

CREATION OF STERILITY FIXERS OF WINTER RYE OF PMS SYSTEM OF PAMPA-TYPE

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Sterility fixers of winter rye of PMS P-type by transferring rf-genes of hybrids on normal plasma of domestic varieties were created. Forms that on 100% fix sterility were selected.

Winter rye – an important cereal crop. Selection of rye is conducted mainly in the direction of a high-yielding, short-stem varieties stable to lodging, complex of the most harmless diseases, with high frost resistance and resistance to sprouting of corn on the root [1, 2]. Transition to heterosis breeding will increase the productivity of the culture.

The task of selection of winter rye is primarily the implementation of breeding programs from the selection of varieties and hybrids of winter rye, which requires creation of intensive type materials which have next characteristics: grain yield of 8.9 t / ha, 70-100 cm plant height, number of grains 70-80 pieces in the ears, 1000 grain weight 35-45 g, contents of protein to 14% and complex resistance to diseases. The task of selection is determined by area and place of cultivation.

Hybrids demonstrated in many ways their superiority over population varieties. Therefore, on the bases of the selection of new material should be extended the works on creating the output forms for the selection process of receiving a new hybrids.

Currently in Ukraine research on creation of hybrids of winter rye is conducted in small amounts – obtained only three hybrids at the Institute of Plant Growing named by V. Yuriev (Pervistok F₁, Slobozhanets F₁, Yurievets F₁). The creation of hybrids is a priority direction for the selection process.

One of the important factors of heterosis achievements is the use of cytoplasmic male sterility (CMS). Abroad heterosis breeding of rye is based only on CMS. For obtaining heterosis effect on the bases of CMS it is necessary to create hybridization components, which include sterile maternal form, its fertile analogue (sterility fixer) and fertility restorer.

Currently, there are about 15 types of CMS in winter rye. The most widespread are two types R-type and Pampa-type. Pampa-type of CMS is the most studied. According to Geiger, sterility of this type is controlled by not less than two pairs of recessive alleles: rf₁rf₁rf₂rf₂. Pampa-type of CMS is characterized by high level of fixing capacity, but the concentration of complete sterility fixers in the population is low [3]. Sterility fixer has normal plasma and two pairs of recessive gene of nucleus Nrf₁rf₁rf₂rf₂.

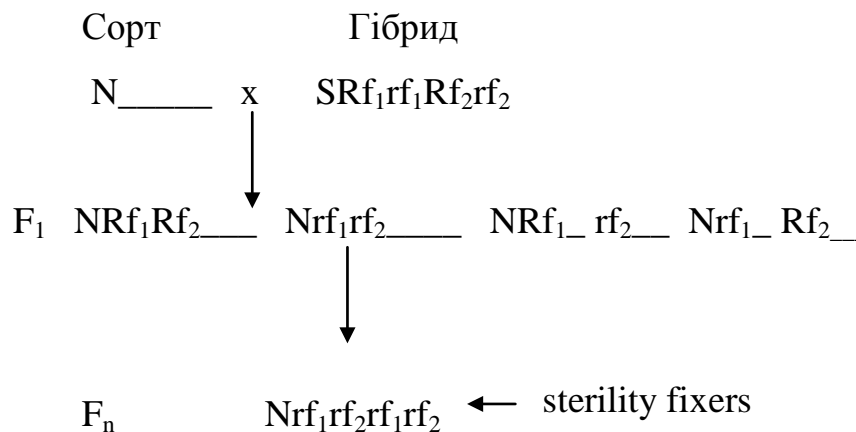
It is possible to get complete sterility fixers by means of transfer of sterility fixing genes from industrial hybrids to materials with normal plasma.

The aim of our study was to identify sterility fixers from the materials obtained as a result of interbreeding of domestic varieties with industrial hybrids.

Research Methodology. Research on the creation of sterility fixers based on the industrial hybrids was conducted for 2008 – 2013 at the research areas of Uman National University of Horticulture. To create candidates for sterility fixers as the maternal form, native varieties was used Borotba, Boguslavka, Verhnyatskyy 38, Kharkivske 98 and Khasto, as a parental – hybrid Pervistok. To identify sterility fixers, obtained candidates for sterility fixers interbred with sterile form. Sterile form excreted during self-pollination of hybrid Pervistok. Sterility of material was determined using a five point scale [4]. Interbreeding, self-pollination and reproduction were performed using pergameneous insulators.

Results of investigation. Using hybrid material to obtain candidates for sterility fixers is quite common genetic technique. Variety has a normal plasma (N), and the hybrid has sterile plasma (S) and two pairs of Rf genes are in the heterozygous state (SRf₁rf₁Rf₂rf₂). During interbreeding of variety and hybrid, genes of sterility fixing transfer to normal plasma.

For genes transfer to normal plasma using an appropriate scheme of interbreeding (pic.).



Pic. The scheme of transfer of the recessive genes rf on N-plasma and obtaining of candidates for sterility fixers

Feature of P-type rye is that fact that genes- restorers of fertility Rf occur with low frequency (3,5%) and genes-fixers of sterility rf – with high frequency (25%), and which genotype exactly has the initial maternal form is unknown.

As a maternal form, was used a variety which can have the following genotypes of plants:

- NRf₁Rf₁Rf₂Rf₂ – normal plasma and two pairs of genes of the nucleus in dominant condition;
- Nrf₁rf₁rf₂rf₂ – normal plasma and two pairs of genes of the nucleus in recessive condition;
- NRf₁Rf₁rf₂rf₂ – normal plasma and the first pair of genes in dominant condition, the second – in recessive;
- Nrf₁rf₁Rf₂Rf₂ – normal plasma and the first pair of genes in recessive condition, the second – in dominant;
- NRf₁rf₁Rf₂rf₂ – normal plasma and two pairs of genes of the nucleus in heterozygous condition.

Depending on genotype of initial maternal form, different percentage of sterility fixers will form.

After interbreeding a quarter of the material will have a genotype Nrf_1-rf_2- . After self-pollination and reproduction of this material, candidates for sterility fixers are obtained, which can include sterility fixers ($Nrf_1rf_1rf_2rf_2$) with a share of 10%.

In our studies, on the initial stage of work, hand castration of maternal material was carried out (varieties Borotba, Boguslavka, Verhnyatskyy 38, Kharkivska 98 and Khasto) and interbred with the parental form – hybrid Pervistok. The resulting material was self-pollinated and propagated.

On the next stage of the work, the analysis of the obtained material was carried out on the basis of “sterility-fertility”. After the allocation of sterility fixers with the genotype $Nrf_1rf_1rf_2rf_2$ in thirteen sprouts from interbreeding of candidates for fixers with sterile form, the formation of different number of sterile plants was observed (70,2 – 100%) (Table).

The highest percentage of sterile forms (at the level of 100%) was observed in s 92 – 1, 78 – 4, 17 – 3, 10 – 3, 86 – 1. These five lines are sterility fixers. Lower percentage, namely 86,1% of sterile plants was formed by sprouts of the line 158 – 4.

Fixing ability of lines – candidates for sterility fixers

№	Sample	Total of plants	Amount of plants		Percent of sterile plants, %
			Fertile	Sterile	
1	86–1	71	0	71	100
2	92–1	49	0	49	100
3	78–4	22	0	22	100
4	10–3	19	0	19	100
5	17–3	17	0	17	100
6	158–4	56	0	48	85,7
7	a10–2	71	16	55	77,5
8	a12–4	53	13	40	75,5
9	a4–4	61	17	44	72,1
10	128–1	47	14	33	70,2

High level of fixing capacity was observed in samples A10 – 2 (77.5%), A12 – 4 (75.5%), a4 – 4 (72.1%), 128 – 1 (70.2%). It should be noted that these sterility fixers had expressed inbred depression.

In the work on creating sterility fixers for various sterile forms of rye should be carefully chosen not only fixers, but also sterile maternal forms with complete sterility $Srf_1rf_1rf_2rf_2$.

Conclusions: Any variety (hybrid) may serve as a material for producing sterility fixers. Using the appropriate combination of interbreeding and conducting analysis of splitting, we can determine the possible proportion of plants with normal

cytoplasm and recessive genes of nucleus.

The study established sterility fixers of winter rye by transferring rf-genes of hybrids on normal plasma of domestic varieties. Selected materials on 100% fix the sterility of the maternal form.

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Создание закрепителей стерильности ржи озимой системы ЦМС Ратра-типа.

В статье приведены приоритетные направления ведения селекции ржи озимой в Украине. Отмечено необходимость создания отечественных гибридов. Определена важная роль цитоплазматической мужской стерильности (ЦМС) в гетерозисной селекции данной культуры.

Отмечено необходимость использования гибридного материала в селекционной схеме при создании закрепителей стерильности. Отражены механизмы переноса rf-генов гибрида на N-плазму сорта путем ручной кастрации и скрещивания кастрированного материала.

Исходными формами для скрещивания служили отечественные сорта и промышленные гибриды.

Приведены результаты исследований по созданию закрепителей стерильности ржи озимой. Доказана возможность создания закрепителей стерильности с использованием отечественного донорного материала.

В результате исследований созданы закрепители стерильности ржи озимой путем переноса rf-генов гибридов на нормальную плазму отечественных сортов. Выделены формы 86 – 1, 92 – 1, 78 – 4, 10 – 3, 17 – 3, которые на 100% закрепляют стерильность материнской формы.

Ключевые слова: рожь озимая, гибрид, закрепитель стерильности, исходный материал.

Pariy F.M., Riybovol Y.S.

Creating of sterility fixers of winter rye CMS system of Ratra type

The article presents the mainstreams of conducting breeding of winter rye in Ukraine. Noted the necessity of domestic hybrids formation. Defined the important role of cytoplasmic male sterility (CMS) in heterosis breeding of the given crop.

Specified the necessity of using of hybrid material in breeding scheme while creating sterility fixers. Reflected transfer mechanisms of rf-gene of hybride on the N-plasma of the sort by means of hand-castration and interbreeding of castrated material.

The initial forms for interbreeding served domestic varieties and manufactured hybrids.

The results of the research of creating of fixers of winter rye sterility are presented. The possibility of creating of sterility fixers using domestic donor material was proved.

As a result of the research the fixers of winter rye was created by means of transfer of rf-gene of hybrides on the normal plasma of domestic varieties. Forms 86 – 1, 92 – 1, 78 – 4, 10 – 3, 17 – 3, which are on 100% fixing the sterility of the maternal form were picked out.

Key words: *winter rye, hybrid, sterility fixer, raw material.*