

ISSN 2518-1483 (Online),  
ISSN 2224-5227 (Print)

2021 • 2

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ  
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ  
**БАЯНДАМАЛАРЫ**

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НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК  
РЕСПУБЛИКИ КАЗАХСТАН

**REPORTS**

OF THE NATIONAL ACADEMY OF SCIENCES  
OF THE REPUBLIC OF KAZAKHSTAN

PUBLISHED SINCE 1944



ALMATY, NAS RK

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«Қазақстан Республикасы Ұлттық ғылым академиясының баяндамалары»

ISSN 2518-1483 (Online),

ISSN 2224-5227 (Print)

Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» Республикалық қоғамдық бірлестігі (Алматы қ.).

Қазақстан Республикасының Ақпарат және қоғамдық даму министрлігінің Ақпарат комитетінде 29.07.2020 ж. берілген № KZ93VPY00025418 мерзімдік басылым тіркеуіне қойылу туралы куәлік.

**Тақырыптық бағыты: наноматериалдар алу, биотехнология және экология саласындағы бірегей зерттеу нәтижелерін жариялау.**

Мерзімділігі: жылына 6 рет.

Тиражы: 300 дана.

Редакцияның мекен-жайы: 050010, Алматы қ., Шевченко көш., 28; 219 бөл.; тел.: 272-13-19, 272-13-18

<http://reports-science.kz/index.php/en/archive>

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Типографияның мекен-жайы: «Аруна» ЖК, Алматы қ., Муратбаева көш., 75.

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**Доклады Национальной академии наук Республики Казахстан»**  
**ISSN 2518-1483 (Online),**  
**ISSN 2224-5227 (Print)**

Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан» (г. Алматы).

Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и общественного развития Республики Казахстан № KZ93VPY00025418, выданное 29.07.2020 г.

**Тематическая направленность:** *публикация оригинальных результатов исследований в области получения наноматериалов, биотехнологии и экологии.*

Периодичность: 6 раз в год.  
Тираж: 300 экземпляров

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28; ком. 219; тел. 272-13-19, 272-13-18

<http://reports-science.kz/index.php/en/archive>

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Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75.

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Owner: RPA "National Academy of Sciences of the Republic of Kazakhstan" (Almaty).

The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Social Development of the Republic of Kazakhstan No. **KZ93VPY00025418**, issued 29.07.2020.**Thematic scope:** *publication of original research results in the field of obtaining nanomaterials, biotechnology and ecology.*

Periodicity: 6 times a year.

Circulation: 300 copies.

Editorial address: 28, Shevchenko str., of. 219, Almaty, 050010, tel. 272-13-19, 272-13-18

<http://reports-science.kz/index.php/en/archive>

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Address of printing house: ST "Aruna", 75, Muratbayev str., Almaty.

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## EFFICIENCY APPLICATIONS OF DOMESTIC PUMPKIN ROOTSTOCKS FOR GRAFTING CUCUMBER IN PROTECTED GROUND

**Abstract.** When growing herbaceous vegetable crops in the world practice, great importance is given to the use of grafting method. The development of environmentally safe methods to increase the yield and resistance of plants to adverse growing conditions is very relevant in vegetable production. One such method in pumpkin crops is grafting. The aim of our work was to study the effect of domestic pumpkin rootstock on growth, development and yield characteristics of cucumber hybrid using grafting method. Grafting on pumpkin species improved the growth and development of plants depending on the rootstock, compared with rootstock plants. The aim of our research was to study the influence of domestic pumpkin rootstock on the growth, development and yield characteristics of the cucumber hybrid (*scion*). As a scion, the variety (*Asylum*), recommended for cultivation in protected ground conditions, was used, which was grafted on five domestic rootstocks: 1 (*Mozoleevskaya 10*), 2 (*Karina*), 3 (*Aphrodite*), 4 (*Mindalnaya*) and Russian selection 5 (*Stofuntovaya*) pumpkins from vegetable and melon crops. According to the generally accepted method, the graft was grafted (cucumber *Asylum*) on the rootstocks of pumpkin. Using a sample of pumpkin 1 (*Mozoleevskaya 10*), flowering began on the fifth day earlier in comparison with non-grafted plants, and when grafting on a sample of pumpkin 4 (*Aphrodite*), the fruit ripened earlier by six days. To get the greatest increase in early productivity by 30%, it is possible to use both rootstocks. A significant increase in total yield was provided by samples of rootstocks 2 (*Karina*) – 3.9 kg/m<sup>2</sup> and 3 (*Stofuntovaya*) - 8.0 kg/m<sup>2</sup>. The grafted cucumber plants with all the rootstocks used were superior to the root ones in height, in terms of the percentage of marketability of fruits and in terms of fruit weight. At the beginning of fruiting on grafted cucumber plants, the number of female flowers increased depending on the sample. In all grafted plants, the dry matter content in the fruit increased significantly. Because of our research, rootstocks 2 (*Karina*) and 3 (*Stofuntovaya*) were noted, which are recommended for use in further research breeding work and the production of grafted plants.

**Key words:** pumpkin, cucumber, grafting, rootstocks, scion, protected ground.

**Introduction.** Cucumber occupies a special place among vegetables. It is one of the few plants that people eat the fruits of when they are unripe. This feature is also associated with the name of the vegetable: the Greeks called the fruit "aoros" - unripe, immature. Took from him the word "augury", and then Russian "cucumber".

The nutritional value of cucumbers is low, but, thanks to their taste qualities, they have remained popular since time immemorial. This plant is one of the few whose fruits are used in a nutritious diet. This feature is also associated with the name of the vegetable: the Greeks called the fruit "aoros" - unripe. The nutritional value of cucumber is not in its nutritional value but in the content of enzymes and mineral salts necessary for better assimilation of other foods. They improve appetite, promote the assimilation of other foods, and are of dietary importance.

In terms of the amount of organic water (95-97%), it surpasses all other vegetables. Fruits contain 4-5% dry matter, including sugars, protein substances, fats, fibre, vitamins, ascorbic acid, provitamin "A", group "B", biotin, folic, nicotinic and pantothenic acids, salts of potassium, sodium, iron, magnesium, zinc, iodine, silver and other useful substances. In this regard, fresh cucumber fruits are of great importance in the nutrition of the population [1].

Cucumber (*Cucumis sativus L.*) is one of the main vegetable crops of protected soil. However, the yield of cucumber remains at a low level. One of the reasons for the low yield in protected soil is a complex of unfavorable abiotic and biotic factors that often develop during the cultivation of plants.

They are especially noticeable when growing cucumbers on the ground. Therefore, the protection of plants in protected ground during the intensification of production involves the use of a large number of pesticides that reduce environmental safety. Currently, the search for new highly effective and environmentally friendly methods to increase plant resistance to adverse growing conditions is promising, as it acts as a basis for the development of cost-effective and long-term pest and disease control programs. One of these methods is grafting on resistant rootstocks [2].

Vegetable growers are faced with the task of increasing the productivity of vegetable crops in the face of the negative impact of biotic and abiotic factors. Vegetable crops are most susceptible to this effect. One of the modern methods of preventing diseases and growing vegetable crops with minimal use of chemicals is ensuring the needs of plants in water and mineral nutrition due to a stable rootstock with a strong root system is the grafting method. In foreign countries, various vaccinations are successfully used for these purposes, as well as for growing strong seedlings. Using this method is cost-effective, and allows you to earn income from the sale of products [3]. Grafting is one of the ways to propagate plants and increase their resistance to adverse environmental conditions. Grafting can be carried out on both fruit and vegetable plants. For vegetables, it began to be used at the beginning of the last century. This process is time-consuming, while the method allows you to increase the yield of fruits.

Grafting technology in vegetable crops is a significant component of the vegetable industry worldwide. Melon crops such as cucumbers, watermelons and melons are grafted for growing in greenhouses. The goal of grafting vegetables is to improve growth and yield by promoting nutrient uptake and increasing resistance to abiotic stresses, soil pests and pathogens [4].

Cucumber (*Cucumis Sativus L.*) Is one of the main vegetables grown in both open and sheltered ground conditions in china, and its excellent cultivation is highly dependent on grafting due to its fragile roots and sensitivity to unsuitable growing conditions. Studies have shown that pumpkin (*Cucurbita L.*) Is an important rootstock for cucumber to improve yield and fruit quality, as well as increase both disease resistance and stress resistance [5]. Although grafting is a widely used technique and is well established, there may be a lack of compatibility between grafting partners, resulting in low survival, weak growth, or even a lack of flowering, which can lead to serious economic losses. The compatibility of the graft directly affects the effectiveness of the graft, so a good affinity of the graft between the rootstock and the graft is a prerequisite for grafting. Graft compatibility, in general, can be defined as the establishment of a successful graft union (going through normal graft union healing, growth, flowering and fruiting after grafting) and the proper functioning of the composite, grafted plant, as well as extended survival [6].

Grafting on vegetables is one of the methods of propagating plants and increasing their resistance to adverse environmental factors. There are many ways to graft vegetable crops. Due to the widespread use of grafting by vegetable growers in Western Europe and Southeast Asia, interest in this method has recently increased [7]. About 95% of watermelons in South Korea and Japan are cultivated on different rootstocks, more than half of cucumbers - in the open ground and 30% - in protected. The method of grafting is widely used in Europe, especially in the Netherlands [8].

For vegetable crops, it was developed and used only in the early twentieth century. Scientists have found that well-developed root systems of some species used as rootstocks provide a high and stable yield of vegetables in the open ground. At the same time, the growing season of grafted plants has reduced and their yield has significantly increased. According to Russian scientist-vegetable grower S. P. Lebedev, the growing season of melon grafting on pumpkin has reduced by 15-30 days and its yield and resistance to cold have significantly increased [9]. Although the vaccine appeared in Russia and Ukraine and did not have a wide industrial application, all experiments on vaccination continue today. One of the famous scientific breeders who used the method of grafting in our country is Michurin Ivan Vladimirovich. He used various methods of tillage, fertilization, and the mentoring method. The method of the mentor (educator) is that in the crown of a hybrid seedling, you can form a scion from the plant and the properties pass to the hybrid. Sometimes you can graft a hybrid on the appropriate rootstock [10].

Cucumbers can be stored fresh all year round. To increase the fruiting period of cucumbers, we decided to try to graft cucumbers on a pumpkin. Pumpkin, unlike cucumber, has a more powerful root system due to this, the grafted cucumber receives more nutrients, becomes less capricious. Pumpkin is less susceptible to fungal diseases. Grafting cucumber on cold-resistant varieties of pumpkin, you can extend the fruiting period of cucumbers. When used as a pumpkin rootstock, cucumber plants receive enhanced nutrition; they are easier to tolerate short-term cold spells [11]. Grafted cucumber plants grow faster, develop better, and are more resistant to diseases and pests.

Cucumber occupies about 60 - 70% of the area in the protected ground. This is one of the most cost-effective crops of protected soil. Cucumber is widely distributed due to its high precocity, shade tolerance, yield and the ability to get fresh fruits almost all year round. Despite the fact that 97 % of the vegetable is pure structured water, the remaining 3 % concentrated a unique set of substances. Trace elements of iron, sodium, magnesium, zinc and phosphorus have a beneficial effect on all organ systems [12].

One of the most effective and environmentally friendly methods of increasing the yield and resistance of plants to adverse growing conditions is grafting on resistant rootstocks. Therefore, the study of the influence of the rootstock type on the growth, development and yield of cucumber in protected soil is relevant. In addition, in the economic conditions of Kazakhstan, it will improve the provision of the population with this valuable dietary product [13].

**Materials and methods of research.** A scientific study performed in 2019-2020 on the conditions of protected soil in the spring-summer turnover in the "breeding greenhouse" of the department of selection of vegetable and melon crops of the regional branch of "Kainar" LLP "Kazakh Research Institute of Fruit and Vegetable Growing". The regional branch of Kainar LLP is located in the foothills of the southeast of Kazakhstan, on the northern slope of Zailiyskiy Alatau (1050 meters above sea level). For rootstocks, use pumpkin varieties that are highly resistant to adverse external factors and soil and climatic conditions in the area.



Figure 1 - Location: "Selection greenhouse" of the department vegetable crop selection of the regional branch "Kainar" Limited Liability Partnership of the Kazakh Research Institute of Fruit And Vegetable growing in 2019-2020, located in the foothill zone of southeast Kazakhstan

As a scion, the *Asylum* variety was used, which was grafted on 5 domestic pumpkin rootstocks from the collection of 1(*Mozoleevskaya 10*), 2(*Karina*), 3(*Stofuntovaya*), 4(*Aphrodite*), 5 (*Mindalnaya*) vegetable and melon plantation crops.

*Asylum* is a common local salad variety. High yielding, precocious, parthenocarpic. It enters fruiting on the 50<sup>th</sup> day of germination. The bush is medium-sized. The green leaf is long, cylindrical, 15-20 cm long, weighing 205-210 g, the ovary and fruit are smooth without omission, the yield, depending on the growing period, is on average 17.0-19.0 kg/m<sup>2</sup>.



Figure 2 - seedlings of cucumber hybrid Asylum

In experiments on the study of cucumber grafting on pumpkins, the seeds of pumpkin samples were sowing 5 days earlier than the seeds of cucumber. The seeds will come up within 4-5 days. Perform grafting by the method of convergence of applied grafting on the fifth day after germination. The criterion for the period of inoculation was the full disclosure of cotyledon leaves in seedlings. In cucumbers and pumpkins, the first real leaf should be at the very beginning of growth. In the rehabilitation chamber, you should put pots with grafted plants after grafting [14]. At high humidity – 95-98% and at a temperature of 25°C, keep the plants for a week. After 7 days after grafting, the chamber ventilated, opening the film for five minutes 3-4 times a day in the first few days, then increasing the time of ventilation. When airing, it is necessary to ensure that the plants do not lose turgor, otherwise, their death is possible. In the rehabilitation chamber, the plants were kept for 10-12 days. In three multiples of re-laying should have been experiments. Planted grafted cucumber plants in the greenhouse carried out in the spring in the phase of 4-5 real leaves at the age of 30-35 days. Care for grafted plants carried out according to the technology generally accepted for cucumber. During the growing season, phenological observations and morphological descriptions carried out, as well as accounting for individual components of the crop [15]. Setting up experiments, conducting records and observations carried out according to the "Methodology of field experience" (with the basics of statistical processing of research results) and "Methodology of experimental business in vegetable and melon growing"[16].

Table 1 - Varieties of pumpkin

Varieties of pumpkin	
Type	Variety names
1. Cucurbita maxima Duch.	Mozoleevskaya 10 <i>Kazakhstan</i>
2. Cucurbita maxima Duch.	Karina <i>Kazakhstan</i>
3. Cucurbita maxima Duch.	Aphrodite <i>Kazakhstan</i>
4. Cucurbita maxima Ecoronata	Mindalnaya <i>Kazakhstan</i>
5. Cucurbita maxima Ecoronata	Stofuntovava <i>Russia</i>

**Results and discussion.** Flowering in grafted cucumber plants occurred earlier by 2-5 days, fruit maturation-by 2.5-6 days in comparison with root plants, except for plants on rootstock 5 (*Mindalnaya*), which had flowering for 5 days, and maturation – 6 days later than the control (figure 3).



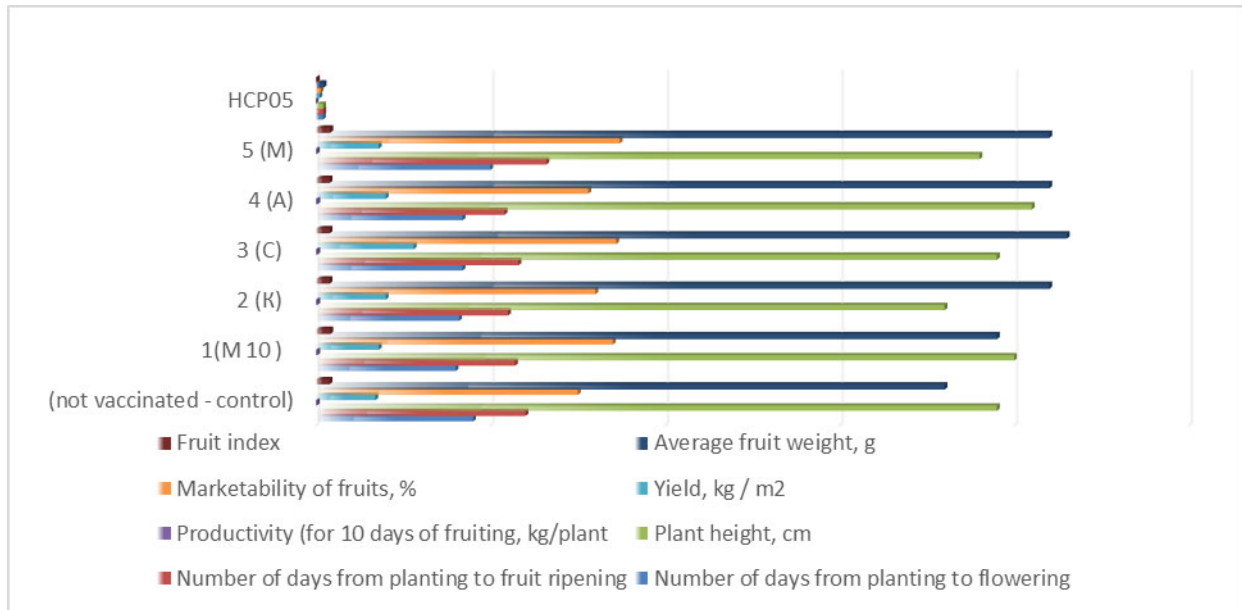


Figure 3 - Indicators of cucumber variety Asylum grafted on rootstocks of large-fruited pumpkin

Grafted cucumber plants on all rootstock samples exceeded root-related plants in height from 4.1 to 20.1%. Grafting cucumber contributed to a significant increase in early and overall productivity. A significant increase in early productivity was observed when grafting on samples of pumpkin 1 (*Mozoleevskaya 10*) and 4 (*Aphrodite*) (120g). The total yield in comparison with root plants increased from 0.6 kg/m<sup>2</sup> to 8.9 kg/m<sup>2</sup>. A large increase in yield was provided on samples of rootstocks 2 (*Karina*) – 3.9 kg/m<sup>2</sup> and 3 *Stofuntovaya*-8.7 kg/m<sup>2</sup>.

An increase in the percentage of marketability of fruits from 4% to 12% and the weight of fruits from 12 g to 40 g was observed. The fetal index did not change significantly. The root system has a significant impact on the growth and rate of development of aboveground organs. In the experiments carried out, the number of male flowers per node significantly decreased in grafted plants at the beginning of fruiting (1-5 nodes), while the number of female flowers increased by 25.1% - 60.1% (table 2).

Table 2 - Grafting impact on quantity of cucumber flowers and qualitative indicators of Asylum variety fruits

Scions	Phase: The beginning of fruiting		Phase: mass fruiting	
	the average number of flowers per node, per piece		average number of flowers per node, pcs	
Asylum (not vaccinated-control)	1,1	2,3	1,5	1,7
1(M 10)	1,7	2,0	2,0	1,3
2 (K)	1,3	2,2	2,2	1,3
3 (C)	1,4	2,2	2,0	1,2
4 (A)	1,7	2,0	2,0	1,4
5 (M)	1,3	2,2	2,2	1,3
HCP05	0,08	0,08	0,08	0,08

In the phase of mass fruiting (5 - 10 nodes), the number of male flowers in terms of one node in comparison with the beginning of fruiting significantly decreased in grafted plants, and the number of female flowers increased. The largest number of female flowers was formed on cucumber plants grafted on pumpkin samples 2 (*Karina*) and 5 (*Mindalnaya*). Grafted plants were the most productive. As a rule, to form in root-related plants in one node one female flower and there were nodes that did not have female flowers at all. At the same time, on plants grafted on samples, in some cases, three or even 4 female flowers were formed in the leaf axil, from which commercial fruits developed. The results of biochemical

analysis showed that the content of dry matter (4.2 - 7.8%) and vitamin C (1.6-8.2%) significantly increased in fruits of all grafted plants.

**Conclusions.** Differences in the phases of development, yield, the chemical composition of fruits and the number of flowers of grafted and non-grafted cucumber plants when grown in winter-spring rotation in a greenhouse are established. When using 1 (*Mozoleevskaya 10*) and 4 (*Aphrodite*) rootstocks, the largest increase in early productivity was obtained (30 %). Samples of rootstocks 2 (*Karina*) and 3 (*Stofuntovaya*) provided a large increase in total yield (3.9 kg / m<sup>2</sup> and 8.0 kg/m<sup>2</sup>, respectively). Grafted cucumber plants in all variants were superior to root plants: in height - from 3.6 to 20.1%, in the percentage of marketability of fruits – from 4% to 12% and by weight of fruits - from 12g to 40 g. In all variants of grafted cucumber plants at the beginning of fruiting, the number of female flowers increased by 25-61%. In all grafted plants, the content of dry matter (3.4-7.8%) and vitamin C (1.8-9.2%) significantly increased. Because of our research, promising rootstocks 2 (*Karina*) and 3 (*Stofuntovaya*) were identified, which are recommended for use in further research, breeding and production of grafted plants. The higher the survival rate of grafting components, the better the grafted plants develop on this rootstock, respectively, the higher the growth, development and productivity of plants. It can be assumed that the higher the compatibility of the components of vaccination, the more effective the use of this method.

Grafting a cucumber plant on a pumpkin promotes more abundant fruiting of plants. Increasing the yield of environmentally friendly cucumber fruits and obtaining with a new cultivation technology grafting a cucumber plant on a pumpkin. In modern conditions, the use of resistant varieties remains the most promising direction, guaranteeing the profitability of various greenhouses. Growing resistant varieties and hybrids can dramatically reduce the cost of plant protection products against pathogens - steaming the soil or expensive pesticides. However, it takes a lot of time and resources to create and evaluate new sustainable hybrids. Low-volume hydroponics, new hybrids for specific climatic conditions and new grafting opportunities are three aspects of success in the greenhouse business at the present stage.

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### **ЖАБЫҚ ЖЕРДЕ ҚИЯР ЕГУ ҮШІН ОТАНДЫҚ АСҚАБАҚ ҚОРЫН ҚОЛДАНУДЫҢ ТИІМДІЛІГІ**

**Аннотация.** Шөпті көкөніс дақылдарын өсіру кезінде, әлемдік тәжірибеде егу әдісін қолдануға үлкен мән беріледі. Қазіргі уақытта көкөніс өсіруде өсімдіктің қолайсыз жағдайына өсімдіктің өнімділігі мен төзімділігін арттырудың экологиялық таза әдістерін жасау өте өзекті болып табылады. Асқабақ дақылдарындағы осы әдістердің бірі – егу. Біздің жұмысымыздың мақсаты егу әдісін қолдана отырып, отандық асқабақ қорының қияр гибридінің (скринингтің) өсу, даму және өнімділік сипаттамаларына әсерін зерттеу болды. Асқабақтың түрлеріне егу өздігінен тамырлайтын өсімдіктермен салыстырғанда тамыр сабағына байланысты өсімдіктердің өсуі мен дамуын жақсартады. Тамыр сабағы ретінде біз асқабақтың қолайсыз сыртқы факторларға төзімділігі жоғары және сол жердің топырақтық-климаттық түрлерін қолдандық. Өсімдік ретінде қорғалған топырақ жағдайында өсіруге ұсынылған сорт (*Асылым*) пайдаланылды, оны бес отандық қорларға егеді: 1 (*Мозолеевская 10*), 2 (*Карина*), 3 (*Афродита*), 4 (*Бадам*) және Ресейлік селекция 5 (*Жүз фунт*) көкөніс және бақша дақылдарынан алынған асқабақ. Егу жалпы қабылданған әдіс бойынша жүргізілді. Асқабақ үлгісін 1 қолданғанда (*Мозолеевская 10*) гүлдену егілмеген өсімдіктермен салыстырғанда бесінші күні басталды, ал асқабақтың 4 (*Афродита*) үлгісіне егілгенде жемістер алты күн бұрын пісіп жетілді. Екі түп тамырмен де 35,5% ерте өнімділіктің ең үлкен өсімі алынды. Жалпы өнімнің айтарлықтай өсуін тамыр сабағының 2 (*Карина*) - 5,1 (4,1) кг/м<sup>2</sup> және 3 (100 фунт) - 8,7 (9,9) кг/м<sup>2</sup> үлгілері қамтамасыз етті. Егілген қияр өсімдіктері барлық тамыр сабақтарын қолдана отырып, жеміс-жидектің тауарлық қабілеттілігі мен салмағы бойынша өздерінің тамырланған өсімдіктерінен асып түсті. Егілген қияр өсімдіктерінде жеміс бере бастағанда, үлгіні ескере отырып, аналық гүлдердің саны көбейді. Барлық егілген өсімдіктерде жемістердегі құрғақ заттардың мөлшері едәуір артты. Біздің зерттеулеріміздің нәтижесінде 2 (*Карина*) және 3 (*Жүз фунт*) тамыр сабақтар белгіленді, оларды әрі зерттеу жұмыстарында және егілген өсімдіктер өндірісінде пайдалануға ұсынылады.

**Түйін сөздер:** асқабақ, қияр, жылыжай, егу, тамыр сабағы, қорғалған топырақ.

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### ЭФФЕКТИВНОСТЬ ПРИМЕНЕНИЯ ОТЕЧЕСТВЕННЫХ ПОДВОЕВ ТЫКВЫ ДЛЯ ПРИВИВКИ ОГУРЦА В ЗАЩИЩЕННОМ ГРУНТЕ

**Аннотация.** При выращивании травянистых овощных культур в мировой практике придается большое значение использованию метода прививки. В овощеводстве очень актуальна разработка экологически безопасных методов повышения урожайности и устойчивости растений к неблагоприятным условиям произрастания. Одним из таких методов у тыквенных культур является прививка. Целью нашей работы было изучение влияния отечественного подвоя тыквы на особенности роста, развития и урожайность гибрида огурца (привой) с использованием метода прививки. Прививка на виды тыкв позволила улучшить рост и развитие растений в зависимости от подвоя, по сравнению с корнесобственными растениями. В качестве привоя использован сорт *Асылым*, рекомендуемый для возделывания в условиях защищенного грунта, который был привит на пяти отечественных подвоях: 1 (*Мозолеевская 10*), 2 (*Карина*), 3 (*Афродита*), 4 (*Миндальная*) и российской селекции 5 (*Стофунтовая*) тыквы из овощебахчевых культур. Прививку проводили по общепринятой методике. При использовании образца тыквы 1 (*Мозолеевская 10*) цветение началось на пятые сутки раньше в сравнении с не привитыми растениями, а при прививке на образец тыквы 4 (*Афродита*) плоды созревали раньше на шесть суток. При использовании обоих подвоев получена самая большая прибавка ранней продуктивности – 35,5%. Существенную прибавку общей урожайности обеспечили образцы подвоев 2 (*Карина*) – 5,1(4,1) кг/м<sup>2</sup> и 3 (*Стофунтовая*) – 8,7 (9,9) кг/м<sup>2</sup>. Привитые растения огурца при всех использованных подвоях превосходили корнесобственные по высоте по проценту товарности плодов и по массе плодов. В начале плодоношения на привитых растениях огурца увеличилось количество женских цветков в зависимости от образца. У всех привитых растений в плодах существенно увеличилось содержание сухого вещества. В результате проведенных нами исследований отмечены подвои 2 (*Карина*) и 3 (*Стофунтовая*), которые рекомендуются для использования в дальнейшей исследовательской селекционной работе и производстве привитых растений.

**Ключевые слова:** тыква, огурец, теплица, прививка, подвои, защищенный грунт.

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**ISSN 2518-1483 (Online), ISSN 2224-5227 (Print)**

<http://reports-science.kz/index.php/en/archive>

Редакторы: *М. С. Ахметова, Д. С. Аленов, Р.Ж. Мрзабаева*

Верстка на компьютере *А. М. Кульгинбаевой*

Подписано в печать 13.04.2021.

Формат 60x881/8. Бумага офсетная. Печать – ризограф.

8,5 п.л. Тираж 300. Заказ 2.

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*Национальная академия наук РК  
050010, Алматы, ул. Шевченко, 28, т. 272-13-18, 272-13-19*