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INCREASING OF SELECTION FREQUENCY OF STERILITY FIXERS OF SUGAR BEET AND PRODUCTIVITY OF PARENT COMPONENT OF HYBRIDS

In the article there is the method of increase of penetrance of new resulted O types in plant-breedings materials of the Uman selection through rekombigenez with tested after economic-valuable by the signs of existent of sterility maintairnes. A base level of the productivity of new maternal forms is sufficient for introduction of them to hybridization with the purpose of receipt of trial MS hybrids.
***Keywords**: rekombigenez; MS hybrid; O types.*

Introduction. So far the main direction in the selection of sugar beets is creation of hybrids with high heterosis effect through hybridization of pollen sterile parent forms and many-seeded pollinators [1]. For getting them it is necessary to have a collection of sterility fixers and their male sterile (MS) analogues with high baseline parameters of agronomic characteristics. It is necessary to choose special fixers of sterility (FS) called O types by using analyzing crossing in beet populations in order to reproduce a number of consecutive generations of pollen sterile forms with undeveloped androecium [2]. Selective and genetic scheme of getting such sterility fixers was developed and described by Owen in the 40s of the last century [3, 4].

FS plants by phenotype do not differ from normal monoecious plants. Therefore, to determine the genotype of the pollinator (a candidate to FS) can be done only by analyzing the crossing method by using hybrid logistic analysis of the received MS hybrid generation. The purpose of analyzing crossings is to determine the genotype of fertile FS plants and selection of forms with the genotype NXxzz.

There are such ways of getting FS as:

- searching of genotypes which fix sterility in one-seeded self-fertile populations, but the frequency of these plants is extremely low;
- selection of the FS from self-incompatible one-seeded materials by using sibling (sister) crossings and taking heterozygous plants with the gene x and z. This method is common, but it is durable;
- using of deep-inbreeding one-seeded lines which through analyzing crossing are studied by fixing ability;
- using of marker genes linked with characteristic of sterility-fertility of androecium. Such method is restrained with the absent of marker genes and methods of their using [5].

Nxxzz genotypes that have the ability to fix sterility occur in panmictic populations of sugar beet depending on the frequency of alleles x and z with different frequency. The frequency of these genotypes ranged from 0 to 6%, although,

according to different authors it can be much higher (up to 20-30%) [2]. In general, it depends on the genetic structure of population on genes fixing sterility-fertility restoration. Therefore, one of the main objectives which intended to improve the methods of creating the parent form is to increase the frequency of meeting O types in selective material and it is mainly connected with the complexity of the search process. Among them is the pre-mating of one-seeded materials with existing best FS which characterized, in addition to high fixing ability, self-fertility, combining ability, resistance to diseases with the aim to saturate them with the genes that control these characteristics. New recombinant genotypes of FS with a set of selective valuable features are identified in such hybrid forms through analyzing crossing. This method can be considered the most rational at present [6]. However, it is also necessary to study the parent component (FS and their MS equivalent) for basic indexes of yield and sugar content because these parameters have impact on efficiency of MS hybrids made on their basis.

The aim of the research is to improve methods of creating new FS through recombigenesis with existing combinative-valuable materials of Uman selection and to test them by a set of agronomic features.

Materials and methods. The study was conducted at the Institute of Root Crops of NAAS from 2008 to 2011 using analyzing and saturating crossings and method of recombigenesis.

Creating of new fixers of sterility with genotype Nxxzz which combine fixing ability, one-seeded and self-fertility after previous crossings with the best existing FS (OT 12-13) was held by traditional method through searching and selecting individual plants which showed fixing ability among one-seeded varieties-populations. For this aim the research contained 6 selective one-seeded numbers and 4 one-seeded varieties-populations of different gene plasma which were sown in selective seed-plot beforehand. They were estimated through a set of biomorphological characteristics and added to analysing crossings. Such crossings (236 combinations) were conducted under parchment isolation-rotators and twin coarse calico isolation. 2 plants were planted in every twin isolation: one of them was a candidate to sterility fixers (from fertile populations) and another one was from a line with pollen sterility. Seeds were taken from parent forms for further genetic genotype analysis of a candidate to O-type and besides from a fertile plant (for renewal of a genotype). After identification, new FS and their MS analogues were studied through basic efficiency in station progeny tests. The area was 13.5 m2 and repeatability was fourfold [7].

Results and discussion. Modification of method of O-type selecting was developed because genotypes Nxxzz are occurred with low frequency (*Figure*) in home varietal populations. That is why it is necessary to analyse a great number of plants of pollinator (theoretically it is about 10000 and more plants). This method is based on crossing previously selected fixers of sterility with genotype Nxxzz in isolations with fertile one-seeded plants from populations. These materials were estimated by its efficiency, separate fertility and other agronomic characteristics.

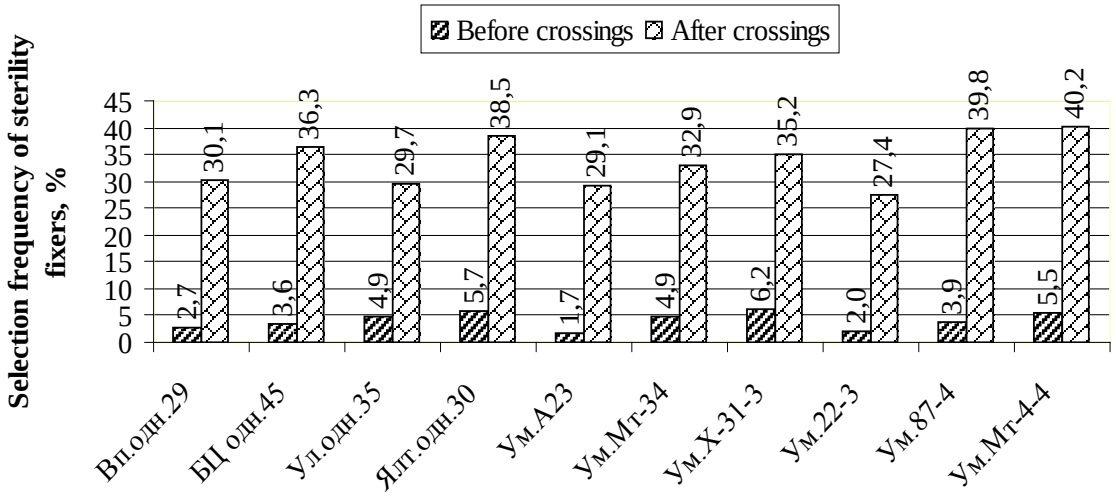

Figure. Comparative frequency analysis of selected FS in selective numbers before and after crossing with number OT 12-13 during 2007-2011

Plant crossing with known genotype Nxxzz (fixing agent) with fertile number OT 12-13 which were previously checked through a set of agronomic characteristics (combining ability, one-seeded, level of sterility fixing, sugar content and others) was conducted. Direct and return hybrids of such pairs are candidates to O types. Under these crossings it is eventuated satiation of genetic structure of fertile plants with recessive genes x and z which condition fixing ability whereupon it can be expected the change of penetration of Nxxzz genotypes.

Thus, frequency of selected O-types in natural populations of one-seeded varieties and one-seeded numbers ranged from 1.7 to 6.2 % (with average index of 4.1 %). It increased significantly and was from 37.4 to 40.2 % while it was 33.9 % among 10 research numbers after previous crossing with O type (selective number OT12-13).

Hereby, selection probability of sterility fixers in these candidates to O-types is rather high that, in general, increases efficiency of selective work with fixers of sterility.

Crop capacity, sugar content and sugar yield in its components – MS lines and O-types was determined in accordance with influence of basic productivity of a parent component to productivity of hybrid in general [8] (*Table*).

According to the table MS forms have higher productivity than FS. It is explained with their relative heterozygosity and lower productivity of FS is interpreted by inbred depression. It indicates that these MS forms in the result of insufficient replacement of their genotype with FS genotype which happens just after the 5th becross generation but they are not their total analogues of sterility.

It is needed to indicate that sugar yield in MS lines was defined more by crop capacity and in FS by sugar content. Sufficient level of basic productivity of parent component lets to expect that in first generation under their crossing with many-seeded pollinators it can be possible to choose experimental hybrids with high competitive heterosis concerning group standard.

Table

Constituent productivity of a parent component of sugar beets during 2007-2010

№	Origin	Productivity			Productivity, % to the standard		
		yield, t/ha	sugar content, %	gathering of sugar t/ha	yield, t/ha	sugar content	gathering of sugar
MS lines							
1	MS 1 239	31.8	16.7	5.3	104.6	98.8	103.1
2	MS 2 141	32.1	16.6	5.3	105.6	98.2	103.5
3	MS 3 33	31.1	16.7	5.2	102.3	98.8	100.8
4	MS 4 132	32.2	16.6	5.4	105.9	98.2	103.9
5	MS 5 565	31.9	16.7	5.3	104.9	98.8	103.5
Fixers of sterility							
6	O type1 239	33.2	16.6	5.5	96.1	100.1	96.8
7	O type2 141	33.7	16.3	5.5	97.1	98.8	96.7
8	O type3 33	34.4	15.9	5.5	99.8	96.4	96.5
9	O type4 132	32.2	16.5	5.3	93.4	100.0	93.7
10	O type5 565	32.4	16.2	5.3	93.9	98.2	92.4
SED_{05}		1.1	0.3	0.4			

Conclusion. Previous crossing of the candidates to O types with complete fixer of sterility tested through agronomic characteristics and selection of new (recombinant) forms with genotype Nxxzz among them increases their penetration in hybrid populations in 8-10 times that positively influences the efficiency of selective work for creating new FS. Basic level of productivity of new made FS and their MS forms is enough for their usage in hybridization with the aim of getting and selection of high-heterosis MS hybrids of sugar beets.

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Анотація

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Підвищення частоти виділення закріплювачів стерильності цукрових буряків і продуктивність материнського компонента гібридів

У статті наведено спосіб підвищення пенетрантності нових О типів у селекційних матеріалах уманської селекції через рекомбігенез з перевіреними за господарсько-цінними ознаками існуючими закріплювачами стерильності. Базисний рівень продуктивності нових материнських форм є достатнім для введення їх у гібридизацію з метою отримання пробних високогетерозисних ЧС гібридів.

***Ключові слова**: рекомбігенез, ЧС гібрид, О типи.*

Аннотация

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Повышение частоты выделения закрепителей стерильности сахарной свеклы и продуктивность материнского компонента гибридов.

В статье приведен способ повышения пенетрантности новых О типов в селекционных материалах уманской селекции на основе рекомбигенеза с проверенными по хозяйственно-ценным признакам существующими закрепителями стерильности. Базисный уровень продуктивности новых материнских форм является достаточным для введения их в гибридизацию с целью получения пробных высокогетерозисных ЧС гибридов.

***Ключевые слова**: рекомбигенез, МС гибрид, О типы.*