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# ECOLOGICAL TESTING OF CARROT VARIETIES FROM TAIWAN IN NORTHERN KAZAKHSTAN

*In 2009 and 2011 under the climatic conditions of the Northern Kazakhstan were conducted environmental tests carrot varieties from Taiwan. According to the results of environmental tests, it was found that due to the unfavorable weather conditions during critical periods of growth and development of plants in 2011 on the ecological nursery plots carrot varieties gave much smaller yield than in 2009. On average for two years under agro ecological conditions of northern Kazakhstan, on gross productivity the Taiwanese carrot cultivars 'Red Judy' and 'Ideal' gave 7,0 and 7,9 % increase in root yield comparing to local cultivar ' Nantes 4', and showed a high yield of marketable products, 94,1 and 93, 6%, respectively.*
***Key words:*** *testing, carrot, variety, Taiwan, North Kazakhstan*

**Introduction.** Among the vegetables carrot is one of the leading crop in Kazakhstan, both by sown area, and by the importance of dietary nutrition value, an evidence of this is dramatic expansion of its acreage and production volume in recent years. In 2011, under carrots were employed 17,7 thousand hectares, which produced 404.2 thousand tons of root crops [1].

As the observations of scientists have shown, varieties and hybrids of agricultural crops from different eco-geographical zones often had a good capacity to adapt to the introduction into new agro-environmental conditions [2-4].

The issue of food security has always given a great importance, and the introduction and expansion of new high-acreage crop varieties through environmental testing is very important. To study the adaptability in northern Kazakhstan were conducted environmental tests of Taiwanese carrot varieties.

**Materials and methods.** Environmental testing of Taiwanese promising carrot cultivars 'Red Sky', 'Red Judy' and 'Ideal' were conducted in 2009 and 2011 on the experimental plot of Kostanay Scientific Research Institute of Agriculture, Kostanay Region. As a standard varieties served domestic cultivars 'Nantskaya 4' (St1) of Nantes type and 'Alau' (St2) of Chantenay type.

The climate in the Kostanay region is sharply continental with cold winters and little snow, and hot dry summers. Kostanay region characterized by prolonged cold spring, late summer precipitation and early autumn frosts. The droughts are especially observed in the end of May and most of June. So it is needed to plant crops so that the young seedlings have time to use the spring moisture reserves in the soil. But climatic factors sometimes vary greatly, causing tension in crop planting periods. Weather conditions during the research changed differently (Table 1).

In May 2009, 59,8 mm of rain fell, and although June turned dry – 3,7 mm, the soil moisture was enough for evened germination and growth of carrots. The summer months were also favorable in terms of available moisture for normal growth and development and high yielding of carrot. In 2011, in May was 34.9 mm of rainfall, June distinguished with abundant rainfall – 94,0 mm, which led to excessive moisture on the soil and negatively affected carrot yield, although July and August rainfall is not much deviated from the multiyear norm and amounted respectively, 41,4 and 28,5 mm. Average daily air temperature during the growing season in the years of trials is not much deviated from the multiyear norm, except in July 2011 when it dropped below the normal by 6 $^0$C.

Soil on the experimental plot is southern low-power black soil. Humus horizon is 41-45 cm, effervescence from HCL below 85 cm, carbonate accumulation on the same depth. Humus content in the plowing layer is 3,0-3,24%, total nitrogen – 0,15-0,16%, phosphorus – 0,10-0,13%. Soil reaction is slightly alkaline. Full field water holding capacity for a meter soil layer is 204,6 mm, wilting point – 70,2 mm, available moisture – 134,4 mm.

*Table 1*

**Weather conditions during the vegetative growth of carrots (by Kostanay agrometeostation, Zarechny)**

| Year | Months | | | |
|---|---|---|---|---|
| | May | June | July | August |
| The amount of precipitation, mm | | | | |
| Multiyear | 31,0 | 45,0 | 50,0 | 30,0 |
| 2009 | 59,8 | 3,7 | 31,6 | 44,7 |
| 2011 | 34,9 | 94,0 | 41,4 | 28,5 |
| Average daily air temperature, °C | | | | |
| Multiyear | 13,0 | 18,3 | 20,2 | 17,8 |
| 2009 | 13,6 | 20,2 | 19,5 | 18,3 |
| 2011 | 14,4 | 18,3 | 14,2 | 16,7 |

As in the experimental nursery there is no irrigation networks, carrot on the ecological testing plots was grown under rainwater irrigation.

At the experimental site was applied the recommended rate of fertilizers that were incorporated at a major tillage in the spring.

Cultural practices for carrot growing included a basic treatment (plowing at 25-27 cm - in the fall, deep cultivation in the combination with harrows - in the spring), seedbed preparation (cultivation, leveling, row and raised bed forming), manually seeding, herbicide application, and hand weeding.

Carrot harvesting and yield record were held in the phase of technical maturity of roots.

Nurseries layout, phenological observations, biometric measurements and harvest recording, as well as statistical data processing was carried out in accordance with methodological guidelines [5-8].

**Results.** The studies have shown (Fig. 1) that between the carrot standard cultivars and the Chinese varieties tested there have been significant differences for yield and its structure.

In 2009, the weather conditions at the experimental plot of Kostanay Scientific Research Institute of Agriculture were very favorable for growing and development of carrots, they expressed neither leaf no root infections, as evidenced by the phenological observations, high yield (83,8-113,8 t/ha) and marketable roots (97,5-99,2%). Record of the gross productivity showed (Table 2) that all studied Taiwanese carrot entries except for 'Red Sky', gave significantly higher yield than standard Nantes 4 - 94.8 t / ha. Of Taiwanese cultivars the maximum yield per unit area was the cultivar 'Ideal', which provided high yield – 112,9 t/ha or by 19,1% yield increase to 'Nantskaya 4'. Average weight of root for accessions ranged from 93.4 to 123.8 , the highest weight of root among Taiwanese accessions was observed in samples of Red Judy , and Ideal, respectively , 167.4 and 120.8 g, 123.8 g in the cultivar Nantes 4 and 115.7 g in cultivar Alau .

In 2011 carrots on the ecological nursery gave significantly fewer yields than in 2009, due to the unfavorable weather conditions during critical periods of growth and development of carrots. On gross productivity only 'Red Judy' and 'Alau' had a tendency to increase towards 'Nantskaya 4'. Marketability of roots in the studied carrot cultivars ranged from 81,0 to 89,0 %. Highest rates of marketability had cultivars 'Red Judy' and Ideal, respectively, 89,0 and 88,7 %, while in cultivar 'Alau' and 'Nantskaya 4' such indices were, respectively, 87,5 % and 81,0%. Average weight of carrot roots varied 66,2 to 77,8 g. Among the Taiwanese samples the highest root weigh was observed in cultivar 'Red Judy' - 77,8 g.

On average, in the ecological trials of 2009 and 2011 under the Northern Kazakhstan conditions, by the gross productivity from the Taiwanese carrot cultivars singled out 'Red Judy' and 'Ideal', giving 7,0 and 7,9% yield increase in regard to the cultivar Nantskaya 4, and showed a high yield of marketable roots, 94,1 and 93,6%, respectively.

*Table 2*

**The results of environmental tests of Taiwanese carrot cultivars in Northern Kazakhstan**

| Cultivar | Gross productivity, t/ha | Increase to st1 | Increase to st2 | Marketability, % | Root weight, g |
|---|---|---|---|---|---|
| 2009 г., LSD05 = 12,1 t/ha | | | | | |
| Nantskaya 4 st1 | 94,8 | 100,0 | 83,3 | 97,7 | 123,8 |
| Alau st2 | 113,8 | 120,0 | 100,0 | 97,5 | 115,7 |
| Red Sky | 83,8 | 88,4 | 73,6 | 98,1 | 93,4 |
| Red Judy | 103,9 | 109,6 | 91,3 | 99,2 | 167,4 |
| Ideal | 112,9 | 119,1 | 99,2 | 98,5 | 120,8 |
| 2011 г., $LSD_{05}$ = 5,3 t/ha | | | | | |
| Nantskaya 4 st1 | 47,7 | 100,0 | 99,6 | 81,0 | 76,3 |
| Alau st2 | 47,9 | 100,4 | 100,0 | 87,5 | 76,6 |
| Red Sky | 41,4 | 86,8 | 86,4 | 81,4 | 66,2 |
| Red Judy | 48,6 | 101,9 | 101,5 | 89,0 | 77,8 |
| Ideal | 40,9 | 85,7 | 85,4 | 88,7 | 65,4 |
| Average for 2009 and 2011 | | | | | |
| Nantskaya 4 st1 | 71,3 | 100,0 | 88,1 | 89,4 | 100,1 |
| Alau st2 | 80,9 | 113,5 | 100,0 | 92,5 | 96,2 |
| Red Sky | 62,6 | 87,9 | 77,4 | 89,8 | 79,8 |
| Red Judy | 76,3 | 107,0 | 94,3 | 94,1 | 122,6 |
| Ideal | 76,9 | 107,9 | 95,1 | 93,6 | 93,1 |

**Conclusion.** Thus, according to the results of tests under the environmental conditions of northern Kazakhstan, out of the Taiwanese carrot cultivars singled out 'Red Judy' and 'Ideal', giving 7,0 and 7,9% yield increase in regard to the local cultivar Nantskaya 4, and showed a high yield of marketable roots, 94,1 and 93,6%, respectively.

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***Анотація***

***Аміров Б.М., Удовицкий А.С., Амірова Ж.С.***

***Екологічна оцінка зразків моркви з Тайваню в умовах північного Казахстану***

*У 2009 і 2011 роках в умовах Північного Казахстану були проведені екологічні випробування Тайваньських зразків моркви. За підсумками екологічних випробувань було встановлено, що внаслідок несприятливих погодних умов у критичні періоди росту і розвитку рослин у 2011 році, морква на екологічному розпліднику дала значно менший врожай, ніж у 2009 році. У середньому за два роки в умовах Північного Казахстану, за загальною продуктивністю серед тайваньських зразків моркви виділилися зразки Red Judy і Ideal, які дали 7,0 і 7,9 % прибавки врожаю коренеплодів до сорту Нантская 4, і показали високий вихід товарної продукції, відповідно 94,1 і 93,6 %.*

***Ключові слова:*** *морква, сорт, оцінка, урожайність, Тайвань, Північний Казахстан*

***Аннотация***

***Амиров Б.М., Удовицкий А.С., Амирова Ж.С.***

***Экологическая оценка образцов моркови из тайваня в условиях северного казахстана***

*В 2009 и 2011 годах в условиях Северного Казахстана были проведены экологические испытания Тайваньских образцов моркови. По итогам экологических испытаний было установлено, что из-за сложившихся неблагоприятных погодных условий в критические периоды роста и развития растений в 2011 году морковь на экологическом питомнике дала значительно меньше урожая, чем в 2009 году. В среднем за два года в условиях Северного Казахстана, по общей продуктивности среди тайваньских образцов моркови выделились образцы Red Judy и Ideal, которые дали 7,0 и 7,9% прибавки урожая корнеплодов к сорту Нантская 4, и показали высокий выход товарной продукции, 94,1 и 93,6%, соответственно.*

***Ключевые слова:*** *морковь, сорт, оценка, урожайность, Тайвань, Северный Казахстан*