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SOURCES OF CROP CAPACITY AND MARKETABILITY OF CARROT ROOTS FOR SELECTION IN THE RIGHT BANK FOREST STEPPE OF UKRAINE

The results of the three-year research (2010-2012) of 16 carrots collection samples of different ecological and geographical *origin from the collection of the National centre of plant genetic resources of Ukraine in terms of yield capacity and marketability of the root crops in the conditions of the right-bank forest-steppe area of Ukraine are presented. The perspective sources of valuable productive-quality signal of carrots which are recommended for use in breeding programs of scientific institutions have been selected.*

Keywords: *carrots, sources, breeding, collection samples, yield capacity, marketability*

Introduction. Carrot *(Daucus carota* L.*)* – is one of the leading agricultural vegetable crops of different use: food, fodder, technical. Its special value lies in its content of vitamins B, C, K, E, PP, A, mineral substances and essential oils. The annual demand of fresh produce per capita is 11–15,5 kg depending on the region.

According to the State Statistics Committee of Ukraine there is insufficient production of carrot and its active import. It is possible to increase carrot production, creating new varieties and F_1 hybrids with high levels of productivity and adaption to the conditions of soil and climatic zones of cultivation.

Taking into consideration the urgency of this problem, for the rapid creation of such biotypes it is necessary to study the collection samples of basic material of carrot based on main agronomic characters, including crop capacity and marketability of this vegetable crop.

L. V. Sazonova determined that indices of crop capacity and marketability of plants refer to the characteristics which expression depends on many factors, especially soil and climatic and genetic and is usually controlled by the interaction of many genes [6]. Recently global climate change took place in Ukraine, in particular in Cherkasy region, where the rise of temperature at +2–5°C and periodic severe droughts are observed. Therefore, the main direction of breeding research at this stage is the creation of varieties and hybrids of carrots, which are able to generate high yields of root crops even under stressful conditions.

Creating hybrids, the selectionist should clearly understand, for which ecological zone are they for and to choose the appropriate basic material. It is noted that some samples are not equally responsive to stress conditions: some of them relatively easily withstand adverse conditions, and other stress adversely affects the individual phases of development [7].

Modern trends of carrot breeding aimed at increase of crop capacity and improvement of root crops quality. These problems are solved by a new generation of carrot hybrids with high competitiveness and adaptability, resistance to diseases, pests and other factors.

It should be noted that, unfortunately, in recent years a decrease in the above mentioned parameters of existing genotypes carrots takes place. This phenomenon is due to their low adaptive capacity, namely fluctuations in yield components from the effects of climatic and soil conditions of the environment.

To create a modern varieties and hybrids of carrot it is necessary to have a diverse basic material that has the ability to transmit valuable traits. This means that selectioners need such varieties, which, together with the economic characteristics have also high adaptive properties to the area of environmental conditions [6]. The varieties of local and breeding populations, as well as from global and domestic selection can serve as basic material for plant selection [4].

The aim of research is to determine the breeding value of collection material of carrot for productive and qualitative indices and the selection of the most suitable varieties for use in breeding programs in order to create high-yielding hybrids with high commercial qualities.

Materials and methods. Researches of the collection varieties were conducted in 2010–2012 on the fields of Uman experimental breeding station of the Institute of bioenergetic crops and sugar beets of NAAS, located in an area of unstable hydration. Soil - podzolized heavy loam chernozem. Weather conditions during the years of studies were satisfactory for the growth and development of carrot.

Materials of the research were 16 carrot varieties of different eco- geographical origin. The growing technology was common for the carrot. Seeding was performed in optimal time (first or second decade of April), the area of accounting area was 2,7 m², repetition 4-time. Predecessor - black fallow, no fertilization.

The study of collection samples of carrot was carried out in accordance with "Methodological instructive regulations on study the world collection of table and fodder crop roots" (1968) [4] and "Textbook of approbation of vegetable crops and fodder root crops" (1982) [5]. Phenological observations and biometric measurements were carried out according to the"Methods of examination of plant varieties for the difference, similarity and stability (BOC) family *Apiaceae Lindl*. – Celery (carrot, parsley, celery, parsnips, cumin, fennel, coriander, fennel, lovage) "(2010) [3].

Statistical analysis of experimental data was performed by the method of analysis of variance according to B. A. Dospiekhov (1985) [2].

Results and discussion. The main objective of our research was to analyze the productive potential of the material of carrot according to cultivation area and the discovery of features of productivity and marketability of root crops.

During the years of research (2010-2012) average crop capacity of root crops was 43.8 t/ha (2010 – 42 t/ha, in 2011 – 54.8 t/ha, in 2012 – 35.3 t/ha). Weather conditions in 2010 in general were favourable for normal growth and development of carrot roots. Precipitation, temperature and air humidity had no significant deviations from the average long-term data. However, it should be noted that the distribution of precipitation for the month was uneven. In 2011, weather factors were particularly favourable for high crop capacity and marketability of carrot, whereas in 2012 the significant lack of soil moisture and elevated air temperatures during the growing season were observed.

Due to the variability of weather conditions during the years of the research and the genetic diversity of the variety examples they were divided were divided into appropriate classes according to their yield capacity (Table 1) [1].

Table 1

Division of carrot variety examples according to general yield capacity of root crops

Yield capacity dated by 100–110-day of vegetation, t/ha	Number of carrot variety examples, %			
	2010	2011	2012	Average
Very low (<20 т/га)	0	0	0	0
Low (21–30 т/га)	6,3	0	12,5	6,3
Average (31–40 т/га)	31,2	0	81,2	37,5
High (41–50 т/га)	50,0	25,0	6,3	27,1
Very high (>50 т/га)	12,5	75,0	0	29,1

Under conditions of the Right-Bank Forest-Steppe of Ukraine in terms of total yield capacity of root crops in 2010, from the variety type Chantenay such variety examples as Wiener halblange 669, Mistseva 10/162 and Mistseva from Chuvashia were separated, which indices were, respectively, 50, 42,5 and 44 t/ha (Table 2).

From the variety type Nantaise valuable source of the trait "yield capacity of root crops" was the variety example Nastusya, which index was 55 t/ha. Under favorable weather conditions in 2011 higher total yield capacity of root crops of the variety type Chantenay had such variety examples as: Wiener halblange 669, Mistseva 10/162, Mistseva k–403, k–507 and Nantaise, which indices were,55,6 , 55, 51, 55 and 51 t/ha respectively.

Table 2

General yield capacity of root crops variety examples of carrot, t/ha

№ of the catalouge UDCC	Variety example	Origin	2010	2011	2012	Average
Variety type Chantaney						
148	Chantaney skvyrska(st.)	Ukraine	38,9	47,0	33,0	39,6
158	Wiener halblange 669	Australia	50,0	55,6	35,8	47,1
160	Mistseva 10/162	Mongolia	42,5	50,0	39,7	44,0
125	Mistseva of Chuvashia	Chuvashia	44,0	49,0	35,8	42,9
159	De-foraggio	Italy	37,0	45,0	32,5	38,2
117	Mistseva к–403	Ukraine	33,0	51,0	31,0	38,3
123	к–507	Mongolia	37,0	55,0	35,3	42,4
111	Nantaise	Romania	30,0	51,0	30,2	37,1
		HIP_{05}	2,0	2,5	1,4	–
Variety type Nantaise						
166	Nantaise kharkivska (st.)	Ukraine	51,0	64,0	34,8	49,9
165	Yaskrava	Ukraine	42,0	63,0	34,0	46,3
127	Nastusia	Ukraine	55,0	55,0	46,0	52,0
156	Biriuchekutskaya 415	Russia	47,0	60,0	40,3	45,7
119	Amsterdamskaya	Netherlands	44,0	53,0	30,0	42,3
151	Linia 81/95	Ukraine	41,0	52,0	35,5	42,8
157	Burean	Netherlands	45,0	75,0	37,2	52,4
130	Krasunia	Ukraine	35,0	52,0	34,1	40,4
		HIP_{05}	2,2	2,9	1,5	–

From the variety type Nantaise the variety example Burean with the yield capacity of 75 t/ha is distinguished. In 2012, the yield of carrot roots was lower than in previous years due to a critical weather conditions. By the variety type Chantenay four variety examples of carrot are distinguished: Wiener halblange 669, Mistseva 10/162, Mistseva of Chuvashia and k–507, the yield capacityof which was 35,8, 39,7, 35,8 and 35,3 t/ha respectively. From the variety type Nantaise - Nastusya, Biriuchekutskaya 415 and Burean, which indiceswere, respectively, 46, 40,3, and 37,2 t/ha.

According to the results of the research as valuable genetic sources of crop capacity characteristics of root crops for further breeding the variety examples of carrot roots that exceeded standards were distinguished and offered Chantenay skvyska and Nantaise kharkivska during 2010–2012: Wiener halblange 669, Mistseva 10/162, Mistseva of Chuvashia, k–507, Nastusya and Burean.

Besides yield capacity commodity indices of carrot roots which depend on the varietal characteristics of plants and soil climatic conditions of the environment, are also very important in the selection of new high-performance varieties and hybrids of carrot. Due to the influence of the above mentioned factors the marketability of carrot roots based on the level of manifestation was divided into appropriate classes (Table 3) [1].

In recent years of carrot production there is a low level of marketability because of changes in agro-climatic growing conditions. This trend exists both in Ukraine and worldwide. In 2010, 100 % of variety examples had very low marketability of root crops, in 2011 43,7 % – very low,

37,5 % – low, 18,8 % – average. In 2012, 37,5 % of variety examples were characterized by very low marketability, 43,7 % – low, 6,3 % – average, 6,3 % – high and 6,2% – very high.

Table 3

Division of carrot variety examples based on the marketability of root crops

Marketability of root crops %	Number of carrot variety examples, %			
	2010	2011	2012	Average
Very low (<65 %)	100	43,7	37,5	60,4
Low (65–75 %)	0	37,5	43,7	27,1
Average (76–85 %)	0	18,8	6,3	8,4
High (86–95 %)	0	0	6,3	2,1
Very high (>95 %)	0	0	6,2	2,0

According to the results of the research, the commodity indices of carrot roots depend not only on their varietal characteristics, but also from soil and climatic growing conditions.

Studying the variety examples of carrots on the basis of marketability of root crops in 2010, no variety type that would exceed the standard was distinguished of the variety type Chantenay. By the variety type Nantaise better standard indices had such varietyexamples Yaskrava and Biriuchekutskaya 415 – 35,7 % and 31,3 % respectively (Table 4).

Table 4

Marketability of root crops of carrot variety examples, %

№ of the catalogue UDCC	Variety example	Origin	2010	2011	2012	Average
Variety type Chantaney						
148	Chantaney skvyrska(st.)	Ukraine	50,0	65,7	74,4	63,4
158	Wiener halblange 669	Australia	38,0	74,0	45,3	52,4
160	Mistseva 10/162	Mongolia	38,6	62,0	65,2	55,3
125	Mistseva of Chuvashia	Chuvashia	20,0	77,0	65,8	54,3
159	De-foraggio	Italy	26,3	55,5	65,2	49,0
117	Mistseva к–403	Ukraine	15,1	54,9	63,9	44,6
123	к–507	Mongolia	29,7	47,3	38,6	38,5
111	Nantaise	Romania	40,0	74,5	52,5	55,7
		HIP_{05}	1,4	2,7	3,4	–
Variety type Nantaise						
166	Nantaise kharkivska (st.)	Ukraine	29,4	64,0	92,8	62,1
165	Yaskrava	Ukraine	35,7	61,9	77,6	58,4
127	Nastusia	Ukraine	10,9	54,5	49,3	38,2
156	Biriuchekutskaya 415	Russia	31,3	69,4	51,4	50,7
119	Amsterdamskaya	Netherlands	11,3	71,6	68,0	50,3
151	Linia 81/95	Ukraine	23,9	84,6	70,1	59,5
157	Burean	Netherlands	17,6	76,0	97,3	63,6
130	Krasunia	Ukraine	22,8	68,7	66,5	52,7
		HIP_{05}	1,4	2,9	3,6	–

In 2011, the marketability of carrot roots was much better. Compared with the standard Chantenay such samples as Wiener halblange 669 and Nantaise were distinguished, which indices were 74 % and 74,5 %. Of the variety type Nantaise five samples of carrot were distinguished: Biriuchekutskaya 415, Amsterdamskaya, Linia 81/95, Burean and Krasunia, which indices were – 69,4, 71,6, 84,6, 76 and 68,7 %, respectively. In 2012, none of the samples was distinguished of the variety type Chantenay for the marketability of carrot. By the variety type Nantaise the significant

difference with the standard had sample Burean, which index was 97,3 % against 92,8 % by the standard.

Conclusions. Under conditions of the Right-Bank Forest-Steppe of Ukraine such promising variety examples based on high indices of carrot yield capacity were distinguished: Wiener halblange 669 - 47.1 t/ha, Mistseva 10/162 - 44 t/ha, Mistseva of Chuvashia – 42,9 t/ha, k–507 – 42,4 t/ha, Nastusya – 52 t/ha, Burean – 52,4 t/ha.

By studying the marketability of root crops, it should be noted that its index was low throughout all the years of the research and ranged on the average for three years from 38,2 % to 63,6 %. Low marketability of most samples in this collection and its strong variation is connected with the fact that the seed of the varieties was obtained in different geographical areas and is not adapted to the climatic conditions of Ukraine.

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Анотація

Леонова К.П., Мельниченко Т.В.

Джерела урожайності та товарності коренеплодів моркви для селекції в правобережному Лісостепу України

Наведено результати трирічних досліджень (2010–2012 рр.) 16 колекційних зразків моркви різного еколого-географічного походження з колекції Національного центру генетичних ресурсів рослин України за показниками урожайності та товарності коренеплодів в умовах Правобережного Лісостепу України. Виділені перспективні джерела цінних продуктивно-якісних ознак коренеплодів моркви, які рекомендовані для використання в селекційних програмах наукових установ.

***Ключові слова**: морква, джерела, селекція, колекційні зразки, урожайність, товарність.*

Аннотация

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Источники урожайности и товарности корнеплодов моркови для селекции в Правобережной Лесостепи Украины

Приведены результаты трехлетних исследований (2010-2012 гг.) 16 коллекционных образцов моркови различного эколого-географического происхождения из коллекции Национального центра генетических ресурсов растений Украины по показателям урожайности и товарности корнеплодов в условиях Правобережной Лесостепи Украины.

Выделены перспективные источники ценных продуктивно-качественных признаков корнеплодов моркови, которые рекомендованы для использования в селекционных программах научных учреждений.

Ключевые слова: *морковь, источники, селекция, коллекционные образцы, урожайность, товарность*