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EFFICIENCY OF DIFFERENT CYCLES OF MULTIPLE INDIVIDUAL-FAMILY SELECTION IN THE BREEDING OF MULTI-SPROUT SUGAR BEET POLLINATORS

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The results of multi-year studies on creating combination-capable multi-sprout sugar beet pollinators by multiple individual-family selection are presented. Changes of major economic and valuable features over time at different stages of selection were evaluated. Combination-capable multi-sprout pollinators with high basic productivity have been created.

Key words: *sugar beet, multi-sprout pollinators, line, population, multiple individual-family selection, selection cycle, heterosis, yield, sugar content.*

Introduction. The sugar beet is a major technical crop in the agriculture of Ukraine. An increase in its area in the long run is natural in connection not only with sugar production, but also with the global trend to use raw materials from sugar beet for environmentally friendly biofuel production. Therefore, an increase in the basic potential of the beet industry due to better technical support of production processes, improvement of cultivation technologies and effective introduction of competitive CMS-based sugar beet hybrids into production is one of the most important objectives of the agribusiness development in Ukraine [1, 2].

Literature review and problem articulation. The transfer of the agrarian sector of the national economy to market principles, when the domestic market is open for imports and there are no mechanisms to protect domestic producers, exacerbates competition with foreign breeding companies [3].

Today, many farmers prefer to grow sugar beet hybrids bred in other countries, not taking into account their inadaptability to the agro-climatic conditions of Ukraine. Recently, this has been especially significant in the context of global warming, when air and soil temperatures markedly increase and there are long rainless periods. This, in addition to energy-intensive cultivation of the crop, was also one of the reasons for a significant reduction in the area under sugar beet [1, 4].

Therefore, the urgent objective of the domestic breeding is to find ways to create a new generation of high-yielding sugar beet hybrids, with high adaptability of plants, improved technological qualities of raw materials, suitable for energy- and environmentally friendly cultivation technologies [5, 6]. All this requires further improvement of breeding designs and methods to obtain hybrids" parents, basing on corresponding patterns of inheritance and variability of the most important breeding/genetic traits [7].

In addition, the success of breeding is largely determined by genetic characterization of starting material. At present, there is a need for analysis of integral genetic systems that control a set of traits in one genotype [8, 9]. As a result, these factors contribute to the creation and targeted further use of new starting material to choose high-yielding combinations for crossing, which is a prerequisite for increasing the efficiency of recombination breeding.

Therefore complex programs on sugar beet breeding for heterosis include various methods and desings, which are constantly complicated by changing directions and goals of studies [10]. However, the use of different selection methods to distinguish valuable genotypes, inbreeding forms to create homozygous lines, of controlled crossing systems to assess hybridization components and to identify the best genotypes as well as of optimal designs of hybridization, reproduction and introduction of hybrids in production are basic in breeders" work [11].

The genetic quality and diversity of starting material are important for effective breeding. The limits of its possible improvement in breeding are determined by prevalence of the best genotypes in populations [12]. Elevation in the proportion of plants with a desired genotype increases the efficiency of breeding. Therefore, the effectiveness of breeding to create high-yielding sugar beet hybrids is ensured both by genetic value and diversity of starting material and by knowledge on genetic determination of economically valuable traits and patterns of their inheritance [13, 14].

Accordingly, genetic analysis of parents is used for genetic regulation of the performance and its elements, which are quantitative traits, as well as for planning rational breeding programs on the creation of CMS-based hybrids. This analysis is based on their evaluation for a whole set of traits, high levels of which mean a stable heterosis effect in the first-generation hybrids [8].

In the traditional breeding for heterosis, the creation of combination-valuable cytoplasmic male sterility-based parents of hybrids is the most pressing problem. Until recently, the prevailing opinion was that the performance of CMS-based sugar beet hybrids is mainly determined by the breeding value of a female component: its performance, combining ability, dioecism, sterility degree, resistance to disease, etc. However, as practice shows, a significant role in creating high-yielding CMS-based sugar beet hybrids is also played by the quality of a multi-sprout pollinator [15, 16].

Multiple individual-family selection is an effective method to create combination-capable multi-sprout sugar beet pollinators [17]. Using this method, narrow-family material, close to lines, with a low inbreeding coefficient, but with high morphological homogeneity, with slightly reduced root yield and almost without reduction in sugar content, is created within three to four generations. Such material can be used as sources of valuable genotypes - ancestors of lines and also directly as pollinators to derive CMS-based sugar beet hybrids.

Our purpose was to create multi-sprout sugar beet pollinators with a narrowed genetic basis, to assess their performance and combining ability over time at different stages of multiple individual-family selection.

Materials and methods. The studies were conducted at the Tobacco Research Station of the NSC «Institute of Agriculture of NAAS» by scientists of the Laboratory of Sugar Beet Breeding in 2009–2020 (Cherkaska Oblast, Uman). Seven diploid multi-sprout sugar beet populations bred in Ukraine were taken as starting material. New multi-sprout pollinators were obtained by multiple individual-family selection. Breeding accessions were tested by the method developed by scientists of the Institute of Bioenergy Crops and Sugar Beet of NAAS [18]. The experiments were carried out in three replications; the record area was 10.8 m^2. The plots were arranged randomly. Three domestic sugar beet hybrids, Bulava, Zluka and Atlant, were used as group references. The GCA was evaluated using unidirectional cyclic crosses on the basis of three CMS-testers. Data were statistically processed, as Dospekhov BA described [19].

Results and discussion. Due to multiple individual-family selection of plant biotypes that were the best in terms of several economically valuable traits, new genotypes of multi-sprout sugar beet pollinators of different selection cycles were obtained and the changes in their basic productivity over time were studied (Fig. 1).

The studies (2009–2020) demonstrated the high efficiency of two or three cycles of individual-family selection to increase the root yields of the multi-sprout sugar beet pollinators.

The root yield increased by 11.7% after two selection cycles and by 13.5% after three selection cycles compared to the original populations. That is, during two – three cycles of continuous individual-family selection, there was a general upward trend in the percentage of high-yielding plant biotypes in the sugar beet breeding material.

Subsequent selection cycles (four and five) were less effective due to inbreeding depression. After four and five selections, the yields of the multi-sprout pollinators were 106.3% and 98.2%, respectively, related to the original populations. A slightly different trend was observed for the sugar content in roots. After four and five selection cycles, the multi-sprout pollinators had the highest content of sugar in roots: 121.6% and 119.5%, respectively, related to the original populations.

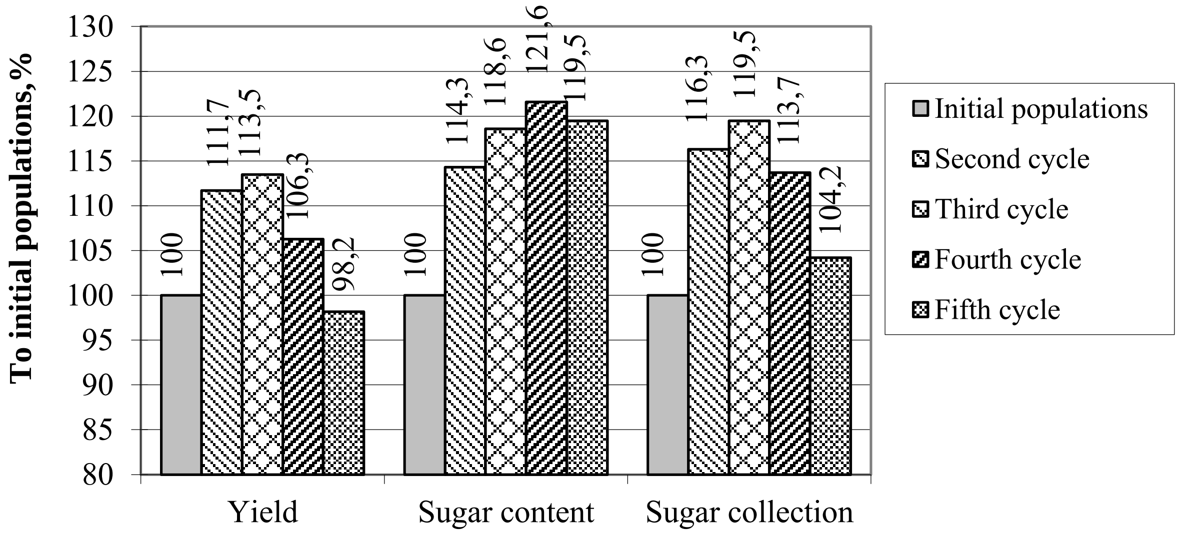

Fig. 1. Performance traits over time in multi-sprout sugar beet pollinators of different cycles of multiple individual-family selection in comparison with the original populations, 2009–2020.

As to the compound trait of «sugar collection», the highest productivity in the multi-sprout pollinators was observed after three selection cycles (119.5%). In subsequent cycles of selection, this parameter decreased.

All this indicates that it is possible to obtain high-yielding breeding material of multi-sprout diploid sugar beet pollinators of early inbreeding generations, which can be used both for selection of valuable genotypes - ancestors of lines and directly as parents of competitive CMS-based hybrids, within two or three cycles of continuous individual-family selection.

However, it should be noted that basic indicators of high performance in parents are not always inherited by their hybrids. Therefore, it is necessary to study the behavior of forms with different genetic structure and origin in crossing and to assess their phenotypic expression in hybrids.

Evaluation of the hybridization potential of the multi-sprout pollinators from different selection cycles showed that the selection multiplicity had a little effect on their combining ability. This is a hereditary trait that is passed down through generations and depends on the genotype of starting. Stably, over all the study years, a high level of the general combining ability was intrinsic to diploid multi-sprout pollinators derived from the following original populations: BZ 15F/19, BZ 76-27/25, and BZ 1729-77/18 (Table 1).

Table 1

Effects of the general combining ability (GCA) of diploid multi-sprout pollinators from different selection cycles, 2012–2020

Tribal designation	GCA effects for							
	root yield				sugar content			
	Number of selection cycles							
	2	3	4	5	2	3	4	5
BZ 33/812	-3.22	-2.91	-2.61	-2.82	+0.15	+0.15	+0.31	0.26
BZ 1729-77/18	+2.02	+2.17	+2.01	+2.11	+0.27	+0.27	+0.21	+0.22
BZ Yu 7/52-27	-2.72	-2.88	-3.17	-3.14	-0.44	-0.44	-0.37	-0.40
BZ 1710-19/15	+0.94	+0.99	+1.19	+0.98	-0.18	-0.25	-0.33	-0.28
BZ 76-27/25	+3.04	+2.56	+3.09	+3.12	+0.31	+2.34	+0.22	+0.29
BZ1705-44/33	-3.50	-2.94	-2.95	-2.85	-0.33	-0.30	-0.29	-0.31
BZ 15F/19	+3.44	+3.01	+2.44	+2.60	+0.22	+0.23	+0.25	+0.22
LSD_{05}	*0.71*	*0.61*	*0.54*	*0.64*	*0.07*	*0.08*	*0.07*	*0.09*

However, as breeding practice shows, it is impossible to obtain high-yielding CMS-based sugar beet hybrids, which would successfully compete with the best domestic and foreign accessions, only due to the hybridization potential of parents, without taking into account their basic productivity. In the sugar beet, this is primarily due to different genetic control of the «root yield» and «sugar content»traits and the nature of their inheritance by hybrids from parents of different genetic structure.

Owing to the 2009–2020 studies, the best multi-sprout pollinators of selection cycle 3, with optimal combinations of the most significant breeding-genetic and economically valuable traits, were obtained and distinguished (Table 2).

Table 2

Performance and technological quality of roots from the best multi-sprout sugar beet pollinators of individual-family selection cycle 3, 2018–2020

Pollinator code	Yield, t/ha	Sugar content, %	Sugar collection, t/ha	Sugar output, t/ha	% to the group reference			
					Yield	Sugar content	Sugar collect lection	Sugar output
BZ 76–5–214	48.7	20.1	9.79	8.50	113.5	102.9	117.0	119.0
BZ 76–5–262	48.2	19.7	9.50	8.14	112.3	100.9	113.5	114.0
BZ 76–5–268	46.4	19.7	9.14	7.82	108.2	101.0	109.2	109.5
BZ 76–5–281	49.3	20.1	9.91	8.66	115.0	102.9	118.4	121.3
BZ 1729–5–221	48.0	19.2	9.22	7.82	111.9	98.6	110.2	109.5
BZ 1729–5–225	48.9	20.2	9.88	8.64	114.0	103.8	118.0	121.0
BZ 1729–5–252	49.9	20.0	9.98	8.70	116.3	102.4	119.2	121.8
BZ 15F–5–200	49.0	19.9	9.75	8.35	114.2	102.0	116.5	116.9
BZ 15F –3–89	49.8	19.6	9.76	8.38	116.0	100.6	116.6	117.4
BZ 15F –3–90	48.0	20.6	9.89	8.67	111.9	105.5	118.2	121.4
St gr.	42.9	19.5	8.37	7.14	–	–	–	–
LSD_{05}	*2.76*	*0.52*	*0.46*	*0.45*	–	–	–	–

The yield and sugar content in roots of the best diploid multi-sprout sugar beet pollinators varied between 108.2–116.3% and 98.6–105.5%, respectively, related to the group reference. As to the sugar collection and output, they exceeded the group reference by 9.2–19.2% and 9.5–21.8%, respectively.

Conclusions. In the 2009–2020 studies, the changes in the performance characteristics of the multi-sprout sugar beet pollinators from different cycles of multiple individual-family selection were investigated over time. The highest basic productivity was seen in the multi-sprout pollinators from selection cycle 3, which should be used both as sources of valuable genotypes – ancestors of lines and directly as parents of hybrids. Ten highly productive multi-sprout sugar beet pollinators with the optimal combinations of the most significant breeding-genetic traits have been created.

Список використаних джерел

1. Роїк М.В. Буряки. Київ: ХХІ, 2001. 320 с.
2. Саблук П.Т., Коденська М.Ю., Власов В.І. Цукробурякове виробництво України: проблеми відродження, перспективи розвитку. Київ: ННЦ ІАЕ, 2007. 390 с.
3. Томашевська О.А., Петриняк Н. С. Проблеми розвитку та підвищення економічної ефективності виробництва цукрових буряків. *Проблеми економіки*. 2017. № 2. С. 347–352.
4. Данилишин М.С. Ефективність діяльності бурякоцукрової галузі України. *Економіка та держава*. 2016. № 1. С.108–111.

5. Роїк М.В., Корнєєва М.О., Дубчак О.В., Вакуленко П.І., Андрєєва Л.С. Створення моделі гібридів цукрових буряків нового покоління. Методичні рекомендації. Київ: ІБК і ЦБ, 2015. 20 с.
6. Роїк М.В., Присяжнюк О.І., Кононюк Н.О., Кулик О.Г. Особливості формування продуктивності гібридів буряків цукрових вітчизняної селекції. *Сортовивчення та охорона прав на сорти рослин*. 2020. № 16(3). С. 277–283. https://doi.org/10.21498/2518-1017.16.3.2020.214929.
7. Корнєєва М.О. Чемерис Л.М., Мацук М.Б. Добір запилювачів для селекції високоцукристих гібридів буряків цукрових з підвищеним адаптивним потенціалом. *Вісник аграрної науки*. 2012. № 11. С. 46–48.
8. Роїк М. ., Корнєєва М.О. Селекція буряків цукрових. Спеціальна селекція польових культур. За ред. М.Я. Молоцького. Біла Церква, 2010. С. 280–285.
9. Biancardi E., Campbell L., Biaggi M. Genetics and breeding of sugar beet. Science Publishers. USA. 2005. P. 173–206.
10. Richardson K. Traditional breeding in sugar beet. *Sugar Tech*. 2010. V. 12 (3–4). P. 181–186. DOI:10.1007/s12355-010-0050-4.
11. Корнєєва М.О., Власюк М.В. Системи контрольованих схрещувань при оцінці комбінаційної здатності селекційних матеріалів цукрових буряків. *Фактори експериментальної еволюції організмів.* Київ: Аграрна наука. 2003. С. 227–233.
12. Frese L., Desprez B., Ziegler D. Potential of genetic resources and breeding strategies for base-broadening in Beta. Broadening the genetic base of crop production. Ed.Cooper H.D., Spillane C., Hodgkin T. UK: Wallingford, 2001. P. 295–309. DOI: 10.1079/9780851994116.0295.
13. Генетические основы селекции растений. Т.2. Частная селекция растений/ науч. ред. А.В. Кильчевский, Л.В. Хотылева. Минск, 2010. 579 с.
14. Корниенко А.В., Моргун А.В., Труш С.Г. Селекция свеклы на гетерозис (*Beta vulgaris* L.). Воронеж, 2007. 255 с.
15. Роик Н.В., Корнеева М.А. Комбинационная способность опылителей сахарной свеклы различной генетической структуры по элементам продуктивности. Энциклопедия рода Beta: Биология, генетика и селекция свеклы. Новосибирск: Сова, 2010. С. 525–541.
16. Hassani M., Heidari B., Stevanato P. Combining abilities of sugar beet genotypes for root- and sugar-related traits under multi-environment trials. *Plant Breeding*. 2019. V. 139. No 1. P. 192–206.
17. Балков И.Я. Селекция сахарной свеклы на гетерозис. Москва: Россельхозиздат, 1978. 167 с.
18. Роїк М.В., Гізбуллін Н.Г., Сінченко В.М., Присяжнюк О.І. та ін. Методики проведення досліджень у буряківництві. Київ: ФОП Корзун Д. Ю., 2014. 374 с.
19. Доспехов Б.А. Методика полевого опыта с основами статистической обработки результатов исследований. Москва: Агропромиздат, 1985. 351 с.

References

1. Royik MV. Beets. Kyiv: XXI, 2001. 320 p.
2. Sabluk PT, Kodenska M.Yu., Vlasov VI. Sugar beet production of Ukraine: problems of revival, prospects of development. Kyiv: NSC IAE, 2007. 390 p.
3. Tomashevska OA, Petrynyak NS. Problems of development and increase of economic efficiency of sugar beet production. Problemy ekonomiky. 2017; 2: 347–352.
4. Danylyshyn MS. Efficiency of activity of sugar beet industry of Ukraine. Ekonomika ta derzhava. 2016; 1: 108–111.
5. Royik MV, Korneeva MO, Dubchak OV, Vakulenko PI, Andreeva LS. Creating a model of new generation sugar beet hybrids. Metodychni rekomendaciyi. Kyiv: IBK I CB, 2015. 20 p.
6. Royik MV, Prysyazhnyuk OI, Kononyuk NO, Kulik OG. Features of formation of productivity of hybrids of sugar beets of domestic selection. Sortovyvchennya ta okhorona prav na sorty roslyn. 2020; 16 (3): 277–283.

7. Korneeva MO, Chemeris LM, Matsuk MB. Selection of pollinators for selection of high-sugar hybrids of sugar beets with high adaptive potential. Visnyk agrarnoyi nauky. 2012; 11: 46–48.
8. Royik MV, Korneeva MO. Selection of sugar beets. In: Special selection of field crops. Molotsky MYa, ed. Bila Tserkva, 2010. P. 280–285.
9. Biancardi E, Campbell L, Biaggi M. Genetics and Breeding of Sugar Beet. Science Publishers. USA. 2005. P.173–206.
10. Richardson K. Traditional Breeding in Sugar Beet. Sugar Tech. 2010; 12(3–4): 181–186.
11. Korneeva MO, Vlasyuk MV. Systems of controlled crosses in assessing the combination ability of breeding materials of sugar beets. Faktory eksperymentalnoyi evolyutsiyi orhanizmiv. Kyiv: Agrarna nauka, 2003. P. 227–233.
12. Frese L, Desprez B, Ziegler D. Potential of genetic resources and breeding strategies for base-broadening in Beta. In: Cooper HD, Spillane C, Hodgkin T, editors. Broadening the genetic base of crop production. UK: Wallingford, 2001. P. 295–309.
13. Genetic bases of plant selection. Vol.2. Private selection of plants. Kilchevsky AV, Khotyleva LV, editors. Minsk, 2010. 579 p.
14. Korniyenko AV, Morhun AV, Trush SH. Selection of beets for heterosis (*Beta vulgaris* L.). Voronezh, 2007. 255 p.
15. Roik NV, Korneeva MA. Combination ability of sugar beet pollinators of different genetic structure by elements of productivity. In: Encyclopedia of the genus Beta: Biology, genetics and selection of beets. Maletsky SI, ed. Novosibirsk: Sova, 2010. P. 525–541.
16. Hassani M, Heidari B, Stevanato P. Combining abilities of sugar beet genotypes for root-and sugar-related traits under multi-environment trials. Plant Breeding. 2019; 139(1): 192–206.
17. Balkov IYa. Selection of sugar beet for heterosis. Moscow: Rosselkhozizdat. 1978. 167 p.
18. Royik MV, Gisbullin NG, Sinchenko VM, Prysiazhnyuk OI. Methods of research in beet growing. Kyiv: FOP Korzun DYu, 2014. 374 p.
19. Dospehov BA. Methods of field experiments with the basic of statistical procesing of research resalts. Moscow: Agropromizdat, 1985. 351 p.

ЕФЕКТИВНІСТЬ РІЗНИХ ЦИКЛІВ БАГАТОРАЗОВОГО ІНДИВІДУАЛЬНО-РОДИННОГО ДОБОРУ В СЕЛЕКЦІЇ БАГАТОРОСТКОВИХ ЗАПИЛЮВАЧІВ БУРЯКІВ ЦУКРОВИХ

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Мета досліджень – створення багаторосткових запилювачів буряків цукрових зі звуженою генетичною основою, оцінка динаміки їх продуктивності та комбінаційної здатності на різних етапах багаторазового індивідуально-родинного добору.

Матеріали і методика досліджень. Дослідження проводилися на Дослідній станції тютюнництва ННЦ «ІЗ НААН» в лабораторії селекції буряків цукрових у 2009–2020 рр. Вихідним матеріалом слугували сім диплоїдних багаторосткових популяцій буряків цукрових вітчизняної селекції. Створення нових багаторосткових запилювачів здійснено з використанням багаторазового індивідуально-родинного добору. Сортовипробування селекційних зразків виконано за методикою, розробленою науковцями ІБК і ЦБ НААН. Оцінку ЗКЗ проведено за схемою односторонніх циклічних схрещувань на основі трьох ЦЧС-тестерів.

Обговорення результатів. За результатами досліджень встановлено високу ефективність двох-трьох циклів індивідуально-родинного добору в підвищенні врожайності коренеплодів багаторосткових запилювачів буряків цукрових. Після дворазового добору врожайність коренеплодів зросла на 11,7 %, а триразового – 13,5 % порівняно з вихідними популяціями. Наступні цикли добору (четвертий-п"ятий) за відповідною ознакою ви-

явилися менш ефективними, внаслідок прояву інбредної депресії. За чотириразового добору врожайність багатоThere росткових запилювачів становила 106,3 %, а п‟ятиразового 98,2 % до вихідних популяцій. Найвищою цукристістю коренеплодів характеризувалися багаторосткові запилювачі четвертого-п‟ятого циклів добору. Їх показники становили 121,6 % і 119,5 % до вихідних популяцій, відповідно.

За комплексною ознакою «збір цукру» найвища продуктивність у багаторосткових запилювачів спостерігалася за триразового добору (119,5 %). У наступних циклах добору цей показник знижувався.

Показники врожайності та цукристості коренеплодів кращих диплоїдних багаторосткових запилювачів буряків цукрових варіювали в межах 108,2–116,3 % і 98,6–105,5 % до групового стандарту. За збором і виходом цукру вони перевищували відповідні показники групового стандарту на 9,2–19,2 % і 9,5–21,8 %.

Висновки. За результатами досліджень вивчено динаміку зміни ознак продуктивності багаторосткових запилювачів буряків цукрових різних циклів багаторазового індивідуально-родинного добору. Встановлено, що найвищою базовою продуктивністю характеризуються багаторосткові запилювачі третього циклу добору, які доцільно використовувати як джерела цінних генотипів-родоначальників ліній, а також безпосередньо в якості батьківських компонентів гібридів. Створено 10 високопродуктивних багаторосткових запилювачів буряків цукрових з оптимальним поєднанням найбільш значимих селекційно-генетичних ознак.

Ключові слова: *буряки цукрові, багаторосткові запилювачі, лінія, популяція, багаторазовий індивідуально-родинний добір, цикл добору, гетерозис, урожайність, цукристість.*

ЭФФЕКТИВНОСТЬ РАЗЛИЧНЫХ ЦИКЛОВ МНОГОКРАТНОГО ИНДИВИДУАЛЬНО-СЕМЕЙСТВЕННОГО ОТБОРА В СЕЛЕКЦИИ МНОГОРОСТКОВЫХ ОПЫЛИТЕЛЕЙ САХАРНОЙ СВЕКЛЫ

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Цель исследований – создание многоростковых опылителей сахарной свеклы со суженной генетической основой, оценка динамики их продуктивности и комбинационной способности на разных этапах многократного индивидуально-семейственного отбора.

Материалы и методика исследований. Исследования проводились на Опытной станции табаководства ННЦ «ИЗ НААН» в лаборатории селекции сахарной свеклы в 2009–2020 гг. Исходным материалом служили семь диплоидных многоростковых популяций сахарной свеклы отечественной селекции. Создание новых многоростковых опылителей осуществлено с использованием многократного индивидуально- семейственного отбора. Сортоиспытания селекционных образцов выполнено по методике, разработанной учеными ИБК и СС НААН. Оценка ОКС проведена по схеме односторонних циклических скрещиваний на основе трех ЦМС-тестеров.

Обсуждение результатов. По результатам исследований установлена высокая эффективность двух-трех циклов индивидуально-семейственного отбора в повышении урожайности корнеплодов многоростковых опылителей сахарной свеклы. После двукратного отбора урожайность корнеплодов выросла на 11,7 %, а трехкратного – 13,5 % по сравнению с исходными популяциями. Следующие циклы отбора (четвертый-пятый) по соответствующему признаку оказались менее эффективными, в результате проявления инбредной депрессии. При четырехкратном отборе урожайность многоростковых опылителей составила 106,3 %, а пятикратного 98,2 % до исходных популяций. Самой высокой сахаристостью корнеплодов характеризовались многоростковые опылители четвертого-

пятого циклов отбора. Их показатели составили 121,6 % и 119,5 % к исходным популяциям, соответственно.

По комплексному признаку «сбор сахара» самая высокая продуктивность многоростковых опылителей наблюдалась при трехкратном отборе (119,5 %). В следующих циклах отбора этот показатель снижался.

Показатели урожайности и сахаристости корнеплодов лучших диплоидных многоростковых опылителей сахарной свеклы варьировали в пределах 108,2–116,3 % и 98,6–105,5 % к групповому стандарту. По сбору и выходу сахара они превышали соответствующие показатели группового стандарта на 9,2–19,2 % и 9,5–21,8 %.

Выводы. По результатам исследований изучена динамика изменения признаков продуктивности многоростковых опылителей сахарной свеклы различных циклов многократного индивидуального-семейственного отбора. Установлено, что самой высокой базовой продуктивностью характеризуются многоростковые опылители третьего цикла отбора, которые целесообразно использовать в качестве источника ценных генотипов-родоначальников линий, а также непосредственно в качестве родительских компонентов гибридов. Создано 10 высокопродуктивных многоростковых опылителей сахарной свеклы с оптимальным сочетанием наиболее значимых селекционно-генетических признаков.

Ключевые слова: *сахарная свекла, многоростковые опылители, линия, популяция, многократный индивидуального-семейственный отбор, цикл отбора, гетерозис, урожайность, сахаристость.*

EFFICIENCY OF DIFFERENT CYCLES OF MULTIPLE INDIVIDUAL-FAMILY SELECTION IN THE BREEDING OF MULTI-SPROUT SUGAR BEET POLLINATORS

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Purpose. To create multi-sprout sugar beet pollinators with a narrowed genetic basis, to assess their productivity and combining ability over time at different stages of multiple individual-family selection.

Materials and methods. The studies were conducted at the Tobacco Experimental Station of the National Research Center «Institute of Agriculture of NAAS» in the Laboratory of Sugar Beet Breeding in 2009–2020. Seven diploid multi-sprout sugar beet populations bred in Ukraine were taken as starting material. New multi-sprout pollinators were obtained by multiple individual-family selection. Breeding accessions were tested by the method developed by scientists of the Institute of Bioenergy Crops and Sugar Beet of NAAS. The GCA was evaluated using unidirectional cyclic crosses on the basis of three CMS-testers.

Results and discussion. The results demonstrated a high efficiency of two and three cycles of individual-family selection for increasing the root yields of the multi-sprout sugar beet pollinators. The root yields increased by 11.7% and 13.5% after two and three selection cycles, respectively, related to the original populations. Subsequent selection cycles (four and five) were less effective due to inbreeding depression. The yields of the multi-sprout pollinators was 106.3% and 98.2% after four and five selection cycles, respectively, related to the original populations. The multi-sprout pollinators from selection cycles four and five had the highest sugar content in roots: 121.6% and 119.5%, respectively, related to the original populations.

As to the compound trait of «sugar collection», the highest productivity in the multi-sprout pollinators was observed after three selection cycles (119.5%). In subsequent cycles of selection, this parameter decreased.

The yield and sugar content in roots of the best diploid multi-sprout sugar beet pollinators varied between 108.2–116.3% and 98.6–105.5%, respectively, related to the group reference. As to the sugar collection and output, they exceeded the group reference by 9.2–19.2% and 9.5–21.8%, respectively.

Conclusions. In the 2009–2020 studies, the changes in the performance characteristics of the multi-sprout sugar beet pollinators from different cycles of multiple individual-family selection were investigated over time. The highest basic productivity was seen in the multi-sprout pollinators from selection cycle 3, which should be used both as sources of valuable genotypes – ancestors of lines and directly as parents of hybrids. Ten highly productive multi-sprout sugar beet pollinators with the optimal combinations of the most significant breeding-genetic traits have been created.

Key words: *sugar beet, multi-sprout pollinators, line, population, multiple individual-family selection, selection cycle, heterosis, yield, sugar content.*