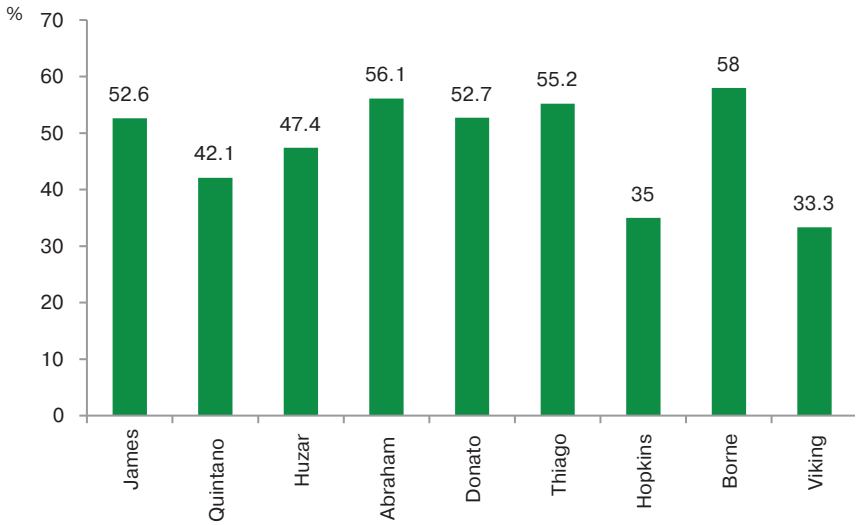
Table 1. **Data on insemination of heifers of different breeds by «Moloko Group» LLC with sexed semen**

Breed	Quantity of inseminated	Pregnant	
		heads	%
Jersey	249	114	45.7
Danish Red	265	139	52.4
Swedish red	89	51	57.3
Total	603	304	50.4

Table 2. **Insemination data of heifers in LLC «Moloko Group» with sexed semen by bulls**

The bull's nickname	Breed	Quantity	Pregnant	
			heads	%
James	Jersey	19	10	52.6
Quintano		95	40	42.1
Huzar		135	64	47.4
Abraham	Danish Red	66	37	56.1
Donato		150	79	52.7
Thiago		29	16	55.2
Hopkins		20	7	35.0
Borne	Swedish Red	86	50	58.0
Viking		3	1	33.3
Total		603	304	50.4

Fig. 1. **The proportion of pregnant heifers when using different bulls**



A total of 603 heifers were inseminated during this period, the proportion of pregnant was 50.4%. In the Jersey breed, 249 heifers or 52.4% were inseminated, of which 114 heads or 45.7% were pregnant, in the red Danish breed — 265 heads of which 139 or 52.4% were pregnant. The highest percentage of pregnancy of heifers was noted in the breed Swedish Red — 57.3. In the Kuban, when using sperm divided by sex, the fertilization of heifers was obtained at the level of 57%; the yield of heifers in the offspring was 87.7% (Kucheryavenko A.V. and oth.).

Data on insemination and pregnancy of heifers of Jersey, red Danish and Swedish red breeds by bulls are presented in table 2 and picture 1.

The largest number of pregnant heifers were from insemination with sperm of bulls: James in the Jersey breed; Abraham, Donato, Thiago — in the red Danish and Born, in the Swedish red.

The proportion of pregnant heifers inseminated with sexed sperm ranged from 33.3 to 58.0 (fig. 1).

To maximize milk production, it is necessary to maintain a high level of reproduction of the herd, to ensure timely fruitful insemination of cows and heifers for the annual production of offspring. One of the criteria for reproduction is the insemination index, which is an indicator of the number of inseminations of queens per fruitful one. Under normal conditions of feeding, maintenance and organization of insemination, this indicator is 1.5–2.0.

Bulls have a certain influence on the pregnancy of heifers. Thus, the highest percentage of pregnancy of heifers was revealed in the bull Born and Abraham (fig. 1).

The insemination index of cows and heifers does not go beyond the optimal values and is 1.7 for cows, 1.5 for heifers in LLC «Moloko Group».

Table 3 presents data on the influence of the season of the year on insemination and pregnancy of heifers for 2018–2019.

Most of all heifers, 149 heads, were inseminated in summer of 2018, 82 of them were pregnant, 42 heads or 36.2% of 116 inseminated heads in the fall of 2019 were pregnant. Low pregnancy rate (36,2%) of heifers in the fall can be interpreted by gynecological diseases.

Table 3. **The influence of the season on insemination and pregnancy of heifers**

Season	Number of inseminated	Pregnant	
		heads	%
2018 year			
summer	149	82	55.0
autumn	75	34	45.3
winter	44	26	59.1
2019 year			
spring	85	47	55.3
summer	86	45	52.3
autumn	116	42	36.2
winter	48	28	58.3

Fig. 2. **Prediction based on autoregression of one of the signs (in this case, insemination of heifers)**

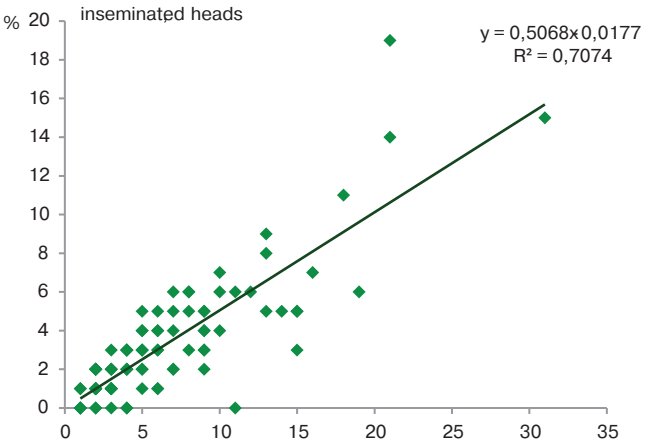
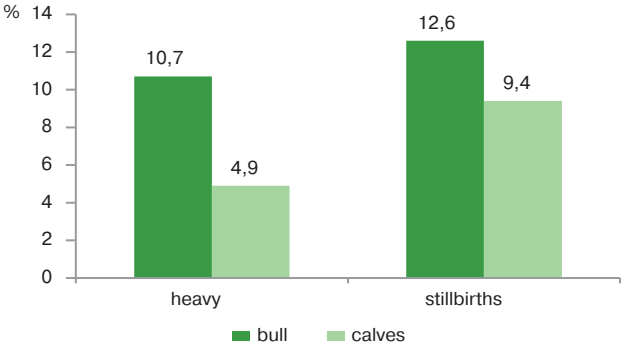


Table 4. **Characteristics of heifers inseminated with the sperm of breeding bulls, divided by sex**

Nickname and number of the stud bulls	Number of heads	Age of 1st insemination	Live weight, kg	Duration of pregnancy of heifers, days
Osofine	8	15	400	278
Nators	12	15	405	280
Donny	10	15	402	268
On average for bulls divided by gender	27	15	400	274

Fig. 3. **The influence of the calf's sex on the ease of calving in first-born heifers**



The lowest percentage of identified pregnant heifers was observed in autumn both in 2018 (45.3%) and 2019 (36.2%), in all other seasons the percentage of pregnant heifers was more than 50%. The highest 58.3–59.1% were recorded in the winter of 2018–2019.

Using a linear type of regression, a correlation and regression analysis of the effect of insemination of heifers on their pregnancy was carried out.

The correlation coefficient between insemination (the number of fruitfully inseminated) and the pregnancy of heifers is high and is 0.841, the coefficient of determination is 0.707. This means that the pregnancy rate of heifers is 70.1% dependent on their insemination.

According to the successful insemination of heifers, it is possible to predict their pregnancy (fig. 2).

Table 4 shows the characteristics of heifers inseminated with sexed sperm of breeding bulls, the heifers selected in groups for insemination had the same live weight of 400 kg and the age of the first insemination was 15 months.

As can be noted, the age of insemination of heifers with separated sperm is on average 15 months with a live weight of 400 kg. The difference between these indicators and the control is unreliable ($p > 0,05$).

In some farms, insemination currently begins at 14–15 months. The duration of pregnancy in the registered heifers inseminated with separated sperm is 268–278 days, on average 274 days. This indicator is within the physiological norm and does not significantly differ from control bulls.

As can be seen from figure 3, at the birth of heifers, 2 times less severe calving was received and more than 3% stillborn, compared with the birth of bulls.

The economic difference can be calculated by multiplying the number of stillbirths by the price of one calf if it were born alive. In addition, the farm may lose the calf's mother. And those heifers who survive after heavy calving are more likely to experience difficulties at the beginning of lactation, have low productivity and more problems with health and fertilization.

Выводы/Conclusion

The use of sexed sperm in individual breeding farms of the Kaluga region has an average fertilization rate of 55%.

In LLC «Moloko Group» the average share of pregnant heifers was 50.4%, with fluctuations from 33.3 to 56.1%. In the Jersey breed 45.7%, in the red Danish heifers 52.5% in LLC «Moloko Group». The highest percentage (57.3) of pregnant heifers was observed in Swedish Red cows. The largest number of pregnant heifers from the insemination of bulls: James in the Jersey breed; Abraham, Donato, Thiago — in the red Danish and Born, in the Swedish Red. The number of inseminations, on average per fruitful one, was 1.7 for cows and 1.5 for heifers.

The lowest percentage of identified pregnant heifers was observed in autumn from 36.2 to 45.3%, in all other seasons the percentage of identified pregnant heifers was more than 50%. The highest pregnancy percentage 58.3–59.1% were recorded in winter.

Все авторы несут ответственность за свою работу и представленные данные.
Все авторы внесли равный вклад в эту научную работу.
Авторы в равной степени участвовали в написании рукописи и несут равную ответственность за плагиат.
Авторы заявляют об отсутствии конфликта интересов.

All authors bear responsibility for the work and presented data.

All authors have made an equal contribution to this scientific work.
The authors were equally involved in writing the manuscript and bear the equal responsibility for plagiarism.
The authors declare no conflict of interest.

ФИНАНСИРОВАНИЕ

Материалы подготовлены в рамках научно-технической программы FZWE-2019-0011 «Разработать адаптивные, экономически обоснованные технологии производства продукции растениеводства и животноводства на основе селекции сельскохозяйственных культур, совершенствования племенной работы и современных агротехнологий»

FUNDING

The materials were prepared as part of the scientific and technical program FZWE-2019-0011 «To develop adaptive, economically sound technologies for the production of crop and livestock products based on the selection of agricultural crops, improvement of breeding work and modern agricultural technologies»

БИБЛИОГРАФИЧЕСКИЙ СПИСОК / REFERENCES

1. Harlap S.Yu., Gorelik A.S., Bitkeeva M.A., Demina N.A., Mullagulova G.M. Dynamics of correlation coefficients of economic and productive characteristics depending on the age of cows. *E3S Web of Conferences*. 2021; 254: 08023. https://doi.org/10.1051/e3sconf/202125408023

2. Likhodeevskaya O.E., Lihodeevskaya O.A., Gorelik O.V., Makarova T.N., Timinskaya I.A. Comparative assessment of productive qualities of holsteinized black-and-white cattle by lines. *IOP Conference Series: Earth and Environmental Science*. 2021; 848: 012082. https://doi.org/10.1088/1755-1315/848/1/012082

3. Fedoseeva N.A., Gorelik O.V., Likhodeevskaya O.E., Knysh I.V., Likhodeevskij G.A. Productive qualities of holsteinized black-and-white cattle. *IOP Conference Series: Earth and Environmental Science*. 2021; 848: 012068. https://doi.org/10.1088/1755-1315/848/1/012068

4. Aspandiyarova M. Successful insemination: a guarantee of farm profit. *Animal Husbandry of Russia*. 2017; (S2): 30–32. (In Russian) eLIBRARY ID: 30006660

5. Medvedev G.F., Gavrichenko N.I., Sorokina S.K. Effectiveness of insemination of Holstein heifers with sexed semen and causes of decline in their reproductive ability after the first calving. *Animal Agriculture and Veterinary Medicine*. 2012; (2): 36–40. (In Russian) eLIBRARY ID: 28133833

6. Nikitin G.S. Modern approaches for obtaining and cryoconservation of cattle embryos in vitro. *International Journal of Veterinary Medicine*. 2021; (3): 192–205. (In Russian) https://doi.org/10.17238/issn2072-2419.2021.3.192

7. Ukrozhenko D.S., Temnikov D.S., Chepushtanova O.V. Classification of sperm production of stud bulls. *Theoretical, practical and safe aspects of farming. A collection of abstracts of the round table*. Ekaterinburg: *Ural State Agrarian University*. 2021; 230–232. (In Russian) eLIBRARY ID: 47633747

8. Kozheko N.P., Shurmanova E.I., Sexed semen - the basis intensive livestock production. *Youth and science*. 2019; (2): 74. (In Russian) eLIBRARY ID: 38163873

9. Buzunova O.V. Evaluation of the effectiveness of different methods of artificial insemination of cows. *Youth and science*. 2019; (9): 27–30. (In Russian) eLIBRARY ID: 42500561

10. Malygina N.A., Popova O.A. Comparative characteristic of hormone programs in artificial insemination of cattle. *Bulletin of Altai State Agricultural University*. 2018; (9): 102–109. Avaible from: http://vestnik.asau.ru/index.php/vestnik/article/view/1195 (In Russian)

11. Sharkaeva G.A. Summary data on insemination of cattle in the context of foreign and domestic companies. *Theory and practice of modern science*. 2021; (2): 93–98. Avaible from: https://sciup.org/140275992 (In Russian)

12. Zhumanov K.Zh., Karymsakov T.N., Kineev M.A., Baimukanov A.D. Development and optimization of the equations of the mixed BLUP model for the evaluation of the breed value of bulls-producers of the golstin black-motioned breed of the Republic of Kazakhstan. *Agrarian science*. 2021; (2): 33–36. (In Russian) https://doi.org/10.32634/0869-8155-2021-345-2-33-36

13. Berry D.P., Coughlan B., Enright B., Coughlan S., Burke M. Factors associated with milking characteristics in dairy cows. *Journal of Dairy Science*. 2013; 96(9): 5943–5953. https://doi.org/10.3168/jds.2012-6162

ОБ АВТОРАХ:

Зоя Сергеевна Санова,
кандидат сельскохозяйственных наук,
Калужский научно-исследовательский институт сельского хозяйства — филиал Федерального исследовательского центра картофеля им. А.Г. Лорха,
ул. Центральная, 2, пос. Калужская опытная сельскохозяйственная станция, Калужская область, 249142, Россия
sanova.zoya@yandex.ru
https//orcid.org0000-0003-1080-4398

Владимир Николаевич Мазуров,
кандидат сельскохозяйственных наук,
Калужский научно-исследовательский институт сельского хозяйства — филиал Федерального исследовательского центра картофеля им. А.Г. Лорха,
ул. Центральная, 2, пос. Калужская опытная сельскохозяйственная станция, Калужская область, 249142, Россия
mazurov@mail.ru
https//orcid.org0000-0003-3427-0116

ABOUT THE AUTHORS:

Zoya Sergeevna Sanova,
Candidate of Agricultural Sciences,
Kaluga Research Agriculture Institute Branch of Russian Potato Research Center named after A.G. Lorch,
2 Tsentralnaya str., Kaluga Experimental Agricultural Station,
Kaluga region, 249142,
Russia
sanova.zoya@yandex.ru
https//orcid.org0000-0003-1080-4398

Vladimir Nikolaevich Mazurov,
Candidate of Agricultural Sciences,
Kaluga Research Agriculture Institute Branch of Russian Potato Research Center Center named after A.G. Lorch,
2 Tsentralnaya str., Kaluga Experimental Agricultural Station, Kaluga region, 249142, Russia
mazurov@mail.ru
https//orcid.org0000-0003-3427-0116