

почв — 4 МБк/м²) по сравнению с другими древесными породами. Высокое содержание ⁹⁰Sr выявлено в почках березы бородавчатой (*Betula verrucosa Ehrh.*). Для оценки вклада пылевого фактора в загрязнение пропелсов одревесневшие побеги последнего года вегетации изолировали пластиковыми мешками, а также использовали метод контрольных клеевых пленок. Полученные результаты показали, что вклад пылевого фактора незначителен и не превышает 0,1 КБк/кг, что составляет 0,4% от вклада основного (биогенного) пути загрязнения (рис 3).

Изученные закономерности в загрязнении радионуклидами медоносных видов растений являются базисными для понимания особенностей загрязнения апипродуктов (меда, пыльцы и прополиса). На основании полученных данных по загрязнению растений-медоносов возможно сделать прогноз загрязнения апипродуктов в зависимости от флористического состава угодий и разработать рекомендации по ведению пчеловодства и получению безопасных для употребления апипродуктов в районах загрязненных радиоактивными веществами. Эти рекомендации предусматривают выращивание определенных сельскохозяйственных культур, характеризующихся низким коэффициентом накопления радионуклидов и рациональное использование естественной медоносной флоры.

ECHINACEA IN UKRAINE: RESULTS OF INTRODUCTION AND STUDY OF BIOLOGY

Victor N. Samorodov, Sergey V. Pospelov
State Agricultural Institute, Ukraine, Poltava

At present Echinacea is one of the most popular medicinal herbs of Ukraine. In our country it is used also as valuable fodder, melliferous and decorative plant (1).

From all today known species of Echinacea Moench in Ukraine were introduced 3 its species: Echinacea purpurea (L.) Moench, Echinacea pallida (Nutt) Nutt and Echinacea angustifolia DC (2).

Taking this into account, in this publication we will give separate characteristic to biological aspects of introduction every of this species.

Echinacea purpurea (L.) Moench. This specie is dominant by its meaning, spreading and extent of study. Its true introduction to Ukraine was conducted 1945. Just at that time the first 5 kg seeds were received from Germany and over All-Union institute of medicinal and aromatic herbs (Moscow) sent to Poltava region to scientific collaborators of Ukrainian zone experimental station of medicinal herbs. In 1947 this enterprise received 5 kg seeds more.

Here, in the center of Ukraine, from 1946 till 1954 was conducted the introduction study of Echinacea.

It was made the conclusion about high ecologically plastic and adaptation of the given species, about perspectives of its further cultivation in Ukraine and other republics of the former UdSSR.

In spite of this there were worked out methods of cultivation Echinacea purpurea, the selection-seedlings work with it was begun.

There were made preparations out of it, which on conclusion of several medical establishments had a high clinical effect. But the works of further study of Echinacea purpurea were terminated.

The second period of resumption of Echinacea purpurea introduction in Ukraine began 70th years in Kiev. Its initiators were collaborators of botanical garden of Taras Schevchenko State University (Kiev) (3).

They conducted not only usual work on studying biological particular features of the given specie, but engaged also in growing its best forms at great production sowing squares. At the same time they popularized Echinacea purpurea as valuable fodder, melliferous and decorative plant.

All this promoted that many specialists knew Echinacea, and also by population, which traditionally cultivated medicinal herbs at their house gardens.

It is also interesting that all this coincided with explosion at the Chernobyl atomic station that had place near Kiev in April 1986. Many of people suffered of its influence, and the protection of immune system became the primary task for them. That's why biology-scientists of different specialization returned their views to Echinacea and began its wide medicinal study. For this they have a need in raw material, that in its turn, promoted to quick spreading of Echinacea purpurea in Ukraine.

At present this specie is cultivated in all 25 regions of Ukraine. People at their house gardens actively cultivate Echinacea purpurea, it is cultivated by different organizations at the sowing squares over 500 ha. As a medicinal raw material is laying in as rhizome with roots so and above part of the plant. Fresh and dry raw material is used for inner needs and for sale abroad.

So quick spreading of Echinacea was promoted with high ecologically adaptability during its introduction to Ukraine at the basis of a number of highly valuable features.

The main of them:

- cold-resistance and frost-resistance;
- satisfactory drought-resistance;
- simple tastes to soils and resistance to its salting.

The totality of this factors, and also the fact that in Ukraine has not generated the complex of pests and diseases, mark it out among other medicinal herbs as one that can be a raw material without use of insecticides and fungicides.

All this, on our mind, promoted to introduction of Echinacea purpurea to Ukraine. And particular features of it individual development testify to this.

According to our information, during the sowing of Echinacea to the open soil the most of its samples was in juvenile condition. Only one of them (firm Jellito, Germany) has that different that near 2% of plants makes progress in going to vegetative period and form fruits. Plants of the first year generate the shortened rosette sprout and at average have 8 leaves on it. The length of graft of leaves - 14,8cm, and of leaves plate - 19,7cm, the breadth - 8,2cm. At the second year of life all samples completely enter in reproductive period, having average height 56,7 cm and amount of leaves in the rosette equal 16,6. The graft length at them is 12,8 cm, leaves plate - 14,5 cm and breadth - 8,5 cm. At the average there are formed 4 inflorescence on one plant and their diameter is equal 4,72 cm. In spite of this it is possible to gather from

0.34 up to 1.68 g of fruits from one plant with a mass of thousand pieces 3.58 - 4.79 g. The crude mass of rhizome with roots of plants of the second year of life is equal 41.4 g. In plants of the third year of vegetation the leaves amount increases up to 41 and the average height makes 82.9 cm. Plants begin to form intensively sprouts which can greatly branch out at some sorts. The sprouts in one plant amount to 12 that involve increasing of inflorescence amount in one plant up to 24. In one inflorescence are 238 flowers at average, among them tubular - 268, and uvular - 14. All this promoted to gather from one plant from 4.6 up to 11.9 g fruits with the mass of thousand pieces - 3.13-3.20 g. It is necessary to mark that some samples and sorts can have parthenocarpic fruits. The crude mass of rhizome with roots at the third year of life can make 118 g by some sorts. The sort Magnus and sample received from the firm Jellito (Germany) were distinguished by totality of signs during the years of study.

About the success of introduction *Echinacea purpurea* in Ukraine testifies not only the fact that it sets fruits good, but also that she gives self-sowing. It was marked for Poltava, Donetsk, Kiev, Lvov, Chernovtzy and other regions. The most plentiful self-sowing appears in years with favorable amount of precipitation.

It is important also that good setting of *Echinacea purpurea* fruits is provided owing to active visiting its inflorescence by bees. By several years studying of collaborators of the Poltava department of the apiculture institute of Ukrainian agrarian sciences academy it was established that in conditions of forest-steppe Ukraine the duration of flowering of this culture verifies from 38 up to 58 days. In spite of this the nectar productivity is 23-58 kg/ha, and pollen productivity - 40-124 kg/ha.

It is interesting also that on the sowing areas of *Echinacea purpurea* it is possible to keep 100-150 bee-families as it have established collaborators of the agriculture institute of the Ukrainian agrarian sciences academy. Here were registered settlements of wide bumblebee (*Bombus*).

All this characterize *Echinacea* as valuable summer-autumn melliferous herb that flowers up to September, while the main part of the plants is already finishing their flowering.

According to our information the genefund of *Echinacea purpurea* is presented by 40 samples. As a rule they are received from botanical gardens of Germany, Italy, Belgium, more seldom from USA.

The given genefund is actively used for conducting selection-seedlings work with *Echinacea purpurea*.

Last years in Ukraine were cultivated three its sorts.

One of them - Princess is created at the experimental station of medicinal herbs of the Ukrainian agrarian science academy (Poltava region). The crop capacity of its dry roots and rhizomes is up to 30 centner/ha (centner per hectare), dry above mass - up to 100 centner/ha, seeds - 2.5-3.5 centner/ha (4).

In the Crimean international institute of untraditional plant growing, ecology and health (Symferopol) is created sort Vitaverna. It differs by its drought-resistance. The capacity of crude rhizomes and roots is up to 90 centner/ha, and crude above mass from 150 up to 270 centner/ha.

The institute of sanitation and revival of the peoples of Ukraine together with the institute of the molecular biology and genesis (Kiev) on the original methodic to

DNK-transformation of medicinal herb *Chelidonium majus* L. have created the sort Polysska Krasunya (5). It distinguishes itself by its winter-resistance and its area reaches the Urals (Russia).

Three highly perspective samples are grown in Nikitsky botanical garden (Yalta), and two by us, in Poltava State Agricultural Institute. So, all received information testifies that introduction work of *Echinacea purpurea* in Ukraine is finished and all preconditions for wide cultivation of domestic species are made.

Echinacea pallida (Nutt.) Nutt. According to the literary information 1978 is initial year of its introduction. This work is connected with the activity of collaborators of botanical garden of the Taras Shevchenko State University (Kiev).

But on our mind they have not given cogent arguments in favour of that they studied just this specie. That's why about the result of introduction of *Echinacea pallida* to Ukraine we can only judge by our own experience.

The beginning of our work with the given specie is 1993. In spite of this we have collected 6 samples of *Echinacea pallida* from Germany and USA.

Such an authoritative scientists on *Echinacea* as U. Bomme and J. Hannig (Germany), Steven Foster (USA) helped us and we express our heartfelt gratitude to them.

So, our five-year experience allows us to make a conclusion, that during the introduction of *Echinacea pallida* to Ukraine the given specie at the complex of its adaptive features doesn't yield to *Echinacea purpurea*, and by draught-resistance even excels it. For Ukraine, especially for its south part, it is a very important advantage.

The success of introduction *Echinacea pallida* in Ukraine is confirmed by the fact, that in our conditions it has a time to go through all periods of development and to set valuable fruits as well as *Echinacea purpurea*.

The given information testifies about this.

So, during the spring sowing to the open soil the *Echinacea pallida*, at the first year of vegetation all its samples were in juvenile condition. In spite of this they formed the shortened rosette sprout and carried in one plant at average 8.8 leaves with the graft length equal 9.8 cm, leaves plate - 16.6 cm and its breadth - 3.24 cm. At the second year of life all samples enter completely to the reproductive period, having average height 72.65 cm and amount of leaves in the rosette equal 18.6. The length of their sprouts made up 11.6 cm, and of leaves plate - 19.4 cm, the breadth - 4.8 cm. At average it was formed in one plant 2.3 inflorescence with the diameter 8 cm. In spite of this it was possible to gather from one plant from 1.46 up to 2.0 g fruits with the mass of thousand pieces 4.15-4.8 g. The crude rhizome mass of plants of the second year of life was equal 21.9 g. It is necessary to mark, that from all studied species only *Echinacea pallida* forms pulpy vertical-thickened rhizome. It is dug very well out, very good and quickly washed. All this has a great economic advantages, gives possibility to receive clean raw material with the low ashy containing and minimal expense quantity for washing. This biology particular feature is promoted quick instillation of *Echinacea pallida* to production, increasing the square of its cultivation in Europe. Plants of the third year of vegetation have a height 92.4 cm. They distinguish with the high degree of leaf bearing. There are 217 leaves at one plant, among them 62 are rosette. The amount of sprouts in one plant reaches 12, and

amount of inflorescence in spite of this is 26,4. One inflorescence has at average 33 flowers, among them 313 - tubular, and 19 - uvular. From one plant it is possible to gather from 10,6 up to 15 g of fruits with the mass of thousand pieces 4,0-6,3 g. and samples can be even 8,2 g. The crude weight of rhizome at this age can reach up to 140 g. But it is necessary to say, that it will have side roots, which could brake off easily, and the core of the root begins to rot. Samples of German firms Jellito and Berghof-Krauter were distinguished by the totality of signs during the years of research.

Genefund of *Echinacea pallida* in Ukraine consists of 20 samples. Selection work with them is conducted in two establishments: Nikitsky botanical garden and in Poltava State Agricultural Institute, where are created already in ones perspective samples.

All this are reassuring results, that allows to hope that this specie of *Echinacea* will receive wide spreading in Ukraine.

In the meanwhile we know only one plantation of *Echinacea pallida*, that takes near two hectares in Poltava region.

Echinacea angustifolia DC. As shows the world experience from all widespread species of *Echinacea* just *Echinacea angustifolia* is missed with other species and at first - with *Echinacea pallida*. This fate doesn't avoid many investigators, which work with *Echinacea* in Ukraine.

For this specie, as well as for above-mentioned, the beginning of introduction was 1978. Just at this year it was sowed in botanical garden of the Taras Shevchenko State University (Kiev). But we believe that in the most establishments of Ukraine are grown other species of *Echinacea* instead of *Echinacea angustifolia*, probably *Echinacea pallida*.

That is why, as in situation with *Echinacea pallida*, we will use our own results by characterizing the introduction work with *Echinacea angustifolia*. They are based on research of 6 samples received 1993 from USA. To this promoted such a specialists of this species, as already mentioned Steven Foster and Kelly Kindsher (USA) which we are also gratitude for their assistance. Just that's why we avoided the confusion, that, as it seems to us, admitted investigators from other scientific establishments of Ukraine in connection with this species.

As regards this specie we can ascertain its high winter- and frost-resistance. From all studied by us species of *Echinacea* it is the most draught-resistant. In connection with it we have not registered pests and diseases.

In conditions of forest-steppe Ukraine this specie also goes through whole period of development, that finishes with setting valuable fruits.

Our experience testifies that during the spring sowing to the open soil the plants of *Echinacea angustifolia* of the first year of life were in juvenile condition. They formed shortened rosette sprout and carried at average in one plant 6,5 leaves with the graft length equal 5,4 cm, leaves plate - 12,6 cm and its breadth 1,9 cm. At the second year of vegetation 36,4% of plants begin the reproductive period having average height 12,6 cm and amount of leaves in the rosette equal 14,6. The graft length made 5,4 cm, leaves plate - 13 cm and its breadth - 2 cm. At average one plant has 1,5 inflorescences with the diameter 3,3 cm. It was possible to gather from 0,28 up to 0,35 g of fruits from one plant with the weight of thousand pieces 2,30-2,9 g. Most

of fruits, gathered from plants of this age, are parthenocarpic. The crude weight of rhizome with roots was equal 6,7 g. From the third year of vegetation all plants are at reproductive development. Their height made 50,4 cm. In all there are formed 107 leaves in one plant, among them 38 are rosette. The amount of sprouts in one plant is not over 11, and amount of inflorescence - 10. One inflorescence has at average 235 flowers, among them 221 - tubular and 14 - uvular. From one plant it is possible to gather from 2,4 up to 2,8 g of fruits with the weight of thousand pieces 2,71-2,81 g. The amount of parthenocarpic fruits can made up to 21% out of whole number of gathered. The crude weight of rhizome with roots makes 11 g. The most valuable can be considered the sample from the preserve Prairie Nursery (USA).

The genefund of *Echinacea angustifolia* is presented by 18 samples, but as we have mentioned already it needs the serious test on authenticity.

The selection work with *Echinacea angustifolia* is carried in Nikitsky botanical garden and in Poltava State Agricultural Institute. Three perspective species are selected in these establishments.

So, all mentioned above three species are introduced successfully in Ukraine and on the basis of studied biological features the individual technology are worked up for each of them, that allows to receive high-quality raw material as for inner use so for sale abroad.

SUMMARY

Представлены итоги интродукционного изучения ценной медоносной и лекарственной культуры - эхинацеи. Рассмотрены три основных вида эхинацей - Э. пурпурная (*Echinacea purpurea*), давно известная в Украине, а также малоизученные Э. Бледная (*Echinacea pallida*) и Э. Узколистная (*Echinacea angustifolia*). На основании проведенных исследований авторы приходят к выводу о возможности успешного промышленного возделывания всех трех указанных видов.

Литература

1. Изучение и использование эхинацей. Материалы международной научной конференции. - Полтава, 21-24 сентября 1998 г./ Полтава: Верстка, 1998 - 156 с.
2. Самородов В.Н., Поспелов С.В. Эхинацея в Украине: полувековой опыт интродукции и возделывания. - Полтава: Верстка, 1999. - 52 с.
3. Смык Г.К., Меньшова В.А. Интродукция и первичная культура эхинацей пурпурной (*Echinacea purpurea* (L.) Moench) на севере Украины // Охрана, изучение и обогащение растительного мира. Республиканский межведомственный научный сборник. - Вып.13 - К.: Вища школа, 1986. - С. 113-116.
4. Марченко Н.Л., Порада О.А. Новый сорт эхинацей пурпуровой Принцеса - джерело збільшення сировини для імуностимуляторів // Проблеми лікарського рослинництва: Тези міжнародної наук.-практ. Конф. 3 нагоди 80-річчя інст.лік.роел.УААН (3-5 липня 1996 р., м.Львів) - Полтава, 1996. - С. 129.
5. Нотопальский А.И., Юркевич Л.Н., Занка Л.А., Гиндич О.В. Эхинацея сорта Полесская Красавица и перспективы ее изучения и использования// Изучение и использование эхинацей. Материалы международной конференции./ Полтава: Верстка, 1998. - С. 30-33.