условий выращивания. Новые ЧМ гибриды благодаря высокой пластичности способны успешно адаптироваться к лимитирующим факторам жизнеобеспечения и стрессовых явлений в различных почвенно-климатических зонах, имеют высокую урожайность корнеплодов, сахаристость и сбор сахара. Наиболее ценными для производства являются гибриды, в которых коэффициент стабильности превышает 70 %. По результатам исследований такому уровню соответствуют все исследуемые ЧМ гибриды – по уровню урожайности корнеплодов, сахаристости и сбору с единицы площади.

Ключевые слова: пластичность, стабильность, коэффициент регрессии, производительность гибридов.

Effect of ecological growing conditions on productivity stability and plasticity of male sterile hybrids of sugar beets

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Adaptive potential of new MS (male sterile) hybrids of sugar beets, developed with tetraploid pollinators of Bila Tserkva selection depending on soil-climatic conditions of the growing area, was studied. The most plastic and stable promising hybrids in a wide range of ecological growing conditions were singled out by regions. Due to high plasticity, new MS hybrids are well adapted to limiting factors of life support and stressful events in various soil-climatic zones; they have high root crop capacity, sugar content and yield.

The most valuable hybrids for cultivation are those whose stability coefficient exceeds 70 %. The research results prove that all the studied MS hybrids correspond to this level both by the level of root crop capacity and sugar content and yield per area unit.

Key words: plasticity, stability, regression coefficient, hybrid productivity.

Надійшла 28.09.2017 р.

UDC 581.143.6

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IMPROVEMENT OF THE ELEMENTS OF TECHNOLOGY OF MICROPROPAGATION CORNUS MAS L.

Існує ряд проблем з розмноженням і поширенням кизилу – надзвичайно цінної плодової культури в Україні. Перспективний спосіб розмноження кизилу – застосування мікроклонального розмноження *in vitro*. Шляхом ряду експериментів нами встановлено технологічні прийоми, які дозволяють удосконалити процес мікроклонального розмноження *Cornus mas L.* (сорти Ніжний та Екзотичний) на етапі введення в асептичну культуру: 1) відбір експлантів у фазу зелений конус; 2) деконтамінація препаратом Бланідас 300 (7 г/л автоклавованого дистиляту); 3) відбір експлантів з бруньок медіальної частини пагона; 4) вирощування донорних рослин в умовах депозитарію; 5) сумісне застосування як антиоксидантів аскорбінової кислоти (15 мг/л) та полівінілпіролідону (0,5 г/л) способом додавання їх у живильне середовище.

Ключові слова: *in vitro*, антиоксидант, деконтамінант, експлант, кизил, рослина-донор.

Introduction. Cornel (dogwood), also referred to as cornelian cherry (Cornus mas L.), a European species, is the only edible of many other species of cornel [1, 2]. The plants of this genus are common in the Eastern and Southern Europe, the Caucasus, Asia Minor, China and Japan. In Ukraine, cornel occupies nets to the most important place among the rare crops due to its unique consumer, medical, technical and other values, as well as to its undemanding to growing conditions. Cornel plants have high decorative qualities due to their early and abundant flowering, dense intensively green leaves, bright and beautiful fruits. They can withstand the cutting well and are resistant to dust and gases. They are used as a hedge in sunny and semi-shadowed areas. The wood is solid, very good, highly valued as a material for joinery and lumber. Cornel has wide ecological amplitude, it can grow in a variety of conditions, spread in the mountains to an altitude of 1000-1500 meters above sea level, grow on any soil.

Cornel is grown in Ukraine on private plot mainly s. The largest in Ukraine and the world industrial cornel orchard of 10.5 thousand trees grown on 14 hectares is located on basis of "Tokmatske 2010" farm. An important fact is that the seedlings were purchased in the Crimea, which makes problems with the purchase of planting material nowadays.

Cornel is propagated mostly by vegetative method in amateur horticulture [3, 4], but propagation by seeds is also quite possible. In propagation by seeds, unstratified seeds sprout only in two years, what is more, not all the seeds sprout. The stratified seeds sprout a year after sowing, but the trees fruit only in 7-10 years. In the case of reproduction the two years old seedlings are grafted by occulation and a yearling can be obtained by fall under appropriate care. Thus, a grafted year-old cultivated cornel seedling, which gives the signal yield a year after planting in the garden, can be obtained 5-6 years after the seeds harvesting. Consequently, there are a number of problems with the reproduction and spread of this extremely valuable fruit crop in Ukraine. A promising way of fruit crops reproduction, cornel in particular, is the use of *in vitro* microclonal reproduction. This technology will reduce the cost of cornel seedling material, reduce the period of seedlings growing from 5-6 to 1-2 years and the seedlings will yield in the second year of cultivation. At the same time, microclonal propagation of trees is complicated as compared to herbaceous plants. Biotechnologists face the problems with endogenous contamination, self-poisoning with phenolic exudate, and hyperhydration of plant tissues at the very first stage [5, 6]. There is no exception to the aseptic culture of cornel [7, 8]. Therefore, it is urgent to develop a protocol for cornel accelerated breeding which allows to obtain up to 1 million seedlings per year from one mother plant of cornel.

The aim of the research is to develop elements of the industrial technology of cornel microclonal propagation.

The objective the research – to develop advanced technological techniques based on experimental studies on *Cornus mas L* microclonal propagation at the stage of introduction into the aseptic culture.

Materials and methods. The experiment was carried out in the laboratory of MKR NPO Prime-Agro Ltd. Nizhnyi and Exotic varieties of *Cornus mas L.* (selected by Klymenko S.V., Grishko National Botanic Garden) were used for the study.

Technological process of aseptic cultivation has been investigated at the stage of introduction into aseptic culture.

For cultivation, an agar medium was used according to the MS (Murazig and Skoog) in its own modification. Modification of the medium involved changes in the macroelements amount (NH_4NO_3 1250 mg/l; KNO_3 1100 mg/l; $MgSO_4x7H_2O$ 770 mg/l; KH_2PO_4 970 mg/l; $CaCl_2$ was replaced by $Ca(NO_3)_2$ 440 mg/l; Ferum and Chelating agent was replaced with Ferylen Fe-EDDHA (ferum by the Italian firm Valagro) in the amount of 183.4 mg/l; ascorbic acid content made 3 mg/l. Light emitting diodes were used for light with the intensity range of 1.8-2.2 kL.

The explants were placed by 5 pcs in 200 ml jars (volume of nutrient medium – 20-22 ml), covered with transparent, suitable for autoclaving polypropylene lids (manufacturer Selena, Smila).

The following substances were used as decontaminants: sodium hypochlorite (control), mercuric cloride, PPM biocide, Blanidas 300. The study of the influence of the donor plants cultivation conditions on the number of decontaminated explants was carried out in open soil and in the depository.

The effect of ascorbic acid, L-cysteine, polyvinylpyrrolidone and activated carbon on the effectiveness of antioxidants was studied. The findings of the research were based on a continuous sampling (100 plants of each variant in a triple repetition).

Research results. Obtaining aseptic plants is the first stage of microclonal propagation. Its success predetermines whether the plant object (sort, breeding number) will be involved in microclonal reproduction. We have investigated different factors influencing the release of primary explants from contaminating microflora: decontaminating substances, explants types, explants selection terms, conditions for donor plants cultivation.

The output of sterile and live explants was influenced by both different decontaminants and the biological features of the cornel variety. Among the studied variants of decontaminant, the least amount of live and sterile cuttings was obtained for the primary explants processing by mercuric cloride (Table 1). In the Nizhnyi variety, 4 % took roots, of which only 2 % were microorganisms free; 2 % took roots in the Exotic variety with no decontaminated explants.

The best results were obtained on the control variant, which provided the use of a solution of sodium hypochlorite. In the Nizhnyi variety, 8 % took roots with 4 % of decontaminated explants. High rates were obtained for daily processing in a 50 % solution of PPM biocide. However, the use of this option has the following disadvantages: firstly, the high cost of the drug, and, secondly, the staff must be available all day long while the shaker is working. The variant with dipping into the nutrient medium was unacceptable due to the death of most explants with hypoxia.

The most effective variant was the domestic Blanidas 300 preparation (7 g / l autoclave distillate). The explants had no burns. The percentage of live explants output made 81 % in the Nizhnyi variety and 44 % in the Exotic variety; the yield of decontaminated explants made 32 % and 18 % respectively.

Table 1 – **Decontaminants effect on sterile primary explants output** (average of three repetitions)

Decontaminant	Planted explants, pcs		Live explants, %		Sterile explants, %	
	N*	E**	N*	E**	N*	E**
Sodium hypochlorite (control)	100	100	8	4	3	1
Mercuric cloride	100	100	4	4	2	0
PPM (addition to the environment)	100	100	16	10	12	4
PPM (24 hours soaking)	100	100	84	80	74	30
Blanidas 300	100	100	81	32	44	18

"N" corresponds to the name of the Nizhnyi variety of cornel

** "E" corresponds to the name of the Exotic variety of cornel

Regarding the different periods of primary explants selection for their sterility (Table 2), the highest selection efficiency in the phase of the "green cone" is found out. Thus, in the Nizhnyi variety, there were 81 % of live explants, of which 44 % were sterile; in the Exotic variety the figures made 32 % and 18 % respectively. The selection in tranquility state – both deep and forced turned to be ineffective.

Table 2 – **Effectiveness of different periods of primary explants selection for the output of sterile ones** (decontamination Blanidas 300, average of three repetitions)

Explants selection term	Planted explants, pcs		Live explants, %		Sterile explants, %	
	N*	E**	N*	N*	E**	N*
Deep state tranquility	100	100	0	0	0	0
Forced state tranquility	100	100	8	4	4	4
The phase of the "green cone"	100	100	81	32	44	18
The second "wave of growth"	100	100	36	41	22	27

* "N" corresponds to the name of the Nizhnyi variety of cornel

** "E" corresponds to the name of the Exotic variety of cornel

The results of the study of the influence of origin of buds from the donor plant shoots reveal a low efficiency of meristem explants decontamination (Table 3). In both varieties, the number of live explants made 6-7 %, of which only 6 % were infection free. The highest yield of live and sterile plants was obtained under selection of explants from the medial buds – 80 % and 35 % in the Nizhnyi variety, and 46 % and 16 %, respectively, in the Exotic variety.

Table 3 – **Influence of cornel explant type on decontamination efficiency**

Explant tбуре	Planted explants, pcs		Live explants, %		Sterile explants, %	
	N*	E**	N*	N*	E**	N*
Meristem	100	100	6	7	6	6
Apical bud	100	100	16	20	8	12
Medial bud	100	100	80	46	35	16
Basal bud	100	100	90	22	16	12

* "N" corresponds to the name of the Nizhnyi variety of cornel

** "E" corresponds to the name of the Exotic variety of cornel

The second stage of the research was to study the influence of conditions for the donor plants cultivation on the number of decontaminated explants among the live ones (Fig. 1). The best variants of the previous experiments were used for this experiment, namely: the selection of explants into the phase of the "green cone", the treatment with Blanidas 300 preparation, the selection of explants from the buds of the medial part of the shoot. High decontamination effect under conditions of growing in the depository was established for both types as compared to growing in the open soil . Conditions of donor explants cultivation

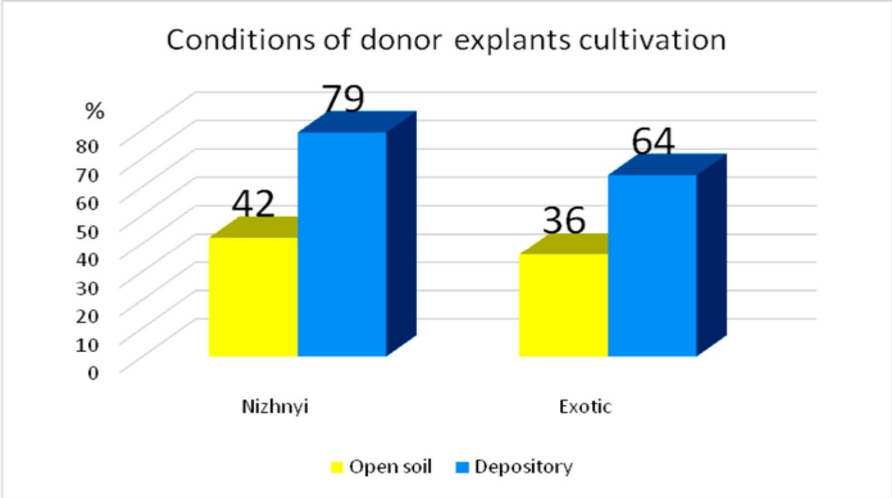

Fig.1. **Influence of conditions of donor explants cultivation on the efficiency of decontamination,** %.

Cornel plants, like most tree crops, are characterized by phenol-like substances release in the wound in order to protect the plant against pathogens that can get into injured areas. These substances are oxidized to tannins in the air (for example, gallic acid) and become toxic to microorganisms. In an open environment, tannins are not toxic to the plant. However, for *in vitro* cultivation in small closed volumes (e.g. in a test-tube), plants are self-destructed by their own phenol-like exudate [5, 9]. Therefore, it is relevant to find the conditions that would minimize the problem during the stabilization period. For this purpose, we investigated the effectiveness of antioxidant use (in pre-selected optimal concentrations: ascorbic acid – 15 mg/l; L-cysteine – 5 mg/l; polyvinylpyrrolidone – 0.5 g/l; activated carbon – 1.0 g/l).

Having compared the effect of adding antioxidants, we established their different activity, which was displayed in reducing the percentage of explants with phenolic exudate (Fig. 2). Cysteine adding proved to by inefficient as an antioxidant. A significant reduction in the percentage of explants with phenolic exudate was observed in variants where polyvinylpyrrolidone and co-administration of ascorbic acid with polyvinylpyrrolidone were added.

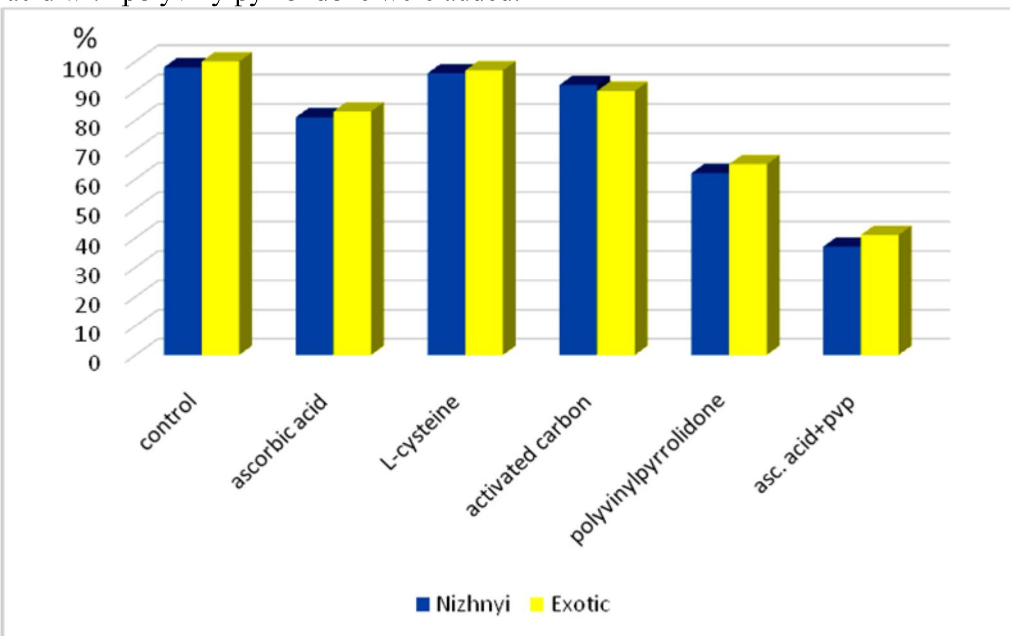

Fig. 2. **Effect of antioxidants adding to the nutrient medium on the number of primary explants with phenolic exudate,** %.

*«asc. acid+pvp» corresponds co-administration of ascorbic acid with polyvinylpyrrolidone

Conclusions. The results of the research reveal that the process of microclonal propagation of *Cornus mas L.* (varieties Nizhnyi and Exotic) can be improved of at the stage of introduction into an aseptic culture by the following technological methods: 1) the explants selection in the phase of "green cone", 2) decontamination with Blanidas 300 preparation (7 g/l of autoclave distillate), 3) selection of explants from the buds of the medial part of the shoots, 4) cultivation of donor plants under the conditions of the depositary, 5) combined use of ascorbic acid antioxidants (15 mg/l) and polyvinylpyrrolidone (0.5 g/l) through their adding to the nutrient medium.

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Совершенствование элементов технологии микроклонального размножения *Cornus mas L.*

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Существует ряд проблем с размножением и распространением кизила – ценнейшей плодовой культуры в Украине. Перспективным способом размножения кизила есть применение микроклонального размножения *in vitro*. Путем ряда экспериментов нами установлены технологические приемы, которые позволяют усовершенствовать процесс микроклонального размножения *Cornus mas L.* (сорта Нежный и Экзотический) на этапе ввода в асептическую культуру: 1) отбор эксплантов в фазе зеленый конус; 2) деконтаминация препаратом Бланидас 300 (7 г/л автоклавированного дистиллята); 3) отбор эксплантов из почек медиальной части побега; 4) выращивания донорных растений в условиях депозитария; 5) совместное применение как антиоксидантов аскорбиновой кислоты (15 мг/л) и поливинилпирролидона (0,5 г/л) способом добавления их в питательную среду.

Ключевые слова: *in vitro*, антиоксидант, деконтаминант, эксплант, кизил, растение-донор.

Improvement of the elements of technology of micropropagation *Cornus mas L.*
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There is a number of problems with the reproduction and spread of cornel – extremely valuable fruit crop in Ukraine. A promising way of cornel reproduction is the use of *in vitro* microclonal propagation.
Through a number of experiments, we have established a number of technological techniques, that can improve the process of microclonal propagation of *Cornus mas L.* (varieties Nizhnyi and Exotic) can be improved of at the stage of introduction into an aseptic culture by the following technological methods: 1) the explants selection in the phase of "green cone"; 2) decontamination with Blanidas 300 preparation (7 g/l of autoclave distillate); 3) selection of explants from the buds of the medial part of the shoots; 4) cultivation of donor plants under the conditions of the depositary; 5) combined use of ascorbic acid antioxidants (15 mg/l) and polyvinylpyrrolidone (0.5 g/l) through their adding to the nutrient medium.
Key words: *in vitro*, antioxidant, decontaminant, explant, cornel, donor plant.

Надійшла 21.09.2017 р.

УДК 631.582 : 631.811/.815/. 816(477.4)

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ВПЛИВ СИСТЕМ ОСНОВНОГО ОБРОБІТКУ І УДОБРЕННЯ НА ВМІСТ В ГРУНТІ ДОСТУПНИХ ДЛЯ РОСЛИН ЕЛЕМЕНТІВ ЖИВЛЕННЯ І ПРОДУКТИВНІСТЬ ПОЛЬОВОЇ СІВОЗМІНИ В ПРАВОБЕРЕЖНОМУ ЛІСОСТЕПУ УКРАЇНИ

Трирічними (2013-2015 рр.) дослідженнями встановлено, що вміст нітратного азоту, рухомого фосфору і обмінного калію в орному шарі чорнозему типового під кукурудзою на зерно вищий за мілкого обробітку, а в полях решти культур п'ятипільної сівозміни – за оранки. За безполицевого обробітку спостерігається локалізація елементів живлення рослин у верхньому (0-10 см) шарі грунту. Продуктивність сівозміни не значно відрізняється за полицевого, диференційованого і мілкого обробітків. За плоскорізного розпушування вона суттєво зменшується порівняно з контролем. Найнижча собівартість 1 т сухої речовини основної і побічної продукції сільськогосподарських культур, найвищі показники рівня рентабельності і коефіцієнта енергетичної ефективності виявились за основного мілкого обробітку в сівозміні дисковою бороною з періодичною оранкою один раз на 5 років за внесення на гектар ріллі 8 т гною + $N_{58}P_{80}K_{80}$.
Ключові слова: обробіток, добрива, грунт, елементи живлення, культура, сівозміна, урожайність, продуктивність.

Постановка проблеми. Важливим фактором росту й розвитку рослин є забезпеченість їх доступними формами елементів азотного і зольного живлення. Дослідження поживного режиму ґрунту і його оптимізація становлять важливу частину загальної проблеми моделей родючості орного шару ґрунтів, які надають можливість встановити шляхи мінімізації механічного обробітку [1, 2].

На сьогодні механічний обробіток майже ніколи не проводиться виключно з метою підвищення рухомості поживних речовин ґрунту, хоча вплив його на зміну вмісту і доступності елементів зольного і азотного живлення рослин зазвичай значний.

Слід відмітити, що й на сьогодні залишається дискусійним питання щодо ефективності органічних і мінеральних добрив за різних способів, заходів, засобів і глибини основного обробітку ґрунту. Різний розподіл добрив в оброблюваному шарі ґрунту впливає на їх ефективність. Але цей факт трактується різними вченими неоднаково.

Наразі відсутня єдина думка щодо оптимальної інтенсивності основного механічного обробітку під культури сівозмін з метою якомога повного забезпечення їх потреб в елементах загального і азотного живлення.

Аналіз останніх досліджень і публікацій. Чіткої залежності вмісту нітратного азоту в орному шарі чорнозему опідзоленого від глибини зяблевої оранки (10-12, 15-17, 20-22, 25-27, 30-32 см) не встановлено науковцями Уманського національного університету садівництва [3].