RESEARCHES ON THE BEHAVIOUR OF CERTAIN GENOTYPES OF CARROT (*DAUCUS CAROTA* L.) AT THE THERMIC AND HYDRIC STRESS CONDITIONS

CERCETĂRI PRIVIND TESTAREA UNOR GENOTIPURI DE MORCOV (*DAUCUS CAROTA* L.) ÎN CONDIȚII DE STRES TERMIC ȘI HIDRIC

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Abstract *Three genotypes of carrot were studied at RDIVFG Vidra, in 2012, for testing purposes under thermal and hydric stress conditions. The experiment was established by sowing in two different periods (April, June), and three different technological: V1- irrigated as per normal growth and development needs, V2- 50% of irrigation standard, V3- not irrigated. The weather conditions in 2012 determined the increase of the irrigation standard for variant V1. For variant V2, the yielding capacity was more than 50% lower than for variant V1. The plants from variant V3 (sown in the month of April) were very small, low quality and improper for consumption. As for variant V3 (sown in the month of June), the seeds did not germinate.*
Key words*: carrot, hydric stress, thermal stress.*

Rezumat. *Trei genotipuri de morcov au fost studiate, la ICDLF Vidra, în anul 2012, în vederea testării în condiții de stres termic și hidric. Experiența a fost înființată prin semănat în două epoci diferite (aprilie, iunie) și trei variante tehnologice: V1- irigat conform necesarului de creștere și dezvoltare, V2- 50% din norma irigare, V3- neirigat. Condițiile climatice din anul 2012 au determinat suplimentarea normei de irigare în varianta V1. La varianta V2 capacitatea de producție a fost cu peste 50% mai mic față de V1. Plantele din variantele V3 (înființată în luna aprilie), au fost foarte mici, de calitate inferioară, improprii consumului. La varianta V3 (înființată în luna iunie), semințele nu au germinat.*
Cuvinte cheie: *morcov, stres hidric, stres termic*

INTRODUCTION

The carrot root shape and size are genetically determined characteristics, (Fremmel and Lauche, 1983 – quoted by Shinohura, 1984), but strongly influenced by the environment and subject to modifications (Kappert and Rudorf, 1962; Korla and Rastogi 1980). In the carrot's vegetative development there are two main phases, that of the primary growth and that of maturation. The first phase is longer or shorter depending on the variety, either early or late, as well as on the environment conditions, especially temperature and humidity. The typical size and shape for the respective variety shall be obtained when a balance between growth and maturation is achieved. The cylindrical shape with rounded head is associated with the root's full development, being a criterion for assessing

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maturation and quality (Rosenfeld, 1998), being mostly preferred by breeders and also by consumers. The variety is unpretentious towards temperature (the seeds germinate starting from 4^0C), while optimal growth temperature is 18 - 25^0C. Above 30^0C, the production decreases and the root is low quality. As to water the biggest requirements are during the seeds' germination and deposition of reserve substances in the root. (Dumitrescu et al.,1998).

Within the context of the current weather changes, the selection of genotypes which are tolerant to thermal and hydric stress represents a major goal in the carrot's amelioration activity we carry out here at the Vegetable and Flower Breeding Research and Development Institute Vidra.

MATERIAL AND METHOD

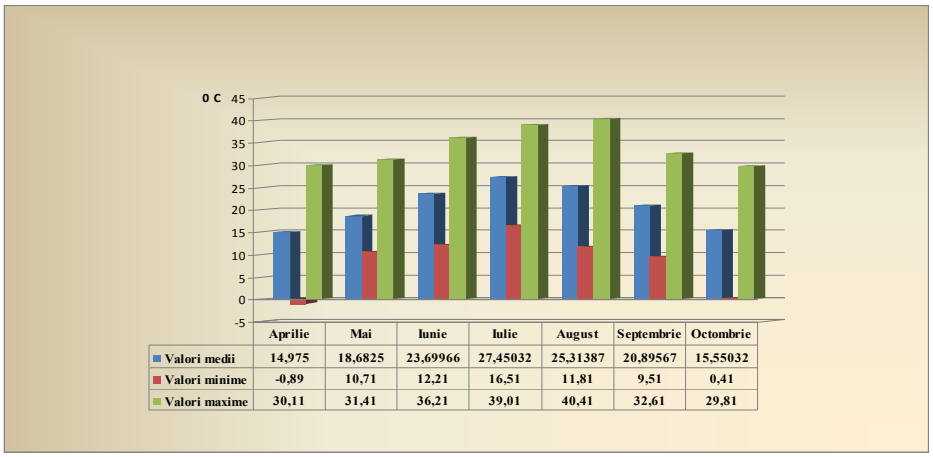
For achieving this goal, as part of ADER 1.1.10 project, three genotypes of carrot (L66, L29, Nabuco) were studied in 2012, at RDIVFG Vidra.

The experiment sample was planted by manual sowing, in two different periods (April and June) and in three technological variants: V1- irrigated as per normal growth and development needs, V2- 50% of irrigation standard, V3- not irrigated. Water administration to the plants was made by dripping.

For the culture in the first period, in V1 variant, the watering standard was 50 m^3/ha applied every five days, until emergence, and then of 200 m^3/ha, every seven days, in the months of: June, July, August and September (in the first two decades). In V2 variant, the watering standard was 50% lower, applied at the same interval and for the same period. In V3 variant, the culture was not irrigated, the watering needs being covered by the precipitations in the area. For the culture in the second period, in V1 variant, the watering standard was 50 m^3/ha, every 48 hours, until emergence (June), and after that of 200 m^3/ha, every seven days in the months of July, August, September and one in the first decade of October. In V2 variant the watering standard was 50% lower, applied at the same interval and for the same period. Plants from the first period were harvested on the 30th of September, while those from the second period were harvested on the 23rd of October. Determinations were made for 75 plants, and the significance of differences was determined by the multiple comparison method.

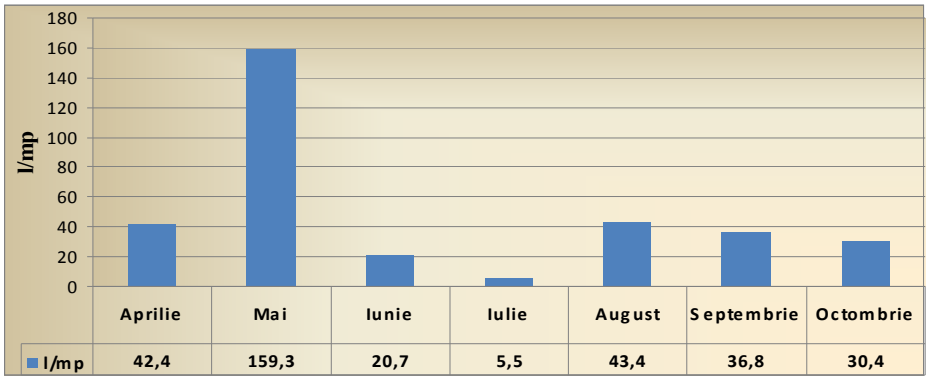
RESULTS AND DISCUSSIONS

In Vidra area, the year 2012 was characterized by extremely high temperatures, in the months of July, August and even September, with maximum temperatures above 30^0C, starting with May (Fig.1). These were correlated with extremely poor precipitations, in the period of June – September, much below the multiannual values (Fig. 2). All this triggered the increase of the irrigation standard to ensure the plants' growth and development, reaching 2800 m^3/ha in the first period and 3400 m^3/ha in the second period, as compared to normal years, when this was of maximum 2400 m^3/ha. This variety requires big quantities of water during the root's lengthwise growth and deposition of reserve substances, as well as small and constant quantities during germination and emergence.



	Aprilie	Mai	Iunie	Iulie	August	Septembrie	Octombrie
Valori medii	14,975	18,6825	23,69966	27,45032	25,31387	20,89567	15,55032
Valori minime	-0,89	10,71	12,21	16,51	11,81	9,51	0,41
Valori maxime	30,11	31,41	36,21	39,01	40,41	32,61	29,81

Fig.1 Evolution of temperatures recorded during the period of April-October 2012



	Aprilie	Mai	Iunie	Iulie	August	Septembrie	Octombrie
l/mp	42,4	159,3	20,7	5,5	43,4	36,8	30,4

Fig. 2 Evolution of precipitations recorded during the period of April-October 2012

In these circumstances, the three carrot genotypes were influenced both by the sowing period and technological variant.

In the first sowing period, in V1 and V2 variants, the seeds germinated based on the water from the soil and that provided by irrigation. There were no significant differences between the two variants until the beginning of June. The drought conditions and temperature increase, and also the reduction of the watering standard finally determined significant yielding capacity differences between V1 and V2. For all genotypes, the yielding capacity was reduced by more than 50% (Table 1). In V3 variant, the seeds germinated more slowly, after 14 days, and the plants' density was lower. The plants continued to develop due to precipitations in May. The high temperatures and drought from the period of June-August determined the plants' poor development, the stopping of the roots' primary lengthwise growth phase, the roots' deformation and ramification. There followed the growth's stopping and tissue premature lignification, the concentration of volatile oils, which determined the roots' bitter taste.

Table 1

The root´s characteristics and yielding capacity - sown in the month of April

Genotyp / technological variant		Length (cm)	Semnification *	Diameter (cm)	Semnification *	Weight (g)	Semnification *	Yielding capacity (t/ha)	Semnification *
L66	V1	14,8	a	3,4	a	150,5	a	46,6	a
	V2	12,8	b	2,2	b	121,0	b	19,7	b
	V3	10,2	c	1,2	c	48,5	c	9,8	c
L29	V1	12,9	a	3,9	a	138,2	a	40,8	a
	V2	10,5	b	2,3	b	106,0	b	17,2	b
	V3	8,8	c	1,8	c	40,8	c	7,2	c
NABUCO	V1	13,2	a	3,4	a	131,3	a	34,8	a
	V2	11,6	b	2,6	a	116,0	b	15,5	b
	V3	9,2	c	1,7	b	41,7	c	6,7	c

*Variants having the same letters do not differ significantly for the level of P=5%

These were improper for consumption. The yielding capacity was extremely low, the culture being economically inefficient since the production obtained could not be used.

For all root characteristics and yielding capacity the differences between the three technological variants are significant (Table 1).

In the second sowing period, the genotypes' behaviour was also determined by the technological variant and environment conditions. The high temperatures, correlated with the low precipitations and atmospheric drought, starting with June, influenced the plants' growth and development. In this period, the seeds' germination was different, for the three technological variants.

In V1 variant the seeds germinated after 6 days, while for V2 after 10 days, the plants' density being lower, as compared to V1. In V3 variant the seeds did not germinate for any genotype. In June, the daytime temperature was above 30^0C, there were no precipitations, and there was no water administered by irrigation.

For the root's characteristics and yielding capacity the differences between the two variants (V1 and V2) are significant, same as for the first sowing period (Table 2).

From the results obtained we can say that for the carrot, the summer culture can not be sown without providing the necessary water quantities for the seeds' germination, and the varieties show their genetic potential when the necessary water quantity is provided.

Table 2

The root´s characteristics and yielding capacity - sown in the month of June

Genotyp	Technological variant	Length (cm)	Diameter (cm)	Weight (g)	Yielding capacity (t/ha)
L66	V1	13,8	3,4	140,5	44,6
	V2	11,8	2,2	109,0	21,7
	V3	-	-	-	-
L29	V1	11,9	3,7	125,2	39,8
	V2	10,7	3,5	106,0	19,4
	V3	-	-	-	-
NABUCO	V1	12,8	2,8	115,3	31,8
	V2	11,0	2,2	98,0	14,5
	V3	-	-	-	-

CONCLUSIONS

The study of the three carrot genotypes (L29, L66, Nabuco), with respect to their behaviour to the thermal and hydric stress, leads to the following conclusions:

1. The extreme weather conditions of 2012 created the conditions for genotypes' testing towards the thermal and hydric stress.
2. The plants' growth and development was influenced by: the environment conditions, the sowing period and technological variant.
3. The extremely high temperatures and extended drought determined the increase of the irrigation standards, as compared to previous years, in both sowing periods, in V1 variant.
4. The yielding capacity in V2 variant, for both sowing periods, was more than 50% lower for all genotypes, being determined by a smaller number of plants per hectare and more reduced roots' weight
5. In V3 variant, sown in the first period (April), the production obtained was very small, low quality and improper for consumption, while sown in the second period (June), the seeds did not germinate for any genotype.

REFERENCES

1. **Dumitrescu M., Scurtu I., Stoian L., Glăman Gh., Costache M., Dițu D., Roman Tr., Lăcătuş V., Rădoi V., Vlad C., Zăgrean V., 1998** - *Producerea legumelor*, Editura ArtPrint, București, p. 297-298.
2. **Kappert H., Rudorf W.**,**1962** - Züchtung von Gemüse. Obst., Reben und Forstpflazen, Möhre. Ed. Paul Parey, Berlin und Hamburg, Vol. VI, p. 1-20.
3. **Korla B.N., Rastogi K.B**., **1980** - *A note phenotypic stability for root yield carrot* (*Daucus carota* L.) *Haryana J*., Horti. Sci., 9, p. 88-89
4. **Rosenfeld H.J**.,**1998** - *Maturity and development of the carrot root* (*Daucus carota* L.), Gartenbauwissenschaft 63 (2), p. 87-94.
5. **Shinohura S**.,**1984** - *Vegetable seed production technology of Japan elucidated with respective variety development*. Histories, particulars, carrot, vol. I.