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Optimization of the medium composition in the micropropagation of wild *Armeniaca vulgaris* (Lam) and apricot cultivars

At each stage of clonal micropropagation, problems such as unsuccessful disinfection, weak reproduction, and abnormal development of microplants appear. The consequences of such failures can lead to necrosis of plants, and sometimes death. Successful plants micropropagation depends on several internal and external factors, including *in vitro* conditions. It is important to create optimal conditions at each stage of clonal micropropagation to achieve a high rate of *in vitro* explants multiplication. The article presents the results of optimization of clonal micropropagation of Armeniaca vulgaris wild apricot and domestic and foreign cultivars Balkiya, Monitoba, Kolkhoznyi, Nikitskyi krasnoshchekyi, Alexander at different propagation stages. Research results showed that the most suitable nutrient medium for wild apricot and cultivated apricot cultivars was Quorin-Lepoivre (QL) containing 0.5 mg/L 6-benzylaminopurine (BAP), 0.5 mg/L gibberellic acid (GA), 0.1 mg/L indole butyric acid (IBA) and 10 mg/L Iron chelate, 1.5 mg/L vitamin C, 0.5 mg/ L B1; 0.5 mg/L B6, also Murashige and Skoog (MS) nutrient medium containing 1.2 mg/L BAP, 0.8 mg/L GA, 0.1 mg/L IBA. The optimal nutrient medium for clonal micropropagation was a mineral medium containing 0.8 mg/L BAP, 0.5 mg/L GA, 0.1 mg/L IBA on the MS base. *In vitro* conditions, 5 varieties of apricots were introduced and propagated.

Keywords: wild apricot, clonal micropropagation, *in vitro*, sterilization, nutrient medium, *Armeniaca vulgaris* (Lam).

Introduction

Wild apricot — *Armeniaca vulgaris* Lam., belongs to the rose family. Common apricot (*A. vulgaris*) is grown in Zhambyl, South Kazakhstan, and Almaty regions of Kazakhstan. It is found on the mountain slopes of the southern and south-eastern regions of Kazakhstan at an altitude of 500–1200 meters. The height of the fruit tree reaches 3–15 meters. The fruit bark of the apricot tree is brown and grayish-brown in color. The fruit pods produce a single flower, which is white or pink, and opens before the leaves. The fruit is fleshy, hairy, and the bone is shiny. Apricot is a bright, heat-loving crop, it grows well in airy, moisture-permeable soils, and clay and salty areas are unsuitable for growing apricots, drought resistant [1]. Apricot trees grow singly or in groups. It blooms in March-April, the flowers are purple or white, fragrant. The fruit ripens in July-August. Apricot fruits ripen early on slopes with good sunlight. The seeds of this apricot contain 30–40 % fat and up to 25 % protein [2].

Prunus Armeniaca L. is the only type of wild apricot in Kazakhstan. It is found in large numbers on the northern slopes of Ile Alatau — in the gorges of the Big and Small Almaty rivers, in Talgar, Aksay, Yesik, Kotyrbulak and Karakuzen, and on the Ketpen ridge [3]. The natural range of the Dzungar Alatau is found in the northern region of the Korgas, Osen and Koktal rivers. Wild apricot of Kazakhstan is resistant to cold, can withstand temperatures of 37–40 °C and heat-resistant +40°C, and is also resistant to pathogens *Coryneumbeijerinckii* Ond., *Sclerotinialaxa*. This is a unique polymorphic species. Wild apricots of Kazakhstan are of great importance for breeding programs. This type of apricot is included in the Red Book of the Republic of Kazakhstan due to its limited distribution area. Another reason for its inclusion in the Red Book is that it is an endemic species of the Northern and Western Tien Shan, a relatively rare species whose distribution area is significantly decreasing. In the 70s and 80s of the last century, the total area of wild meadows in Kazakhstan was 1675 hectares [4]. Currently, the distribution area of wild apricot *Armeniaca vulgaris* is about 1500 ha.

The most dangerous virus of stone fruit crops, including apricots, is Plum Pox virus (PPV) or Sharka of plum. Sharka virus belongs to the group of potyviruses, it is easily transmitted by ticks without modification

and creates permanent foci in wild woody plants, especially in birch. Sharka disease is very harmful, causes a lot of product losses and reduces the commercial quality of stone fruit crops (apricots, plums, peaches). In affected trees, the virus appears on the first leaves of spring in the form of broad rings, spots, arcs and stripes from bright green to pale yellow. In fruit, Sharka disease causes necrosis in the form of fingerprint-like spots, streaks and arcs, which leads to premature fruit drop and eventually requires the removal of infected trees [5]. Identification of strains of apricot PPV detected in stone fruit crops in different regions of the Russian Federation was carried out. For this purpose, strain-specific monoclonal antibodies and primers, PCRRFLP and sequencing of the resulting amplification products were used. The PPV-D strain was found to be widespread. Isolates of the PPV-M strain were detected only in peaches and apricots in Krasnodar and Stavropol regions. PPV-C strain was detected in cherries in Belgorod and Samara regions. The previously rare PPV-W strain was detected in Belgorod, Voronezh, Moscow regions and Stavropol region. A PPV isolate, which differs from all known strains of this virus in terms of serological and molecular properties, was found in Samara region [6].

Currently, 10 strains of the virus have been identified in the world, including PPV-D and PPV-W strains found in Kazakhstan. The virus has been detected in private farms, production and collection orchards of apricots and plums, but scientists have not determined the spread of the virus in natural populations of wild apricots. Researchers have noted that the genetic diversity of Kazakhstani wild apricot in the Tien-Shan mountain range has a special place in selection programs aimed at obtaining genotypes resistant to late flowering and fruiting, frost and various pathogens [7].

Among wild apricots with high polymorphism in the Dzungar and Ile Alatau, domestic scientists selected forms based on ripening period, fruit quality, length of rest period, short endurance, and resistance to diseases for use in selection work [8].

The volume of all bone crops in Kazakhstan is 9,377.1 ha, including 4,345.1 ha of apricots. Only 5 varieties and 1 breeder are included in the state list of breeding achievements allowed for use on the territory of Kazakhstan [9]. In the production, selected forms of wild apricot are used as a seed carrier. As a result of the slow study of the achievements of Kazakh and foreign breeding, the assortment of varieties used in horticulture, as well as the state list, are not updated. One of the ways to contribute to breeding research and their widespread distribution is to introduce the achievements of biotechnology into the breeding-technological process [10].

In this regard, the role of clonal micropropagation *in vitro* is important in order to speed up their reproduction while preserving certain genetic features of genotypes, to obtain plants cured of fungal and bacterial infections. The steps of the clone micropropagation method have been improved for rapid reproduction of selected apricot forms and domestic and foreign apricot varieties that can be used as potential breeders.

Experimental

Plant material and their preparation: The research was conducted in the laboratory of the Genetic Resources of Horticultural Crops of the Kazakh Fruit and Vegetable Research Institute. As a research object, Balkiya, Monitoba, Kolkhoznyi, Nikitskyi krasnoshchekyi, Alexander cultivars were taken from the field and *in vitro* collection of the Institute (3–5 cm long cuttings). Wild apricot germplasm (seeds) was collected from the territory of the Talgar branch of the Ile Alatau state National Natural Park.

The seeds of wild apricots were collected in autumn when they were fully ripe. Seedlings of apricot varieties were placed in water to awaken buds in January-February, after the air temperature was below -10oC, at a temperature of +4 °C for 30 days, and then at room temperature (+22–24 °C). Awakened buds were prepared for introduction into the *in vitro* environment. The seeds of the wild apricot were separated with the help of an archaeocole, and the seeds were introduced into the nutrient medium.

In the course of the research, common biotechnological methods and information and methods developed by scientists of the KazF&VRI were used [10-11]. Disinfection agents were tested for *in vitro* penetration of apricot seeds and buds. The experiment was conducted according to 7 versions (Table 1).

Table 1

Scheme of testing sterilization agents for *in vitro* inoculation of apricot seeds and buds

I№	Decontamination agent	Exposure time
ФА	$HgCl_2$ 0,1 %	0,1 % $HgCl_2$ 3 min → 70 % EtOH 30 sec. → 20 % bleach + Twin-20 1-2 drops 15 min shaking in distilled water 5→10→15 min
ВБ	$HgCl_2$ 0,1 %	0,1 % $HgCl_2$ 4 min → 70 % EtOH 30 sec. → 20 % bleach +Twin-20 1-2 drops 15 min shaking in distilled water 5→10→15 min
ИВ	$HgCl_2$ 0,1 %	0,1 % $HgCl_2$ 5 min → 70 % EtOH 30 sec. → 20 % bleach + Twin-20 1-2 drops 15 min shaking in distilled water 5→10→15 min
ГГ	$HgCl_2$ 0,1 %	0,1 % $HgCl_2$ 6 min → 70 % EtOH 30 sec. → 20 % bleach + Twin-20 1-2 drops 15 min shaking in distilled water 5→10→15 min
ДД	Belizna (25 % NaOCl) 3:1	BELIZNA (25 % NaOCl) 7min →70 % EtOH 30 sec. → 20 % bleach + Twin -20 1-2 drops15 min shaking in distilled water 5→10→15 min
ЖЖ	Domestos (5 % NaOCl) + 2:1 (H_2O).	Domestos (5 % NaOCl) 8 min70 % EtOH 30 sec. → 20 % bleach+ Twin-20 1-2 drops 15 min→ shaking in distilled water 5→10→15 min
ИИ	Domestos (5 % NaOCl) 2:1 (H_2O).	Domestos (5 % NaOCl) 9 min→ 70 % EtOH 30 sec. → 20 % bleach+ Twin-20 1-2 drops 15 min shaking in distilled water 5→10→15 min

Wild apricot seeds were disinfected according to the following scheme: put apricot seeds in sand for 40 minutes in tap water; disinfection agents; shaking in distilled water 5→10→15 min; separating the grain from the outer shell; removal of the embryo (fetus) inside the grain; introduction into the culture medium [12] (Fig. 1).

After disinfection by the above-mentioned methods, each apricot genotype contains 30 g/L sucrose, 12 mg/ L Fe, 0.100 mg/L mesoinosit; vitamins: 0.4 mg/L B1, 0.5 mg/L B6, 1.5 mg/L C-growth regulators: 2.0 mg/L GA, 0.1 mg/L IBA, 0.8 mg/L BAP — were introduced into MS medium. The pH value of the medium was adjusted to 5.7 ± 0.2. Then 6 g/L agar-agar was added to the medium before autoclaving at 121°C for 15 minutes. The volume of the nutrient medium is 15 ml. The effect of disinfection agents on the elimination of bacterial and fungal infections was evaluated after 30 days.

The modified composition of MS and Quorin-Lepoivre (QL) media was tested for clonal micropropagation of plants introduced into the nutrient medium after decontamination [14]. Experimental scheme for determining the effect of plant growth regulators in the nutrient medium for *in vitro* clonal micropropagation of wild type and cultivated varieties of apricot, mg/l:

1. QL — 0.3 BAP; 0.2 GA; 0.1 IBA.
2. QL — 0.5 BAP; 0.5GA; 0.1 IBA.
3. QL — 1.0 BAP; 0.1 IBA.
4. MS — 100 % — 0.3 BAP; 0.2 GA; 0.1 IBA.
5. MS — 100 % — 0.8 BAP; 0.5 GA; 0.1 IBA.
6. MS — 100 % — 1.0 BAP; 0.1 IBA; 0.8 GA.

In vitro culture conditions: pH of the culture medium was 5.7 in all experiments. The microplants were grown in special glass jars and Magenta GA7 dishes in an average of 40 ml of culture medium. Every 4 weeks, the microplants were transferred to a new culture medium. Plants were grown at 24 °C in a 16-h photoperiod, 40 μmol m-2s-1 light, in a growth room equipped with fluorescent lamps.

Observations of plants introduced *in vitro* were carried out after 30 days (the duration of one passage), considering the number of living, dead and infected explants. The average reproduction coefficient for 1 passage for each genotype was calculated using the formula:

$P = a/(b*c)$

a — the number of newly formed shoots;

b — the number of shoots planted for reproduction;

c — the number of passages.

Results and discussion

Researches were carried out on sprouts and seeds of domestic and foreign cultivated and wild apricot forms. A study was conducted on the effectiveness of using various disinfectants to inhibit the growth of saprophytic and pathogenic microflora during sprouting and insemination of wild and cultivated apricot genotypes. This stage is one of the first and most important studies in clone micropropagation, and the success of

further work is directly related to it. Scientist Soliman H., agreeing with this opinion, in his study proposed *in vitro* reproduction biotechnology based on the El-Hamawey apricot variety. According to him, for successful disinfection of plant material from microflora (plant viability — 83.71 %, low contamination — 9.66 %) 1 min. It is reported that immersion in 70 % ethanol, followed by immersion in a solution containing three drops of Tween 20/500 ml of 0.75 % NaOCl for 10 min is effective and a germination ratio of 2.3 can be achieved [15]. In our experiments, disinfection of sprouts and seeds of wild types and cultivars of apricots is shown in Table 2. 30 plants were tested for each experimental variant to determine the disinfection agent.

1 — apricot endocarps; 2 — endocarp and seed; 3 — embryo in medium

Figure 1. Embryo transfer of wild apricot in vitro

Table 2

Effectiveness of agents in disinfection of plant parts of wild type and cultivated varieties of apricot

№	Decontamination agent	Exposure time	Wild apricot *A. vulgaris* (seed)			Balkiya (bud)		
			number of sprouts, pcs	damage indicator, pcs	the ability to regenerate, %	number of sprouts, pcs	damage indicator, pcs	the ability to regenerate, %
A	HgCl2 0,1 %	0,1 % HgCl2 3 min → 20 % bleach + Twin-20 1-2 drops 15 min	30	9	21	30	11	19
B	HgCl2 0,1 %	0,1 % HgCl2 4 min → 20 % bleach + Twin-20 1-2 drops 15 min	30	6	24	30	7	23
C	HgCl2 0,1 %	0,1 % HgCl2 5 min → 20 % bleach + Twin-20 1-2 drops 15 min	30	12	18	30	9	21
D	HgCl2 0,1 %	0,1 % HgCl2 6 min → 20 % bleach + Twin-20 1-2 drops 15 min	30	16	14	30	14	16
E	Belizna (25 % NaOCl) 3\1(H2O).	Belizna (25 % NaOCl) 7 min → 20 % bleach + Twin-20 1-2 drops 15 min	30	16	14	30	19	11

Continuation of Table 2

№	Decontamination agent	Exposure time	Wild apricot *A. vulgaris* (seed)			Balkiya (bud)		
			number of sprouts, pcs	damage indicator, pcs	the ability to regenerate, %	number of sprouts, pcs	damage indicator, pcs	the ability to regenerate, %
F	Domestos (5 % NaOCl) + 2: 1 (H2O).	Domestos (5 % NaOCl) 8 min→ 20 % bleach + Twin-20 1-2 drops 15 min	30	19	11	30	17	13
G	Domestos (5 % NaOCl) 2:1 (H2O).	Domestos (5 % NaOCl) 9 min→ 20 % bleach + Twin-20 1-2 drops 15 min	30	21	9	30	16	14

From the table, seeds and crown buds of wild apricot tree and cultivars showed effective decontamination with 0.1 % $HgCl_2$ at 3 min exposure time, with 24 % of explants capable of regeneration (treatment A). Option E had 14 % of the plants capable of regeneration during disinfection with "Belizna" 3\1, and the number of plants capable of regeneration during the agent "*Domestos"* in versions F and G was 10 %.

Varieties do not have the same response to disinfection with different agents. For example, while 0.1 % $HgCl_2$ caused necrosis of several shoots of wild apricot during disinfection at 3-minute exposure, no necrosis was observed in cultivated varieties, but the number of shoots damaged by bacteria and fungi was higher. Similar differences were observed in the same cultivars, with some plants dying and others recovering after the same manipulations.

According to the results of our experiments, although $HgCl_2$ 0.1 % indicated in version A is effective; we can also recommend "Domestos" solution. Although mercury-containing products are highly effective, many scientists, including us, recommend household products that contain less toxic, safer, and more economical chlorine. During the search for alternative agents, scientists found that shaking in a solution of egg yolk + 20 % NaOCl + 2 drops of Twin-20 for 20 min is enough to disinfect green growths when introducing apple borers into the nutrient medium *in vitro* [16].

The growth factor of different genotypes of plants is affected not only by the composition of growth regulators and varietal characteristics, but also by the composition of the nutrient medium, infection of explants with viruses and other latent pathogens, and organic acids [17].

Agarized QL medium supplemented with sorbitol (20 g/L) and benzylaminopurine (3 mg/L) was used for *in vitro* culture and initiation of meristem growth. Shoot propagation was carried out on QL agar medium modified with microsalts and vitamins supplemented with sucrose (30 g/L), benzylaminopurine (0.2, 0.5 or 2.0 mg/L) and indolyl fatty acid (0.04 mg/L). It was found that for optimal reproduction, it is necessary to alternate growing plants in a medium with a concentration of benzylaminopurine of 2 mg/L (increased reproduction ratio) and 0.2–0.5 mg/L (increased shoot length) (Fig. 2).

Figure 2. Growth and development of wild apricot seeds in an artificial nutrient medium for 1–3 months

The composition of the artificial nutrient medium is of considerable importance in *in vitro* conditions of introduced seeds and crown buds of wild apricot and cultivated apricot varieties. The number of explants capable of regeneration of the wild apricot form obtained from the Aksai Gorge is 48.5 %, the average number of explants capable of regeneration of the wild apricot form obtained from the Kotyrbulak Gorge is 37.1 %, and the cultural varieties: Balkiya 37 %, the lowest number of explants capable of regeneration is Kolkhoznyi 28 % had. Other varieties of apricot showed an average index (Fig. 2).

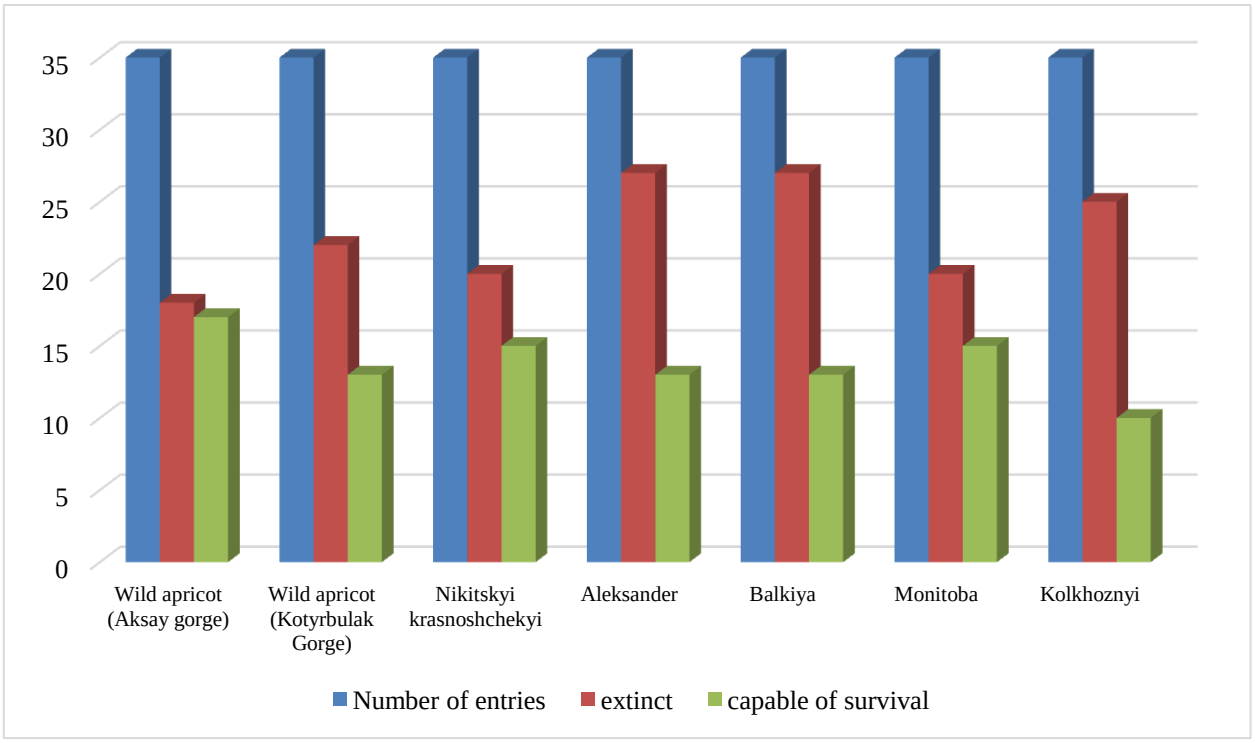

Figure 3. The results of introduction and growth of cultural varieties

Table 2

Effect of nutrient medium composition of wild apricot and cultivated apricot samples on plant reproduction

Indicators	Medium options	Wild apricot	Balkiya	Nikitskyi krasnoshchekyi
The length of the main plant, cm	QL — 0.3 BAP; 0.2 GA; 0.1 IBA	0.9	0.7	0.7
	QL — 0.5 BAP; 0.5 GA; 0.1 IBA	1.3	1.0	0.9
	QL — 1.0 BAP; 0.1 IBA	0.7	0.6	0.7
	MS — 100 % — 0.3 BAP; 0.2 GA; 0.1 IBA	0.9	0.8	0.8
	MS — 100 % — 0.8 BAP; 0.5 GA; 0.1 IBA	1.2	1.0	1.1
	MS — 100 % — 1.0 BAP; 0.1 IBA; 0.8 GA	1.4	1.1	11
The number of leaves on the main plant, cm	QL — 0.3 BAP; 0.2 GA; 0.1 IBA	4	4	4
	QL — 0.5 BAP; 0.5 GA; 0.1 IBA	7	5	5
	QL — 1.0 BAP; 0.1 IBA	5	4	3
	MS — 100 % — 0.3 BAP; 0.2 GA; 0.1 IBA	9	6	5
	MS — 100 % — 0.8 BAP; 0.5 GA; 0.1 IBA	8	6	6
	MS — 100 % — 1.0 BAP; 0.1 IBA; 0.8 GA	10	9	8
Increased number of sprouts, specimen	QL — 0.3 BAP; 0.2 GA; 0.1 IBA	2	2	2
	QL — 0.5 BAP; 0.5 GA; 0.1 IBA	6	4	3
	QL — 1.0 BAP; 0.1 IBA	7	4	4
	MS — 100 % — 0.3 BAP; 0.2 GA; 0.1 IBA	4	3	3
	MS — 100 % — 0.8 BAP; 0.5 GA; 0.1 IBA	8	7	7
	MS — 100 % — 1.0 BAP; 0.1 IBA; 0.8 GA	6	5	6

The effectiveness of this stage depends on the composition of the nutrient medium. Upper seeds and apical buds were introduced into improved media (QL and MC). The most suitable for the introduction of *in vitro* cultivars and the emergence of seedlings was QL (Table 2) QL 0.5 mg/L BAP, 0.5 mg/L GA, 0.1 mg/L IBA with the addition of 39 pieces in the 1st planting microplant was obtained. MS showed good performance in improved medium containing 0.8 mg/L BAP, 0.5 mg/L GA, 0.1 mg/L IBA 31 plants showed their ability to recover. Based on the information in the literature, 0.5-1.0 mg/L BAP is used for high growth of seeds and buds of apricot varieties (Table 2).

In order to rapidly increase varieties and selected forms of apricot crops, stages of their clonal micropropagation have been improved with the help of biotechnological methods. In order to accelerate this process, it is necessary to add biotechnological methods to the production technology, in particular, clonal micropropagation.

Clonal reproduction accelerates the direct reproduction of varieties while preserving the genetic characteristics of these species. This is a model of vegetative propagation, for example, to grafting, but this model is carried out in a completely sterilized nutrient medium, under controlled temperature and light conditions. Meristem sprouts are used as starting material. Under the right conditions, after a few weeks, the sprouts will produce several plant shoots, which in turn will allow additional sprouts to be planted in a new nutrient medium. In this way, thousands of seedlings are obtained after several cultivations.

The *in vitro* method allows long-term storage of test-tube plants at the following temperatures, creation of a valuable “Bank” of plant samples, and international exchange of test-tube plants without quarantine objects. A valuable genotype in storage and a cured plant, if necessary, allow to obtain a quick breeding process or a cured production planting material that does not require recontamination. This, in turn, allows to save material and labor resources in testing and recovery time.

Table 3

Clonal micropropagation of wild and cultivated apricot genotypes

№	Sorts	Those taken for reproduction, pcs	Number in multiplication, pcs	Passage number	Average number planted in passage I, pcs	Multiplication factor
1	Wild apricot (Kotyrbulak)	7	26	3	3.6	3.7
2	Nikitskyi krasnoshchekyi	10	52	4	12.5	1.3
3	Aleksander	11	37	4	9.25	0.85

Continuation of Table 3

№	Sorts	Those taken for reproduction, pcs	Number in multiplication, pcs	Passage number	Average number planted in passage I, pcs	Multiplication factor
4	Balkiya	15	49	3	16.3	1.1
5	Monitoba	6	17	3	5.7	0.9
6	Kolkhoznyi	6	18	3	6.0	1.0

It can be seen from the table that the highest rate is 3.7 % when introducing wild apricot, so after the first pass when introducing 10 pieces, we get 96 microplants and 49 microplants of Balkiya varieties after the first planting. The lowest rate of Manitoba cultivars was 0.9 % in one passage of 17 microplants.

Conclusions

As a result of the conducted research, it was found that plants capable of regeneration during disinfection during the extraction of seeds and buds of wild apricots and cultivated cultivars *in vitro* (exposure to $HgCl_2$ for 4 minutes was the most effective. Hormonal composition of the nutrient medium was selected to stimulate regenerative isolation (MS) mineral base, twice the amount of the composition, 1.5 mg/L vitamin C, 2 mg/L glycine, 0.5 mg/L BAP, 0.1 mg/L IMK. The optimal medium for microclonal reproduction of wild apricot and cultivated varieties was determined, which contains: 0.8 mg/L BAP, 0.5 mg/L GA, 0.1 mg/L IBA. Based on the results of the above experiments, 5 varieties and 2 wild types were introduced into *in vitro* culture and multiplied.

In the second stage of clonal micropropagation, introduction to *in vitro* culture, various modifications of MS culture medium were used. The composition of nutrient media was determined for isolation of aseptic tips of apricot tree shoots and clonal micropropagation. 6 versions of media based on the mineral base of MS nutrient media in full concentration and 50 % nitrogen content were tested. MS medium was optimal for introduction into *in vitro* culture, phytohormones 00.8 mg/L BAP, 0.5 mg/L GA, 0.1 mg/L IBA, 30 g/L sucrose, regeneration of apricot plants in this nutrient medium was 3.7 %. In this regard, the composition of nutrient media has been optimized. Basically, it was an agar-free medium with various additives to reduce oxidative processes (vitamin C, iron chelate) and growth regulators (BAP, GA).

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Жабайы *Armeniaca vulgaris* (Lam) және мәдени өрік сұрыптарын микрокөбейтуде қоректік ортаның құрамын оңтайландыру

Өсімдіктерді клондық микрокөбейтудің әр кезеңінде сәтсіз залалсыздандыру, әлсіз көбею, микроөсімдіктердің қалыптан тыс дамуы сияқты қиындықтар пайда болады. Мұндай сәтсіздіктердің салдары өсімдіктердің некрозына, кейде тіршілігін жоюына әкелуі мүмкін. Өсімдіктердің сәтті микрокөбеюі бірнеше ішкі және сыртқы факторларға, соның ішінде *in vitro* жағдайларына байланысты. Эксплантардың *in vitro* көбеюінің жоғары коэффициентіне қол жеткізу үшін клондық микрокөбейтудің әрбір кезеңінде оңтайлы жағдайлар жасау маңызды. Мақалада *Armeniaca vulgaris* жабайы өрігі және отандық, шетелдік селекцияның «Балқия», «Монитоба», «Колхозный», «Никитский краснощёкий», «Александр» сияқты сұрыптарды клондық микрокөбейтудің әртүрлі кезеңдердегі оңтайландыру нәтижелері келтірілген. Зерттеу нәтижелері жабайы өрік және мәдени өрік сұрыптарын *in vitro* жағдайына енгізу үшін ең қолайлы қоректік орта құрамында 0,5 мг/л 6-бензиламинопурин, 10 мг/л темір хелаты, 1,5 мг/л С дәрумені, 0,5 мг/л В1; 0,5 мг/л В6 бар Quorin-Lepoivre (QL) екендігі анықталды. Өсімдіктердің өсу реттегіштері 0,5 мг/л құрайтын Murashige және Skoog (MS) қоректік ортасы жабайы өрік және мәдени сұрыптарының тұқымдары және төбе бүршіктерін енгізуге қолайлы. Клондық микрокөбейту үшін оңтайлы қоректік орта құрамында 0,8 мг/л БАП, 0,5 мг/л ГҚ, 0,1 мг/л ИМҚ бар MS минералды ортасы болып анықталды. Жабайы өрік пен мәдени өріктің 5 сұрыпы *in vitro* ортасына енгізіліп, көбейтілді.

Кілт сөздер: жабайы өрік, клонды микрокөбейту, *in vitro*, залалсыздандыру, қоректік орта, *Armeniaca vulgaris* (Lam).

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Оптимизация состава питательной среды при клональном микроразмножении абрикоса дикорастущего *Armeniaca vulgaris* (Lam) и культурных сортов

На каждом этапе клонального микроразмножения растений возникают такие проблемы, как неудачная дезинфекция, слабая репродукция и аномальное развитие микрорастений. Последствия таких неудач могут привести к некрозу растений, а иногда и гибели. Успешное микроразмножение растений зависит от ряда внутренних и внешних факторов, в том числе от условий in vitro. Для достижения высокой скорости размножения эксплантов *in vitro* важно создать оптимальные условия на каждом этапе клонального микроразмножения. В статье представлены результаты оптимизации клонального микроразмножения дикого абрикоса Armeniaca vulgaris, отечественных и зарубежных сортов Балкия, Мо-

нитоба, Колхозный, Никитский краснощекий, Александр на разных этапах. Результаты исследования показали, что наиболее подходящей питательной средой для введения для дикого абрикоса и культурных сортов абрикоса является Корин-Лепуавр (QL), содержащий 0,5 мг/л 6-бензиламинопурин, 10 мг/л хелата железа, 1,5 мг/л витамина С, 0,5 мг/л В1; 0,5 мг/л В6. Питательную среду Мурасиге и Скуга (MS), содержащую 0,5 мг/л РРР, использовали для регенерации семян дикого абрикоса и побегов культурных сортов. Оптимальная питательная среда для клонального микроразмножения — 0,8 мг/л БАП, 0,5 мг/л ГК, 0,1 мг/л ИМК на минеральной среде MS. Введено *in vitro* и размножено в искусственных условиях 5 генотипов дикого и культурного абрикоса.

Ключевые слова: дикий абрикос, клональное микроразмножение, *in vitro*, стерилизация, питательная среда, *Armeniaca vulgaris*(Lam).

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