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and uses of Echinacea

## **PARTICULAR FEATURES OF GROWING ECHINACEA IN UKRAINE AND REGULATION OF RAW MATERIAL QUALITY.**

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In spite of medicinal features and high ornamentalness of *Echinacea* species, the introducing to culture and elaboration of methods of its cultivating began intensively in Ukraine after Chernobyl disaster, when the question of creating immunostimulating preparations became very actual.

Thanks to its high ecological plasticity *Echinacea* can be cultivated in different kinds of soils in Ukraine. There is a positive experience of its growing in the northern part of Russia (Leningrad and Novgorod regions), south of Russia (Stavropol district), in Byelorussia, Moldova.

Researches, carried out by us, show that *Echinacea purpurea* seeds could be sowed after stratification on  $t^{\circ}\text{C}=+2-4^{\circ}\text{C}$  during 20-30 days. They sprout simultaneously and develop well. As regards *Echinacea pallida* and *Echinacea angustifolia*, seeds of these species sprout bad and there is a need in a long stratification of seeds during 60-90 days at the period of storing for receiving good shoots. This allows to increase greatly germination of seeds.

In spite of the fact, that *Echinacea* can grow on different kinds of soil it is more preferable to cultivate it on the soils of a light or middle mechanical structure for receiving high harvest of roots and herb. On other kinds of soil the harvest of roots is more labor-consuming and connected with considerable losses of the harvest.

In the crop rotation it is better to place *Echinacea* after bare and occupied fallow, winter wheat, leguminous plants, one-year herbs and mixture herbs, one-year medicinal herbs.

While at the primary period of development *Echinacea* is very painful and develops bad, it is necessary to conduct in the crop rotation before 2-3 years of *Echinacea* sowing systematic weeds control by agrarian technique and chemical methods.

By the sowing after winter wheat the soil must be ploughed to the depth 25-27 cm at the end of July-beginning of August and the surface of the field is made even. After appearing of weeds the make 1-2 cultivation. If the previous culture is harvesting late they conduct ploughing without smoothing the soil. In spring the soil is cultivated to depth 6-8 cm, then smoothed and thickened. On light(sandy) soils it is enough to make only smoothing of soil.

The early spring method of seeds sowing is the most widely used. First of all it is connected with that seeds are placed to depth 0,5-1,5 cm and there is a need in enough moisture reserve in soil for receiving successful shoots. The sowing in later terms was less effective (table 1).

*1. The influence of sowing terms Echinacea purpurea on crop capacity of herb and roots (average data of 5 year)*

Terms of sowing	capacity of dry raw material				content of the polysaccharides sum in the herb, %	Quantity of extractive substances in roots, %
	herb		root			
	t/ha	%	t/ha	%		
<b>First year</b>						
1 <sup>st</sup> -early spring (control)	3.34	100.0	1.08	100.0	16.6	39.2
2 <sup>nd</sup> - in 7 days	3.12	93.4	0.83	76.8	18.1	39.2
3 <sup>rd</sup> - in 14 days	2.44	73.2	0.62	57.4	16.7	42.2
4 <sup>th</sup> - in 21 days	2.07	62.0	0.59	54.6	16.3	39.7
<b>Second year</b>						
1 <sup>st</sup> -early spring (control)	8.23	100.0	2.91	100.0	10.8	31.6
2 <sup>nd</sup> - in 7 days	7.14	86.7	2.71	93.0	10.5	31.4
3 <sup>rd</sup> - in 14 days	6.77	82.3	2.23	76.5	10.8	29.8
4 <sup>th</sup> - in 21 days	5.02	61.0	1.60	55.0	10.8	28.2

Good results were shown also by sowing seeds late in autumn before soil freezing. In this case seeds have a natural stratification during the winter and in spring give simultaneously shoots.

Our experience shows, that for *Echinacea pallida* and *Echinacea angustifolia* it is advisable to transplant in soil the seedlings. In this case the expenditure of seeds considerably lowers and plants are transplanted to plantation with constant square of nutrition. That's why in spring seeds are sowed in hothouse and in 2-3 months seedlings with 4-6 leaves are transplanted into field.

By growing *Echinacea* on great sowing areas the most optimal is sowing with the space between rows 45 cm. In some cases it can be increased up to 60-70 cm. The norm of seeds sowing is from 3-4 kg/ha up to 6-8 kg/ha depending upon the technique and method of cultivation.

By care of crops of the first year of vegetation the easiest and most effective agrotechnique method is before-sprout and after-sprout harrowing, that provides removal of 76% shoots of one-year weeds. On plantation of the second year they make harrowing and mellowing of soil

early in spring in order to move away dead parts of plants and to improve air and nutrition soil conditions.

Phytopatology and entomology researches show, that in conditions of Ukraine Echinacea is astonished by pests and diseases. Among pathogenic fungi prevail genera of Fusarium, Botrytis, Cercospora, Ascochita, Septoria. But the most mass and strongly pronounced character has virus disease. Its speeding reaches 60 % and increases on plantation of the third and fourth year. Steadiness to diseases can be increased by placing the whole dose of mineral fertilization, and also by timely removal of weeds from crops. Researches show that chemical mordant - fungicides are not suitable for Echinacea, while they lower seeds germination. As regards pests, Echinacea is steady to insects damage. Specific pests one not revealed in Ukraine still. The species composition of pests consist of polyphages, widespread in agricultural cultures. They are beet aphid (*Aphis fabae*), grass bug (*Lygus rugulipennis*), cockhaver (*Melolontha melolontha*), gamma moth (*Phytometra gamma*), beet webworm (*Pyrausta nicticalis*) and others.

Increasing of crop capacity and quality of raw material is promoted by placing in soil organic and mineral fertilization. Conducted researches show (the date received by our colleagues) that by placing in soil fertilization in autumn before plowing we increase the crop capacity of the herb and roots of Echinacea as at first (table 2), so at the second year (table 3) of vegetation. At the second year it is advisable to conduct feeding of plants early in spring by mineral fertilization in doze  $N_{45}$  or  $(NPK)_{45}$  (table 4).

During the estimation of accumulation polysaccharides in above part of Echinacea purpurea it is established, that their content in different parts of the plants differs on the periods of vegetation and terms all polysaccharides in inflorescence of the second year (12.3%) and leaves (11.4%). At the third year of vegetation its amount lowers. Taking this

*2. Crop capacity of dry raw material of Echinacea purpurea at the first year and its quality depending on conditions of mineral nutrition*

Variants	roots		herbs	
	capacity, t/ha	quantity of extractive substances, %	capacity, t/ha	quantity of extractive substances %
Without fertilization (control)	1.39	41.9	3.59	14.9
Mineral fertilization	1.61	42.1	4.23	12.9
Organic fertilization	1.92	45.5	4.57	11.3
Mineral + organic fertilization	1.82	43.6	5.01	11.4

*3. Crop capacity of dry raw material of Echinacea purpurea at the second year and its quality depending on conditions of mineral nutrition*

Variants	roots		herbs	
	capacity, t/ha	quantity of extractive substances, %	capacity, t/ha	quantity of extractive substances %
Without fertilization (control)	1.64	39.9	6.73	8.2
Mineral fertilization	2.63	40.0	9.00	7.8
Organic fertilization	1.95	39.4	8.35	8.0
Mineral + organic fertilization	2.66	40.0	10.54	7.7

*4. The influence of near-root feedings on crop capacity of dry herb and root Echinacea purpurea at the first year*

Variants	roots		herbs	
	capacity, t/ha	quantity of extractive substances, %	capacity, t/ha	quantity of extractive substances %
Without fertilization (control)	1.78	37.9	6.00	-
N60P90 (background)	1.87	36.8	6.71	-
N60P90 + ammonium nitrate	2.46	37.0	9.05	-
N60P90 + carbonate ammonium	2.44	36.8	8.97	-
N60P90 + nitrophoska	2.84	37.4	10.68	-

into account it is advisable to gather herb in the period of whole flowering at the second year of vegetation. As regards roots, the content of extractive substances in plants of the first year is 41.9-45.5% that a little bit higher, than at the second year of vegetation (39.9-40.0%). But the crop capacity of plants of the second year exceed by 2.5-8.4 centner/ha the crop capacity of plants of the first year of vegetation. It is necessary to mention that feeding by Mg and Zn promoted to improving of raw material quality.

The harvest of Echinacea root is conducted at the end of September- October after the end of vegetation by special combine. After this roots are washed out of soil and dried at the temperature 50-60 °C.

At present the question of standardization of raw material is very actual. while it is not established yet exact what compound provokes pharmacological effect. That's why the problem of standardization in Ukraine and in the countries of CIS in whole is not solved finally. At present Russian pharmacologists test Echinacea purpurea on content of cichoric acid. In Ukraine they offer to estimate the quality of raw material on polysaccharides (inulin) and phenol compounds. These question

become more and more problematic if to take into account, that we speak now only about *Echinacea purpurea* and don't touch upon other species, which are widespread in the world - *Echinacea pallida* and *Echinacea angustifolia*. In this plan we are faced with a great work on studying chemical composition of these species and further standardization.

So, last year it was conducted great scientific-research work on studying agrotechnical methods of cultivating species of *Echinacea* in conditions of Ukraine. It is necessary to mention especially the work of scientists of Experimental Station of Medicinal Herbs of the Ukrainian Academy of Agricultural Sciences (Poltava region), Institute of Farming of the Academy of Agricultural Sciences (Kiev), and also the pioneer activity of Research & Production Enterprise «Phytocom» (Poltava) on introduction and cultivation *Echinacea pallida* and *Echinacea angustifolia*. Practical experience shows the possibility of receiving good and stable yields of this unique plant.